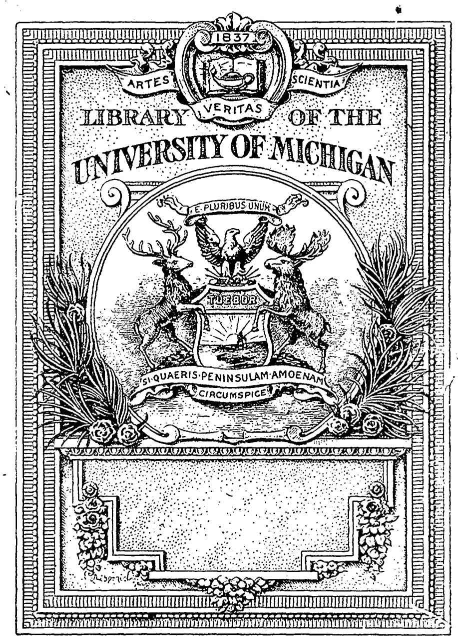
THE
ENGLISH
MECHANIC

VOL.
44

SEP. 1886
TO
FEB. 1887

THE
ENGLISH MECHANIC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ENGLISH MECHANIC

AND

WORLD OF SCIENCE.

WITH WHICH ARE INCORPORATED

"THE MECHANIC," "SCIENTIFIC OPINION," AND "THE BRITISH & FOREIGN MECHANIC."

ILLUSTRATED WITH NUMEROUS PRACTICAL ENGRAVINGS.

VOLUME XLIV.

PUBLISHED (FOR THE PROPRIETOR) BY E. J. KIBBLEWHITE,

AT THE

Office: 332, STRAND, LONDON, W.C.

SOLD BY ALL BOOKSELLERS AND NEWSAGENTS IN THE KINGDOM.

1887.

PRINTED BY BRADLEY AND COMPANY,
12, 13, AND 14, FETTER LANE, LONDON, E.C.

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ILLUSTRATIONS.

THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

NOTES ON THE CHAMBER ORGAN.—III.

BY GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

I NOW come to the consideration of the most important matters connected with the Chamber Organ—matters on which the true beauty and distinctive character of the instrument depend. I allude to the scaling, voicing, and disposition of the speaking stops; their selection for combination, solo, and accompanimental purposes; and the means to be provided for imparting expression to them. It must be obvious, in an instrument of a very limited number of stops, such as I have contemplated in the foregoing remarks, that the selection of the speaking stops is a matter of the highest importance; and that their scaling, winding, and voicing must be most carefully calculated and adapted, so as to secure the maximum variety and purity of tone, combined with perfect mixing qualities. These conditions of excellence are, it is to be regretted, seldom met with together, even in large instruments by modern builders; in small instruments they are, it may be said, never seriously aimed at. Herein lies the cause of the insipid and sometimes almost offensive tonal character of the ordinary Chamber Organs of the day.

The construction of a Chamber Organ which shall be worthy of the name, and which shall be to the domestic music-room or drawing-room what the great concert organ is to the public concert-hall, is a problem quite worthy of both the professional builder's and the musician's earnest attention. That the problem can be solved I have, at least to my mind, satisfactorily proved; and that its solution is not attended with extreme difficulty can be safely asserted. For a successful issue, it is necessary that the individual who makes the essay should approach the matter without any prejudice or preconceived ideas founded on the ordinary existing examples. To this openness of mind must, of course, be added a knowledge of the nicities of the art of organ building, and a refined and cultivated ear for musical sounds.

In the following Notes will be found the results of many years' earnest study of the subject, necessarily in a very brief and condensed form; but, I trust, sufficiently full to convey my meaning to readers interested in, and somewhat acquainted with, organ building.

Speaking Stops.

The first matter claiming attention with reference to the speaking stops is their scaling—that is, the dimensions and relative proportions of the transverse sections of their respective pipes. On the question of scaling not a little uncertainty and difference of opinion obtains amongst experts; and, accordingly, it is extremely difficult to lay down any hard and fast rules. The commonly accepted notion of deriving the scales of the subordinate stops from the principal stop (*Open Diapason*) is out of all reason with reference to a small Chamber Organ of fifteen or twenty stops. It would be reasonable if the oldfashioned specification still obtained of planting the Great wind-chest with an *Open Diapason*, *Stopped Diapason*, *Principal*, *Twelfth*, and *Fifteenth* only; but in an instrument where such a time-worn idea finds no fruition it is unnecessary and undesirable to adopt any traditional notions respecting derived scales.

It is imperative that all the stops of a Chamber Organ should be of delicate and refined intonation, with, at the same time, sufficient brilliancy and distinctive character to render them effective, both as combination and as solo registers. Such a class of tone may be secured by two distinctly different methods of procedure—namely, by adopting very small scales and a moderately high pressure of wind, or by adopting medium scales and a low pressure of wind.

At this point it is desirable to discuss the question of wind pressure, with the view of arriving at some conclusion anent that most suitable for a Chamber Organ. In my opinion, the maximum pressure should be set at 2½in. and the minimum at 1½in. The adoption of a higher pressure than the maximum above given is not to be recommended, even when very small scales are used, because it tends to impart a harsh and screaming intonation. Experience has taught me that a pressure of 2⅜in. is perfectly suitable for medium scaled stops which are required to yield tones combining fulness with brilliancy. At this pressure, a sufficient amount of wind can be supplied to all pipes to produce, with consistent and skilful voicing, the smooth and round tones so desirable in a Chamber Organ, but without any unpleasant windiness.

It must be borne in mind that a Chamber Organ must be literally *all tone*—that is, the tone must be entirely free from the hiss of escaping wind, or from any objectionable quality which interferes with its purity. In the case of my Chamber Organ, which has a wind pressure, for both manual and pedal departments, of 2⅜in., I have succeeded in so scaling, voicing, and regulating its 1,162 pipes that even the full tone is innocent of any hissing noise or other trace of windiness. I am free to admit that much care, to say nothing of skill, is required to arrive at so desirable a result; but it is satisfactory to know that it *can* be arrived at.

At the pressure of 2⅜in. or 2¼in., scales sufficiently large can be introduced to yield tones of great fulness and purity. For instance, the Principale, 16ft. (Pedal *Open Diapason*) in my organ measures 10in. by 8in., internally, at the C C C pipe; while the C C pipe of the Principale Grande, 8ft. (Great *Open Diapason*), is 5¼in. in diameter. With this pressure sufficient character can also be obtained from medium-scaled reed stops, without the disagreeable buzz inherent in reed pipes on 3in. and still higher pressures. Another and very important advantage attending the 2⅜in. pressure is that it is perfectly suitable for both the pedal and manual departments. If a much lighter wind is adopted for the manuals, the 2⅜in. will have to be retained for all the Pedal registers, for they will not speak promptly on a very light pressure. In a small instrument, and where space is limited, it is inconvenient, if not impossible, to have different pressures of wind; but where there is a separate bellows-chamber provided, under or adjoining the apartment in which the organ is located, there will probably be no difficulty in accommodating the two reservoirs required for the different pressures.

There are several flue stops, highly suitable for the Chamber Organ, especially if they are not to be inclosed in a swell-box, which can be voiced to yield tones of singular richness and beauty on wind of 2in. pressure; but this is certainly the lowest pressure that should ever be used for entire manual departments. Lower pressures should only be employed for a few stops, which may, for the sake of distinction, be designated echo stops. The so-called *Vox Angelica* may be voiced to yield whispering tones of exquisite quality on 1½in. wind.

It will be gathered from the preceding brief remarks that I am not in favour of the wholesale adoption of small scales for the stops of a properly-appointed Chamber Organ. For the more important stops, or those which form the vertebræ, so to speak, of the tonal structure, I advocate what, for the purpose of a Chamber Organ, may be considered large scales; depending upon skilful voicing, well-regulated winding, and moderate

pressure to produce the dignified, round, and absolutely pure tones required. These remarks apply specially to the fundamental unison registers. When we come to consider the octave and super-octave stops we must recognise the necessity of subduing their tones, so as to avoid any tendency to impart a screaming character to the combinations they may be called upon to enter. Considerable judgment must be exercised in the selection of the octave stops, because in a small organ they must not only be generally available in combination with unisons of various strengths of tone, but also as solo stops. It should never be overlooked that in a *small* Chamber Organ every stop must be equally useful, even including the Mixture when such a stop is inserted. In my own organ this idea has been consistently carried out, and it is not too much to say that in it every manual register is equally useful. Two extreme instances are sufficient to prove this statement. The Voce Umana fulfils its special office when assisted by the Tremolant: it can also be used in combination with any of the other stops, or entirely alone (without the Tremolant) as a quiet unison reed, in either melody or harmony. Again, the Ripieno di cinque (Mixture, V ranks) can be used to impart richness and brilliancy to the full organ, or be used with any *one* of the softer unison registers, producing combinations of exquisite quality and of singularly sympathetic character.

But to return to the scales of the octave stops. When an *Open Diapason* is introduced, the Tenor C pipe of which measures 3¼in. in diameter, and a derived Octave is likewise inserted, the C C pipe of the latter should not exceed 2¾in. in diameter. In addition to this reduction of scale, it should have less wind and be accordingly voiced to yield a tone much softer and of a more "silvery" quality than that of the fundamental unison. Such an Octave is perfectly suitable for solo and combination purposes generally. In very small instruments, or on one or other of the manuals of a larger organ, it may be advisable to insert the octave stop in the form of a 4ft. Flute of medium scale. There can be no question as to the utility of such an arrangement.

In a Chamber Organ it is not at all necessary —indeed, in the generality of cases it is inexpedient—to introduce a Twelfth; but if such a mutation stop is contemplated, let it be kept very small in scale, so that its tone may do little more than enhance the second harmonic upper partial tones of the unison stops. It should be little, if anything, larger than an ordinary *Dulciana* in scale.

When we come to consider the Super-octave or Fifteenth, taste must decide in what form the stop had best be introduced. Shall it follow the oldfashioned lines, and be merely a part of the so-called "*Diapason-work*," made to a scale somewhat less than that of the Octave; or shall it assume an entirely different nature, with the view of becoming a useful solo as well as a combination stop? Questions such as these crop up at almost every turn in Chamber Organ building, and demand careful consideration. In an instrument of from fifteen to twenty stops, it is safe to say that only one Super-octave is really necessary; indeed, it is most inadvisable to sacrifice any of the more important stops which such an organ ought to contain for the sake of duplicating so acute a register. The most useful form for the Super-octave is that of a Flute; and when such is adopted the stop becomes a Piccolo, perfectly suitable for both solo and combination purposes. In tone this stop should be much more prominent than the Twelfth, but less so than the true Octave above spoken of. As a solo register its tone should be sufficiently bright to be self-assertive, but totally devoid of anything approaching a screaming character.

In Chamber Organs of the size here contemplated it is unusual to introduce "harmonic-corroborating" stops; but this, I think, is a great mistake. Without a Mixture of some kind it is impossible to secure that quality of tone which contributes so largely to the glory of the organ. The old masters and those who followed them calculated the scales of their Mixtures from those of the foundation stops, hence their great brilliancy and assertive character. Such compound registers are more than "harmonic-corroborating" stops, to use Dr. Hopkins's expressive term; they are in truth *harmonic-creating* registers. I question the wisdom of introducing large-scaled and loudly-voiced Mixtures even in large instruments; in small organs I am quite satisfied they are out of place. It must be obvious if they are loud and assertive they can only be used in combinations in which all the foundation-work is present. This is an undesirable narrowing of their utility, and one that should systematically be avoided. In a properly balanced Chamber Organ a Mixture is of immense value and interest; but, of course, that value and interest entirely depend upon the nature of the stop in question. It must be of exceptional quality, and the softest possible intonation, secured by smallness of scale and careful voicing. I am not speaking without experience in the matter, for, after due consideration, I inserted in my own Chamber Organ a Mixture of five ranks, which, while it has sufficient "harmonic-corroborating" power to enrich the full organ tone, can be used, even in full chords and with a most pleasing effect, in combination with the Principale Dolce (a soft-toned *Dulciana*) only.

This is a test which I venture to think very few old or modern Mixtures of five ranks could be successfully subjected to; but it is one which every Chamber Organ Mixture should stand in a perfectly satisfactory manner. The Mixture, whatever the number of its ranks or its component intervals may be, must be formed of pipes of an extremely small scale, voiced and regulated in such a manner as to give the mutation ranks less prominence than those which present such intervals as the 8ve, 15th, 22nd, and 29th. The compositions of the Mixtures to be recommended for the Chamber Organ are given further on.

The scales of what may be considered the solo stops, such as the Flute, Violin, Violoncello, Oboe, Clarinet, Horn, Trumpet, &c., should be kept sufficiently large to produce the characteristic tones respectively aimed at. In all, however, a perfect mixing quality is quite as important as the individual or solo tone; and this consideration dictates a decided leaning towards small scales in stops of so assertive a character. As it is impossible in an article like this to do more than give the merest outline of this branch of my subject, I must content myself with the above general hints, and pass on to the consideration of the stops which are most suitable for the class of Chamber Organ I am advocating.

In an organ of the moderate size contemplated in this essay, a chief unison stop of the true English *Open Diapason* species should certainly be introduced in the leading manual department, and should extend throughout the compass of the instrument. Its tone should be full and round, devoid of any hissing or windiness. Again I must touch on this subject of windiness. Perhaps nothing is more objectionable in an organ, which has to be listened to at so short a distance, than the unmusical sound of escaping wind or the hiss which so commonly characterises loudly and badly voiced organ pipes, and no pains should be spared to get rid of the nuisance. The usual organ builder's expedient of boxing up the pipes with the view of subduing any such objectionable quality does not altogether cure the evil. If it diminishes the noise complained of, it also detracts very materially from the freedom and richness of the musical tone of the pipes—it reduces one evil only to create another. The noise must be cured in the pipes themselves, by skilful voicing and the exact adjustment of their supply of wind. This fact must never be overlooked in Chamber Organ building.

Taking it for granted that an important unison register, as above mentioned, has been decided on for the chief manual department, let us designate it by its proper name, Principal, 8ft.,* and turn our attention to the question respecting the most appropriate Octave to combine with it. If only one stop of 4ft. is to be inserted in this department, it is advisable to depart from the commonly accepted practice of introducing an Octave of the same species as the Principal, 8ft., and to adopt in its stead a stop which shall at once fulfil the ordinary office of an Octave in combination, and be a useful solo register. When two 4ft. stops are to be inserted, one should certainly be a cylindrical metal stop, considerably smaller in scale, but generally resembling the unison Principal in character. Its tone should, as already pointed out, be lighter and more "silvery," so as to render it useful as an Octave in combination with other unisons than the Principal. The second register should be a Flute, 4ft., of medium strength. This arrangement secures diversity of tone, an advantage in a Chamber Organ never to be lost sight of. When only one Flute of 4ft. is introduced, it should be constructed and voiced to imitate as closely as possible the tones of the orchestral instrument, and be, accordingly, labelled Orchestral Flute or Flauto Traverso. In an instrument of, say, fifteen speaking stops there may be four and in one of twenty stops five flute-toned registers inserted with advantage. When the Chamber Organ is used in concerted music along with stringed instruments and the piano, the flute quality is of the greatest value. It enables the organ to hold itself distinct, and to add a very desirable quality to the *ensemble*.

When four Flutes are introduced, there should be two of unison pitch, of different qualities and strengths of tone; one an open stop (open from Tenor C) of the *Clarabella* type, and the other a covered stop of the *Lieblich Gedact* character: one open Flute of 4ft. (Orchestral Flute), and one open Flute or Piccolo of 2ft. When five Flutes are inserted there may either be another covered unison of different intonation, or a second octave Flute of the *Lieblich Gedact* type, voiced much softer than the Orchestral Flute. This may be a small-scaled half-covered wood stop throughout. I may just mention by way of a practical illustration that in my own Chamber Organ, of nineteen speaking stops, there are the following six flute-toned registers in the manual departments:—1. Flauto Primo (*Doppel-flöte*), 8ft. tone. 2. Flauto Secondo (*Lieblich Gedact*), 8ft. tone. 3. Flauto Tedesca (a species of *Clarabella*, open from Tenor C), 8ft. 4. Flauto Traverso, 4ft. 5. Flauto d'Amore (small-scaled register, half-covered throughout), 4ft. tone. 6. Piccolo, 2ft. The diversity in strength and character of tone, as well as in pitch, presented by these stops renders them invaluable.

As I have already dwelt on the subject of the Twelfth and Super-octave stops, while speaking more particularly of scales, it is unnecessary to again allude to it. With the view of impressing the reader with certain most important matters for consideration, I have, perhaps, more than once repeated myself already, but need not continue the practice, when nothing is to be gained by it.

In addition to the full-toned Principal, 8ft., already discussed, the Chamber Organ should certainly contain a delicate unison

* See my previous article on "Organ-Stop Nomenclature" in ENGLISH MECHANIC, present volume, p. 319.

stop of pure organ tone. The stop known as the *Dulciana* exactly supplies what is required. As this register will be in a swell-box, it will be inconvenient, if not impossible, in all ordinary cases to carry it down in open pipes to CC. Beautiful as the lowest octave is when voiced by a master, its omission is not a serious matter. The octave may be grooved into the bass of some other soft stop, or may be inserted in stopped pipes of very small scale and quiet intonation. When space will permit, the open metal pipes should be carried down to Gamut G. If a still softer unison is required, the so-called *Vox Angelica* may be resorted to. This stop must not, however, be confounded with the duplex *Voix Célestes*. In its proper form, it is an open, cylindrical metal stop, of the smallest scale yet introduced; in tone it may be said to be an echo *Dulciana*. I question the utility of its introduction, however, and should certainly not insert it in any instrument unless there was a distinct Echo department to receive it.

ERRATA IN ARTICLE II., PAGE 543.—In line 37 of third column, for "from C C to a^3" *read* from C C to a^2. In line 40 of third column, for "from Tenor C to a^2" *read* from Tenor C to a^3.

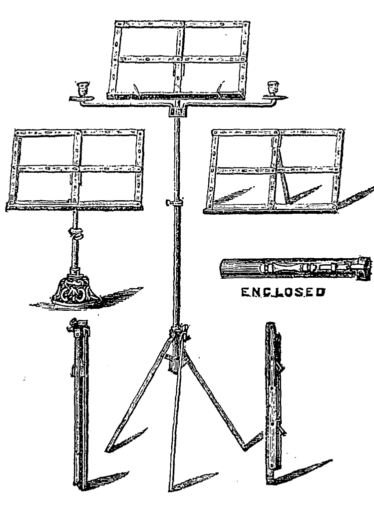
(*To be continued.*)

TOBACCO-GROWING IN ENGLAND.

AS most of our readers are aware, several experimental plots of tobacco-plants are being cultivated this year in England with the view of determining whether it will be profitable to grow the "weed" as a regular branch of agricultural industry. For many years Nicotiana macrophylla has been grown in large gardens as a border-plant, its general appearance recommending it to gardeners, while the leaves dried and cured in a rough-and-ready fashion were found useful for fumigating the greenhouses. Those interested in the cultivation of the plant for purposes of trade will, of course, pay a visit to Kew, where, in a bed opposite No. 2 Museum, they can see the different species of Nicotiana, and form their own conclusions as to the sorts likely to yield a return for the trouble and labour. In Norfolk, Lord Walsingham has a large plot, and in Kent both Lord Harris and Mr. Faunce de Laune have experimental plots of about half an acre, all of which are, we believe, doing as well as can be expected considering the season. At Plaistow, in Kent, Messrs. Carter have about three-quarters of an acre devoted to a number of varieties which are known to grow well and to yield excellent tobacco. The most promising of these are the varieties which are long-jointed and broad-leaved, for they carry the foliage clear of the soil, and are, therefore, less liable to be injured by slugs or disfigured by dirt, while the air, having freer circulation they ripen better or earlier. Tobacco in this country must be treated much in the same way as half-hardy plants—dahlias, for instance. The seeds must be raised early in heat, and the plants be kept growing in frames, so as to be ready for planting-out as early as possible in June. The ground, too, must be properly prepared, and be thrown up into flat-topped ridges or hillocks, so that the plants stand well up from the general level with about 4ft. between the rows, and 3ft. between the individuals. At Sharsted Court, near Sittingbourne, Mr. De Laune's place, the ground chosen was formerly part of a hop-garden, and the tobacco "plantation" is surrounded and sheltered by hops, the manure used being "farmyard" and sheep droppings. Here the plants have grown so luxuriantly that there is now scarcely sufficient space to get between them to pull off the heads of seed from time to time. Some of them have attained a height of 5ft. with about ten serviceable leaves, the dimensions of which are often 3ft. by 18in.; but, as a number of varieties are grown, there is naturally great diversity in the habit—some being close and dwarf, while others are tall and straggling, with all sorts of shades of green in the leaves. Stopping the main stems and removing laterals provides plenty of work for labourers; but it remains to be seen whether, even in favoured parts, tobacco can be grown as a profitable crop. It is stated by those who should know that the money value of a crop of tobacco is considerably higher than a similar area of wheat, barley, or oats will yield, but owing to the comparatively tender nature of the plant there are more expenses in rearing it, and we suspect more still in cultivating and finally curing it; but if it can be grown, as it is, in Germany, it may be that by judicious selection of varieties we may also find in tobacco a profitable crop for our farmers, especially if the land can be made to yield something else in between—even if only sheep feed. In Kent there is not likely to be much difficulty experienced in drying and curing the leaves, for there hop-oasts are plentiful, and the different methods of curing can be tried without much expenditure of capital; but although there praiseworthy experiments have been made, it is well known that the majority of those who have undertaken the work have only a hope that they will be successful. It is known well enough that the tobacco-plant will grow and ripen its leaves in this country, but as the value of the crop depends on its quality, we must wait and see how the produce of the experimental plots turns out before we can form a definite opinion as to the profitable nature of the cultivation. It is for this reason that so many different varieties have been tried—some of them for the first time in this country—and it may be that possibly we shall find one or more which equal the famed growths of Havannah, Virginia, and Maryland: but it must be confessed that it will be an agreeable surprise if they do. We understand that Mr. Jenkins, the Secretary of the Royal Agricultural Society, is preparing a report on the experimental plots from personal inspection, and on his conclusions a great deal will depend, not only as to the future cultivation of tobacco in the United Kingdom, but also as to the excise regulations which the Government will make.

PEENE'S PATENT PORTABLE MUSIC STAND.

THE legs in this Stand, which we illustrate, are expanded by sliding them down the central tube, and when at bottom of tube, by



merely pressing on top connection, the legs will open into position. The desk is opened for use by pulling up the two ladders, the one to the left, the other to the right, and then both the uprights are inserted in the V-shaped clip. These stands are suited for orchestral societies, bands, or for drawing-room use. They will be found to take up very little space when folded, the legs folding perfectly flat against the central tube. The desk also closes in a very small compass, and the patentee says they are considerably less in price than other stands of a similar kind.

The Stand has received a certificate of merit from the "Inventions," Science and Art Department, Section No. 12, Wolverton. A light stand suitable for carrying in violin case is also made by the inventor.

BRITISH ASSOCIATION.

PRESIDENT'S ADDRESS.

THE fifty-sixth annual meeting of the British Association for the Advancement of Science was opened in Birmingham on Wednesday last, the 1st inst., when the president, Sir J. William Dawson, C.M.G., M.A., LL.D., F.R.S., F.G.S., principal and vice-chancellor of McGill University, Montreal, delivered an address, from which we extract the following:—After some introductory remarks, in which the president referred to the last meeting in Birmingham and the founding of the Mason College, he said:—

In a recent address, the late President of the Royal Society called attention to the fact that within the lifetime of the older men of science of the present day, the greater part of the vast body of knowledge included in the modern sciences of physics, chemistry, biology, and geology, has been accumulated, and the most important advances made in its application to such common and familiar things as the railway, ocean navigation, the electric telegraph, electric lighting, the telephone, the germ theory of disease, the use of anæsthetics, the processes of metallurgy, and the dyeing of fabrics. Even since the last meeting in this city, much of this great work has been done, and has led to general results of the most marvellous kind. What at that time could have appeared more chimerical than the opening up by the enterprise of one British colony of a shorter road to the East by way of the extreme west, realising what was happily called by Milton and Cheadle "the new North-west Passage," making Japan the next neighbour of Canada on the west, and offering to Britain a new way to her Eastern possessions? or than the possibility of this Association holding a successful meeting on the other side of the Atlantic? To have ventured to predict such things in 1865 would have appeared quite visionary, yet we are now invited to meet in Australia, and may proceed thither by the Canadian Pacific Railway and its new lines of steamers, returning by the Suez Canal. To-day this is quite as feasible as the Canadian visit would have been in 1865. It is science that has thus brought the once widely-separated parts of the world nearer to each other, and is breaking down those geographical barriers which have separated the different portions of our widely extended British race. Its work in this is not yet complete. Its goal to-day is its starting-point to-morrow. It is as far as at any previous time from seeing the limit of its conquests, and every victory gained is but the opening of the way for a farther advance. By its visit to Canada the British Association has asserted its imperial character, and has consolidated the scientific interests of Her Majesty's dominions, in advance of that great gathering of the industrial products of all parts of the empire now on exhibition in London, and in advance of any political plans of Imperial federation. There has even been a project before us for an international scientific convention, in which the great English republic of America shall take part, a project the realisation of which was to some extent anticipated in the fusion of the members of the British and American Associations at Montreal and Philadelphia in 1884. As a Canadian, as a past President of the American Association, and now honoured with the Presidency of this Association, I may be held to represent in my own person this scientific union of the British Islands, of the various Colonies, and of the great Republic, which, whatever the difficulties attending its formal accomplishment at present, is certain to lead to an actual and real union for scientific work. In furtherance of this I am glad to see here to-day influential representatives of most of the British Colonies, of India, and of the United States. We welcome here also delegates from other countries, and though the barrier of language may at present prevent a larger union, we may entertain the hope that Britain, America, India, and the Colonies, working together in the interests of science, may ultimately render our English tongue the most general vehicle of scientific thought and discovery, a consummation of which I think there are at present many indications. But, while science marches on from victory to victory, its path is marked by the resting-places of those who have fought its battles and assured its advance. In looking back to 1865 there rise before me the once familiar countenances of Phillips, Murchison, Lyell, Forbes, Jeffreys, Jukes, Rolleston, Miller, Spottiswoode, Fairbairn, Gassiot, Carpenter, and a host of others, present in full vigour at that meeting, but no more with us. These were veterans of science; but, alas! many then young and rising in fame are also numbered with the dead. It may be that before another Birmingham meeting many of us, the older members now, will also have passed away. But these men have left behind them ineffaceable monuments of their work, in which they still survive, and we rejoice to believe that, though dead to us, they live in that company of the great and

good of all ages who have entered into that unseen universe where all that is high and holy and beautiful must go on accumulating till the time of the restitution of all things. Let us follow their example and carry on their work, as God may give us power and opportunity, gathering in precious stores of knowledge and of thought, in the belief that all truth is immortal, and must go on for ever bestowing blessings on mankind. Thus will the memory of the mighty dead remain to us as a power which—

Like a star
Beacons from the abode where the eternal are.

I do not wish, however, to occupy your time longer with general or personal matters, but rather to take the opportunity afforded by this address to invite your attention to some topics of scientific interest. In attempting to do this I must have before me the warning conveyed by Prof. Huxley, in the address to which I have already referred, that in our time Science, like Tarpeia, may be crushed with the weight of the rewards bestowed on her. In other words, it is imposible for any man to keep pace with the progress of more than one limited branch of science, and it is equally impossible to find an audience of scientific men of whom anything more than a mere fraction can be expected to take an interest in any one subject. There is, however, some consolation in the knowledge that a speaker who is sufficiently simple for those who are advanced specialists in other departments, will of necessity be also sufficiently simple to be understood by the general public who are specialists in nothing. On this principle a geologist of the old school, accustomed to a great variety of work, may hope to so scatter his fire as to reach the greater part of the audience. In endeavouring to secure this end, I have sought inspiration from that ocean which connects rather than separates Britain and America, and may almost be said to be an English sea—the North Atlantic. The geological history of this depression of the earth's crust, and its relation to the continental masses which limit it, may furnish a theme at once generally intelligible and connected with great questions as to the structure and history of the earth, which have excited the attention alike of physicists, geologists, biologists, geographers, and ethnologists. Should I, in treating of these questions, appear to be somewhat abrupt and dogmatic, and to indicate rather than state the evidence of the general views announced, I trust you will kindly attribute this to the exigencies of a short address.

The Geology of the Atlantic.

If we imagine an observer contemplating the earth from a convenient distance in space, and scrutinising its features as it rolls before him, we may suppose him to be struck with the fact that eleven-sixteenths of its surface are covered with water, and that the land is so unequally distributed that from one point of view he would see a hemisphere almost exclusively oceanic, while nearly the whole of the dry land is gathered in the opposite hemisphere. He might observe that the great oceanic area of the Pacific and Antarctic Oceans is dotted with islands—like a shallow pool with stones rising above its surface—as if its general depth were small in comparison with its area. He might also notice that a mass or belt of land surrounds each pole, and that the northern ring sends off to the southward three vast tongues of land and of mountain chains, terminating respectively in South America, South Africa, and Australia, towards which feebler and insular processes are given off by the Antarctic continental mass. This, as some geographers have observed, gives a rudely three-ribbed aspect to the earth, though two of the three ribs are crowded together and form the Europ-asian mass or double continent, while the third is isolated in the single continent of America. He might also observe that the northern girdle is cut across, so that the Atlantic opens by a wide space into the Arctic Sea, while the Pacific is contracted towards the north, but confluent with the Antarctic Ocean. The Atlantic is also relatively deeper and less cumbered with islands than the Pacific, which has the higher ridges near its shores, constituting what some visitors to the Pacific coast of America have not inaptly called the "back of the world," while the wider slopes face the narrower ocean, into which for this reason the greater part of the drainage of the land is poured. The Pacific and Atlantic, though both depressions or flattenings of the earth, are, as we shall find, different in age, character, and conditions; and the Atlantic, though the smaller, is the older, and from the geological point of view, in some respects, the more important of the two. If our imaginary observer had the means of knowing anything of the rock formations of the continents, he would notice that those bounding the North Atlantic are in general of great age, some belonging to the Laurentian system. On the other hand, he would see that many of the mountain ranges along the Pacific are comparatively new, and that modern igneous action occurs in connection with them. Thus he might be led to believe that the Atlantic, though comparatively narrow, is an older feature of the earth's surface, while the Pacific belongs to more modern times. But he would note in connection with this that the oldest rocks of the great continental masses are mostly towards their northern ends, and that the borders of the northern ring of land and certain ridges extending southwards from it constitute the most ancient and permanent elevations of the earth's crust, though now greatly surpassed by mountains of more recent age nearer the Equator. Before leaving this general survey we may make one further remark. An observer looking at the earth from without would notice that the margins of the Atlantic and the main lines of direction of its mountain chains are north-east and south-west, and north-west and south-east, as if some early causes had determined the occurrence of elevations along great circles of the earth's surface tangent to the Polar circles. We are invited by the preceding general glance at the surface of the earth to ask certain questions respecting the Atlantic. (1) What has at first determined its position and form? (2) What changes has it experienced in the lapse of geological time? (3) What relations have these changes borne to the development of life on the land and in the water? (4) What is its probable future?

The Interior of the Earth.

Before attempting to answer these questions, which I shall not take up formally in succession, but rather in connection with each other, it is necessary to state as briefly as possible certain general conclusions respecting the interior of the earth. It is popularly supposed that we know nothing of this beyond a superficial crust perhaps averaging 50,000 to 100,000ft. in thickness. It is true we have no means of exploration in the earth's interior; but the conjoined labours of physicists and geologists have now proceeded sufficiently far to throw much inferential light on the subject, and to enable us to make some general affirmations with certainty; and these it is the more necessary to state distinctly, since they are often treated as mere subjects of speculation and fruitless discussion. (1) Since the dawn of geological science, it has been evident that the crust on which we live must be supported on a plastic or partially liquid mass of heated rock, approximately uniform in quality under the whole of its area. This is a legitimate conclusion from the wide distribution of volcanic phenomena, and from the fact that the ejections of volcanoes, while locally of various kinds, are similar in every part of the world. It led to the old idea of a fluid interior of the earth; but this is now generally abandoned, and this interior heated and plastic layer is regarded as merely an under-crust. (2) We have reason to believe, as the result of astronomical investigations, that, notwithstanding the plasticity or liquidity of the under-crust, the mass of the earth—its nucleus as we may call it—is practically solid and of great density and hardness. Thus we have the apparent paradox of a solid yet fluid earth; solid in its astronomical relations, liquid or plastic for the purposes of volcanic action and superficial movements. (3) The plastic sub-crust is not in a state of dry igneous fusion; but in that condition of aqueo-igneous or hydro-thermic fusion which arises from the action of heat on moist substances, and which may either be regarded as a fusion or as a species of solution at a very high temperature. This we learn from the phenomena of volcanic action, and from the composition of the volcanic and plutonic rocks, as well as from such chemical experiments as those of Daubrée, and of Tilden and Shenstone. (4) The interior sub-crust is not perfectly homogeneous, but may be roughly divided into two layers or magmas, as they have been called: an upper, highly silicious or acidic, of low specific gravity and light-coloured, and corresponding to such kinds of plutonic and volcanic rocks as granite and trachyte; and a lower, less silicious or more basic, more dense, and more highly charged with iron, and corresponding to such igneous rocks as the dolerites, basalts, and kindred lavas. It is interesting here to note that this conclusion, elaborated by Durocher and Von Waltershausen, and usually connected with their names, appears to have been first announced by John Phillips in his "Geological Manual," and as a mere common-sense deduction from the observed phenomena of volcanic action and the probable results of the gradual cooling of the earth. It receives striking confirmation from the observed succession of acidic and basic volcanic rocks of all geological periods and in all localities. It would even seem, from recent spectroscopic investigations of Lockyer, that there is evidence of a similar succession of magmas in the heavenly bodies, and the discovery by Nordenskiöld of native iron in Greenland basalts, affords a probability that the inner magma is in part metallic. (5) Where rents or fissures form in the upper crust, the material of the lower crust is forced upwards by the pressure of the less supported portions of the former, giving rise to volcanic phenomena either of an explosive or quiet character, as may be determined by contact with water. The underlying material may also be carried to the surface by the agency of heated water, producing those quiet discharges which Hunt has named crenitic. It is to be observed here that explosive volcanic phenomena, and the formation of cones, are, as Prestwich has well remarked, characteristic of an old and thickened crust; quiet ejection from fissures and hydro-thermal action may have been more common in earlier periods and with a thinner over-crust. (6) The contraction of the earth's interior by cooling and by the emission of material from below the over-crust, has caused this crust to press downwards, and therefore laterally, and so to effect great bends, folds, and plications; and these modified subsequently by surface denudation constitute mountain chains and continental plateaus. As Hall long ago pointed out, such lines of folding have been produced more especially where thick sediments had been laid down on the sea bottom. Thus we have here another apparent paradox—namely, that the elevations of the earth's crust occur in the places where the greatest burden of detritus has been laid down upon it, and where consequently the crust has been softened and depressed. We must beware, in this connection, of exaggerated notions of the extent of contraction and of crumpling required to form mountains. Bonney has well shown, in lectures delivered at the London Institution, that an amount of contraction, almost inappreciable in comparison with the diameter of the earth, would be sufficient; and that as the greatest mountain chains are less than 1,600th of the earth's radius in height, they would on an artificial globe 1ft. in diameter be no more important than the slight inequalities that might result from the paper gores overlapping each other at the edges. (7) The crushing and sliding of the over-crust implied in these movements raise some serious questions of a physical character. One of these relates to the rapidity or slowness of such movements, and the consequent degree of intensity of the heat developed, as a possible cause of metamorphism of rocks. Another has reference to the possibility of changes in the equilibrium of the earth itself as resulting from local collapse and ridging. These questions in connection with the present dissociation of the axis of rotation from the magnetic poles, and with changes of climate, have attracted some attention, and probably deserve further consideration on the part of the physicists. In so far as geological evidence is concerned, it would seem that the general association of crumpling with metamorphism indicates a certain rapidity in the process of mountain-making, and consequent development of heat, and the arrangement of the older rocks around the Arctic basin forbids us from assuming any extensive movement of the axis of rotation, though it does not exclude changes to a limited extent. I hope that Professor Darwin will discuss these points in his address to the Physical Section. I wish to formulate these principles as distinctly as possible, and as the result of all the long series of observations, calculations, and discussions since the time of Werner and Hutton, and in which a vast number of able physicists and naturalists have borne a part, because they may be considered as certain deductions from our actual knowledge, and because they lie at the foundation of a rational physical geology. We may popularise these deductions by comparing the earth to a drupe or stone-fruit, such as a plum or peach, somewhat dried up. It has a large and intensely hard stone and kernal, a thin pulp made up of two layers, an inner more dense and dark-coloured, and an outer less dense and light-coloured. These constitute the under-crust. On the outside it has a thin membrane or over-crust. In the process of drying it has slightly shrunk, so as to produce ridges and hollows of the outer crust, and this outer crust has cracked in some places, allowing portions of the pulp to ooze out—in some of these its lower dark substance, in others its upper and lighter material. The analogy extends no further, for there is nothing in our withered fruit to represent the oceans occupying the lower parts of the surface or the deposits which they have laid down. Keeping in view these general conclusions, let us now turn to their bearing on the origin and history of the North Atlantic.

The Basin of the Atlantic.

Though the Atlantic is a deep ocean, its basin does not constitute so much a depression of the crust of the earth as a flattening of it, and this, as recent soundings have shown, with a slight ridge or elevation along its middle, and banks or terraces fringing the edges, so that its form is not so much that of a basin as that of a shallow plate with its middle a little raised. Its true permanent margins are composed of portions of the over-crust folded, ridged up, and crushed, as if by lateral pressure emanating from the sea itself. We cannot, for example, look at a geological map of America without perceiving that the Appalachian ridges, which

intervene between the Atlantic and the St. Lawrence valley, have been driven bodily back by a force acting from the east, and that they have resisted this pressure only where, as in the Gulf of St. Lawrence and the Catskill region of New York, they have been protected by outlying masses of very old rocks, as, for example, by that of the island of Newfoundland and that of the Adirondack Mountains. The admirable work begun by my friend and fellow-student Prof. James Nicol, followed up by Hicks, Lapworth, and others, and now, after long controversy, fully confirmed by the recent observations of the geological survey of Scotland, has shown the most intense action of the same kind on the east side of the ocean in the Scottish highlands; and the more widely distributed Eozoic rocks of Scandinavia may be appealed to in further evidence of this. If we now inquire as to the cause of the Atlantic depression, we must go back to a time when the areas occupied by the Atlantic and its bounding coasts were parts of a shoreless sea in which the earliest gneisses or stratified granites of the Laurentian age were being laid down in vastly-extended beds. These ancient crystalline rocks have been the subject of much discussion and controversy, and as they constitute the lowest and probably the firmest part of the Atlantic sea-bed, it is necessary to inquire as to their origin and history. Dr. Bonney, the late President of the Geological Society, in his anniversary address, and Dr. Sterry Hunt, in an elaborate paper communicated to the Royal Society of Canada, have ably summed up the hypotheses as to the origin of the oldest Laurentian beds. At the bases of these hypotheses lies the admission that the immensely thick beds of orthoclase gneiss, which are the oldest stratified rocks known to us, are substantially the same in composition with the upper or siliceous magma or layer of the under-crust. They are, in short, its materials either in their primitive condition or merely rearranged. One theory considers them as original products of cooling, owing their lamination merely to the successive stages of the process. Another view refers them to the waste and rearrangement of the materials of a previously massive granite. Still another holds that all our granites really arise from the fusion of old gneisses of originally aqueous origin, while a fourth refers the gneisses themselves to molecular changes effected in granite by pressure. These several views, in so far as they relate to the oldest or fundamental Laurentian gneiss, may be arranged under the following heads: (1) *Endoplutonic*, or that which regards all the old gneisses as molten rocks cooled from without inward in successive layers. (2) *Exoplutonic*, or that which considers them as made up of matter ejected from below the upper crust in the manner of volcanic action. (3) *Metamorphic*, which supposes the old gneisses to arise from the crystallisation of detrital matter spread over the sea-bottom, and either igneous or derived from the decay of igneous rocks. (4) *Chaotic* or *Thermo-chaotic*, or the theory of deposit from the turbid waters of a primeval ocean either with or without the aid of heat. In one form this was the old theory of Werner. (5) *Crenitic* or Hydro-thermic, which supposes the action of heated waters penetrating below the crust to be constantly bringing up to the surface mineral matters in solution and depositing these so as to form felspathic and other rocks. It will be observed, in regard to these theories, that none of them supposes that the old gneiss is an ordinary sediment, but that all regard it as formed in exceptional circumstances, these circumstances being the absence of land and of sub-aërial decay of rock, and the presence wholly or principally of the material of the upper surface of the recently hardened crust. This being granted, the question arises, Ought we not to combine these several theories and to believe that the cooling crust has hardened in successive layers from without inward; that at the same time fissures were locally discharging igneous matter to the surface; that matter held in suspension in the ocean and matter held in solution by heated waters rising from beneath the outer crust were mingling their materials in the deposits of the primitive ocean? It would seem that the combination of all these agencies may safely be invoked as causes of the pre-Atlantic deposits. This is the eclectic position which I endeavoured to maintain in my address before the Minneapolis Meeting of the American Association in 1883, and which I still hold to be in every way probable.

Metamorphism.

A word here as to metamorphism, a theory which, like many others, has been first run to death and then discredited, but which to the moderate degree in which it was originally held by Lyell is still valid. Nothing can be more certain than that the composition of the Laurentian gneisses forbids us to suppose that they can be ordinary sediments metamorphosed. They are rocks peculiar in their origin, and not paralleled unless exceptionally in later times. On the other hand, they have undoubtedly experienced very important changes, more especially as to crystallisation, the state of combination of their ingredients, and the development of disseminated minerals; and while this may in part be attributed to the mechanical pressure to which they have been subjected, it requires also the action of hydrothermic agencies. Any theory which fails to invoke both of these kinds of force must necessarily be partial and imperfect. But all metamorphic rocks are not of the same character with the gneisses of the Lower Laurentian. Even in the Middle and Upper Laurentian we have metamorphic rocks—e.g., quartzite and limestone, which must originally have been ordinary aqueous deposits. Still more in the succeeding Huronian and its associated series of beds, and in the Lower Palæozoic, local metamorphic change has been undergone by rocks quite similar to those which in their unaltered state constitute regular sedimentary deposits. In the case of these later rocks it is to be borne in mind that, while some may have been of volcanic origin, others may have been sediments rich in undecomposed fragments of silicates. It is a mistake to suppose that the ordinary decay of stratified siliceous rocks is a process of kaolinisation so perfect as to eliminate all alkaline matters. On the contrary, the fact, which Judd has recently well illustrated in the case of the mud of the Nile, applies to a great number of similar deposits in all parts of the world, and shows that the finest sediments have not always been so completely lixiviated as to be destitute of the basic matters necessary for their conversion into gneiss, mica-schist, and similar rocks when the necessary agencies of metamorphism are applied to them, and this quite independently of any extraneous matters introduced into them by water or otherwise. Still, it must be steadily kept in view that many of the old pre-Cambrian crystalline rocks must have been different originally from those succeeding them, and that consequently these last, even when metamorphosed, present different characters. I may remark here that, though a palæontologist rather than a lithologist, it gives me great pleasure to find so much attention now given in this country to the old crystalline rocks, and to their study microscopically and chemically as well as in the field, a work in which Sorby and Allport were pioneers. As a pupil of the late Prof. Jameson, of Edinburgh, my own attention was early attracted to the study of minerals and rocks as the stable foundations of geological science; and as far back as 1841 I had learnt of the late Mr. Sanderson, of Edinburgh, who worked at Nicol's sections, how to slice rocks and fossils; and since that time I have been in the habit of examining everything with the microscope. The modern developments in this direction are therefore very gratifying to me, even though, as is natural, they may sometimes appear to be pushed too far or their value overestimated. That these old gneisses were deposited not only in what is now the bed of the Atlantic, but also on the great continental areas of America and Europe, anyone who considers the wide extent of these rocks represented on the map recently published by Prof. Holl can readily understand. It is true that Holl supposes that the basin of the Atlantic itself may have been land at this time, but there is no evidence of this, more especially as the material of the gneiss could not have been detritus derived from sub-aërial decay of rock.

The Cooling of the Earth.

Let us suppose, then, the floor of old ocean covered with a flat pavement of gneiss, or of that material which is now gneiss, the next question is how and when did this original bed become converted into sea and land. Here we have some things certain, others most debatable. That the cooling mass, especially if it was sending out volumes of softened rocky material, either in the exoplutonic or in the crenitic way, and piling this on the surface, must soon become too small for its shell, is apparent; but when and where would the collapse, crushing, and wrinkling inevitable from this cause begin? Where they did begin is indicated by the lines of mountain-chains which traverse the Laurentian districts; but the reason why is less apparent. The more or less unequal cooling, hardening, and conductive power of the outer crust we may readily assume. The driftage unequally of water-borne detritus to the south-west by the bottom currents of the sea is another cause, and, as we shall soon see, most effective. Still another is the greater cooling and hardening of the crust in the polar regions, and the tendency to collapse of the equatorial protuberance from the slackening of the earth's rotation. Besides these the internal tides of the earth's substance at the times of solstice would exert an oblique pulling force on the crust, which might tend to crack it along diagonal lines. From whichever of these causes, or the combination of the whole, we know that within the Laurentian time folded portions of the earth's crust began to rise above the general surface in broad belts running from N.E. to S.W., and from N.W. to S.E., where the older mountains of Eastern America and Western Europe now stand, and that the subsidence of the oceanic areas allowed by this crumpling of the crust permitted other areas on both sides of what is now the Atlantic to form limited table-lands. This was the beginning of a process repeated again and again in subsequent times, and which began in the Middle Laurentian, when for the first time we find beds of quartzite, limestone, and iron ore, and graphitic beds, indicating that there was already land and water, and that the sea, and perhaps the land, swarmed with animal and plant life of forms unknown to us, for the most part, now. Independently of the questions as to the animal nature of Eozoon, I hold that we know, as certainly as we can know anything inferentially, the existence of these primitive forms of life. If I were to conjecture what were the early forms of plant and animal life, I would suppose that just as in the Palæozoic the acrogens culminated in gigantic and complex forest trees, so in the Laurentian the algæ, the lichens, and the mosses grew to dimensions and assumed complexity of structure unexampled in later times, and that in the sea the humbler forms of Protozoa and Hydrozoa were the dominant types, but in gigantic and complex forms. The land of this period was probably limited, for the most part, to high latitudes, and its aspect, though more rugged and abrupt and of greater elevation, must have been of that character which we still see in the Laurentian hills. The distribution of this ancient land is indicated by the long lines of old Laurentian rock extending from the Labrador coast and the north shore of the St. Lawrence, and along the eastern slopes of the Appalachians in America, and the like rocks of the Hebrides, the Western Highlands, and the Scandinavian mountains. A small but interesting remnant is that in the Malvern Hills, so well described by Holl. It will be well to note here and to fix on our minds that the ancient ridges of Eastern America and Western Europe have been greatly denuded and wasted since Laurentian times, and that it is along their eastern sides that the greatest sedimentary accumulations have been deposited. From this time dates the introduction of that dominance of existing causes which forms the basis of uniformitarianism in geology, and which had to go on with various and great modifications of detail, through the successive stages of the geological history, till the land and water of the northern hemisphere attained to their present complex structure.

Growth of Continents and Seas.

So soon as we have a circumpolar belt or patches of Eozoic land and ridges running southward from it, we enter on new and more complicated methods of growth of the continents and seas. Here we are indebted to Le Conte for clearly pointing out that our original Eozoic tracts of continent were in the earliest times areas of deposition, and that the first elevations of land out of the primeval ocean must have differed in important points from all that have succeeded them; but they were equally amenable to the ordinary laws of denudation. Portions of these oldest crystalline rocks, raised out of the protecting water, were now eroded by atmospheric agents, and especially by the carbonic acid, then existing in the atmosphere perhaps more abundantly than at present, under whose influence the hardest of the gneissic rocks gradually decay. The Arctic lands were subjected in addition to the powerful mechanical force of frost and thaw. Thus every shower of rain and every swollen stream would carry into the sea the products of the waste of land, sorting them into fine clays and coarser sands; and the cold currents which cling to the ocean bottom, now determined in their courses, not merely by the earth's rotation, but also by the lines of folding on both sides of the Atlantic, would carry south-westward, and pile up in marginal banks of great thickness, the *débris* produced from the rapid waste of the land already existing in the Arctic regions. The Atlantic, opening widely to the north, and having large rivers pouring into it, was especially the ocean characterised, as time advanced, by the prevalence of these phenomena. Thus throughout the geological history it has happened that, while the middle of the Atlantic has received merely organic deposits of shells of Foraminifera and similar organisms, and this probably only to a small amount, its margins have had piled upon them beds of detritus of immense thickness. Prof. Hall, of Albany, was the first geologist who pointed out the last cosmic importance of these deposits, and that the mountains of both sides of the Atlantic owe their origin to these great lines of deposition, along with the fact, afterwards more fully insisted on by Rogers, that the portions of the crust which received these masses of *débris* became thereby weighted down and softened, and were more liable than other parts to lateral crushing. Thus in the later Eozoic and early Palæozoic times, which succeeded the first foldings of the oldest Laurentian, great ridges were thrown up, along the edges of which were beds of limestone, and on their summits and sides

thick masses of ejected igneous rocks. In the bed of the central Atlantic there are no such accumulations. It must have been a flat, or slightly-ridged, plate of the ancient gneiss, hard and resisting, though perhaps with a few cracks, through which igneous matter welled up, as in Iceland and the Azores in more modern times. In this condition of things we have causes tending to perpetuate and extend the distinctions of ocean and continent, mountain and plain, already begun; and of these we may more especially note the continued subsidence of the areas of greatest marine deposition. This has long attracted attention, and affords very convincing evidence of the connection of sedimentary deposit as a cause with the subsidence of the crust. We are indebted to a French physicist, M. Faye, for an important suggestion on this subject. It is that the sediment accumulated along the shores of the ocean presented an obstacle to radiation, and consequently to cooling of the crust, while the ocean floor, unprotected and unweighted, and constantly bathed with currents of cold water, having great power of convection of heat, would be more rapidly cooled, and so would become thicker and stronger. This suggestion is complementary to the theory of Professor Hall, that the areas of greatest deposit on the margins of the ocean are necessarily those of greatest folding and consequent elevation. We have thus a hard, thick, resisting ocean-bottom which, as it settles down toward the interior, under the influence of gravity, squeezes upward and folds and plicates all the soft sediments deposited on its edges. The Atlantic area is almost an unbroken cake of this kind. The Pacific area has cracked in many places, allowing the interior fluid matter to ooze out in volcanic ejections. It may be said that all this supposes a permanent continuance of the ocean-basins, whereas many geologists postulate a Mid-Atlantic continent to give the thick masses of detritus found in the older formations both in Eastern America and Western Europe, and which thin off in proceeding into the interior of both continents. I prefer, with Hall, to consider these belts of sediment as in the main the deposits of northern currents, and derived from Arctic land, and that like the great banks of the American coast at the present day, which are being built up by the present Arctic current, they had little to do with any direct drainage from the adjacent shore. We need not deny, however, that such ridges of land as existed along the Atlantic margins were contributing their quota of river-borne material, just as on a still greater scale the Amazon and Mississippi are doing now, and this especially on the sides toward the present continental plateaus, though the greater part must have been derived from the wide tracts of Laurentian land within the Arctic Circle or near to it. It is further obvious that the ordinary reasoning respecting the necessity of continental areas in the present ocean basins would actually oblige us to suppose that the whole of the oceans and continents had repeatedly changed places. This consideration opposes enormous physical difficulties to any theory of alternations of the oceanic and continental areas, except locally at their margins. I would, however, refer you for a more full discussion of these points to the address to be delivered to-morrow by the president of the Geological Section. But the permanence of the Atlantic depression does not exclude the idea of successive submergences of the continental plateaus and marginal slopes, alternating with periods of elevation, when the ocean retreated from the continents and contracted its limits. In this respect the Atlantic of to-day is much smaller than it was in those times when it spread widely over the continental plains and slopes, and much larger than it has been in times of continental elevation. This leads us to the further consideration that, while the ocean-beds have been sinking, other areas have been better supported, and constitute the continental plateaus; and that it has been at or near the junctions of these sinking and rising areas that the thickest deposits of detritus, the most extensive foldings, and the greatest ejections of volcanic matter have occurred. There has thus been a permanence of the position of the continents and oceans throughout geological time, but with many oscillations of these areas, producing submergencies and emergencies of the land. In this way we can reconcile the vast vicissitudes of the continental areas in different geological periods with that continuity of development from north to south, and from the interiors to the margins, which is so marked a feature. We have for this reason to formulate another apparent geological paradox—namely, that while in one sense the continental and oceanic areas are permanent, in another they have been in continual movement. Nor does this view exclude extension of the continental borders or of chains of islands beyond their present limits at certain periods; and, indeed, the general principle already stated, that subsidence of the ocean bed has produced elevation of the land, implies in earlier periods a shallower ocean and many possibilities as to volcanic islands, and low continental margins creeping out into the sea; while it is also to be noted that there are, as already stated, bordering shelves, constituting shallows in the ocean, which at certain periods have emerged as land. We are thus compelled to believe in the contemporaneous existence in all geological periods, except perhaps the earliest of them, of three distinct conditions of areas on the surface of the earth. (1) Oceanic areas of deep sea, which always continued to occupy in whole or in part the bed of the present ocean. (2) Continental plateaus and marginal shelves, existing as low flats or higher table-lands liable to periodical submergence and emergence. (3) Lines of plication and folding, more especially along the borders of the oceans, forming elevated portions of land, rarely altogether submerged, and constantly affording the material of sedimentary accumulations, while they were also the seats of powerful volcanic ejections. In the successive geological periods the continental plateaus, when submerged, owing to their vast extent of warm and shallow sea, have been the great theatres of the development of marine life and of the deposition of organic limestones, and when elevated they have furnished the abodes of the noblest land faunas and floras. The mountain belts, especially in the north, have been the refuge and stronghold of land life in periods of submergence, and the deep ocean basins have been the perennial abodes of pelagic and abyssal creatures, and the refuge of multitudes of other marine animals and plants in times of continental elevation. These general facts are full of importance with reference to the question of the succession of formations and of life in the geological history of the earth.

The History of the Atlantic.

So much time has been occupied with these general views that it would be impossible to trace the history of the Atlantic in detail through the ages of the Palæozoic, Mesozoic, and Tertiary. We may, however, shortly glance at the changes of the three kinds of surface already referred to. The bed of the ocean seems to have remained on the whole abyssal, but there were probably periods when those shallow reaches of the Atlantic which stretch across its most northern portion, and partly separate it from the Arctic basin, presented connecting coasts or continuous chains of islands sufficient to permit animals and plants to pass over. At certain periods also there were not unlikely groups of volcanic islands, like the Azores, in the temperate and tropical Atlantic. More especially might this be the case in that early time when it was more like the present Pacific; and the line of the great volcanic belt of the Mediterranean, the mid-Atlantic banks, the Azores, and the West India Islands point to the possibility of such partial connections. These were stepping-stones, so to speak, over which land organisms might cross, and some of these may be connected with the fabulous or prehistoric Atlantic. In the Cambrian and Ordovician periods the distinctions, already referred to, into continental plateaus, mountain ridges, and ocean depths were first developed, and we find already great masses of sediment accumulating on the seaward sides of the old Laurentian ridges, and internal deposits thining away from these ridges over the submerged continental areas, and presenting very dissimilar conditions of sedimentation. It would seem also that, as Hicks has argued for Europe, and Logan and Hall for America, this Cambrian age was one of slow subsidence of the land previously elevated, accompanied with or caused by thick deposits of detritus along the borders of the subsiding land, which was probably covered with the decomposing rock arising from long ages of sub-aërial waste. In the coal-formation age, its characteristic swampy flats stretched in some places far into the shallower parts of the ocean. In the Jurassic the American continent probably extended further to sea than at present. In the Wealden age there was much land to the west and north of Great Britain, and Professor Bonney has directed attention to the evidence of the existence of this land as far back as the Trias, while Mr. Starkie Gardiner has insisted on connecting links to the southward as evidenced by fossil plants. So late as the Post-Glacial, or early human period, large tracts now submerged formed portions of the continents. On the other hand the internal plains of America and Europe were often submerged. Such submergencies are indicated by the great limestones of the Palæozoic, by the chalk and its representative beds in the Cretaceous, by the Nummulitic formation in the Eocene, and lastly by the great Pleistocene submergence, one of the most remarkable of all, one in which nearly the whole northern hemisphere participated, and which was probably separated from the present time by only a few thousands of years. These submergencies and elevations were not always alike on the two sides of the Atlantic. The Salina period of the Silurian, for example, and the Jurassic, show continental elevation in America not shared by Europe. The great subsidences of the Cretaceous and the Eocene were proportionally deeper and wider on the eastern continent, and this and the direction of the land being from north to south cause more ancient forms of life to survive in America. These elevations and submergences of the plateaus alternated with the periods of mountain-making plication, which was going on at intervals at the close of the Eozoic, at the beginning of the Cambrian, at the close of the Siluro-Cambrian, in the Permian, and in Europe and Western America in the Tertiary. The series of changes, however, affecting all these areas was of a highly complex character, and embraces the whole physical history of the geological ages. We may note here that the unconformities caused by these movements and by subsequent denundation constitute what Le Conte has called "lost intervals," one of the most important of which is supposed to have occurred at the end of the Eozoic. It is to be observed, however, that as every such movement is followed by gradual subsidence, the seeming loss is caused merely by the overlapping of the successive beds deposited. We may also note a fact which I have long ago insisted on, the regular pulsations of the continental areas, giving us alternations in each great system of formations of deep-sea and shallow-water beds, so that the successive groups of formations may be divided into triplets of shallow-water, deep-water, and shallow-water strata, alternating in each period. But I must here call you attention to still another geological paradox —namely, that the deep sea, which is so great a barrier to the passage of the shallow-water animals, seems, under certain conditions, to afford facilities for the transmission of land animals and plants. The connections established by the observations of the *Challenger*, and so well expounded by Wallace and Hemsley, between the floras of oceanic islands and the continents establish this conclusively. Thus the Bermudas, altogether recent islands, have been stocked, by the agency chiefly of the ocean currents and of birds, with nearly 150 species of continental plants, and the facts collected by Hemsley as to the present facilities of transmission, along with the evidence afforded by older oceanic islands which have been receiving animal and vegetable colonists for longer periods, go far to show that, time being given, the sea actually affords facilities for the migrations of the inhabitants of the land greater than those of continuous continents.

The Climate of the Atlantic.

We can scarcely doubt that the close connection of the Atlantic and Arctic oceans is one factor in those remarkable vicissitudes of climate experienced by the former, and in which the Pacific area has also shared in connection with the Antarctic Sea. No geological facts are indeed at first sight more strange and inexplicable than the changes of climate in the Atlantic area, even in comparatively modern periods. We know that in the early Tertiary perpetual summer reigned as far north as the middle of Greenland, and that in the Pleistocene the arctic cold advanced, until an almost perennial winter prevailed, half way to the equator. It is no wonder that nearly every cause available in the heavens and the earth has been invoked to account for these astounding facts. It will, I hope, meet with the approval of your veteran glaciologist, Dr. Crosskey, if, neglecting most of these theoretical views, I venture to invite your attention in connection with this question chiefly to the old Lyellian doctrine of the modification of climate by geographical changes. Let us, at least, consider how much these are able to account for. The ocean is a great equaliser of extremes of temperature. It does this by its great capacity for heat and by its cooling and heating power when passing from the solid into the liquid and gaseous states, and the reverse. It also acts by its mobility, its currents serving to convey heat to greater distances or to cool the air by the movement of cold, icy waters. The land, on the other hand, cools or warms rapidly, and can transmit its influence to a distance only by the winds, and the influence so transmitted is rather in the nature of a disturbing than an equalising cause. It follows that any change in the distribution of land and water must affect climate, more especially if it changes the character or course of the ocean currents. At the present time the North Atlantic presents some very peculiar and in some respects exceptional features, which are most instructive with reference to its past history. The great internal plateau of the American continent is now dry land; the passage across Central America between the Atlantic and Pacific is blocked; the Atlantic opens very widely to the north; the high mass of Greenland towers in its northern part. The effects are that the great equatorial current running across from Africa, and embayed in the Gulf of Mexico, is thrown northward and eastward in the Gulf Stream, acting as a hot-water apparatus to heat up to an exceptional degree the western coast of Europe. On the other hand, the cold Arctic current from the Polar seas is thrown to the westward, and runs down from Greenland past the American shore. The pilot chart for June of this

year shows vast fields of drift ice on the western side of the Atlantic as far south as the latitude of 40°. So far, therefore, the Glacial Age in that part of the Atlantic still extends; this at a time when, on the eastern side of the ocean, the culture of cereals reaches in Norway beyond the Arctic Circle. Let us inquire into some of the details of these phenomena. The warm water thrown into the North Atlantic not only increases the temperature of its whole waters, but gives an exceptionally mild climate to Western Europe. Still, the countervailing influence of the Arctic currents and the Greenland ice is sufficient to permit icebergs which creep down to the mouth of the Strait of Belle Isle, in the latitude of the south of England, to remain unmelted till the snows of a succeeding winter fall upon them. Now let us suppose that a subsidence of land in tropical America were to allow the equatorial current to pass through into the Pacific. The effect would at once be to reduce the temperature of Norway and Britain to that of Greenland and Labrador at present, while the latter countries would themselves become colder. The northern ice, drifting down into the Atlantic, would not, as now, be melted rapidly by the warm water which it meets in the Gulf Stream. Much larger quantities of it would remain undissolved in summer, and thus an accumulation of permanent ice would take place, along the American coast at first, but probably at length even on the European side. This would still further chill the atmosphere, glaciers would be established on all the mountains of temperate Europe and America, the summer would be kept cold by melting ice and snow, and at length all Eastern America and Europe might become uninhabitable, except by arctic animals and plants, as far south as perhaps 40° of north latitude. This would be simply a return of the Glacial age. I have assumed only one geographical change; but other and more complete changes of subsidence and elevation might take place with effects on climate still more decisive; more especially would this be the case if there were a considerable submergence of the land in temperate latitudes. We may suppose an opposite case. The high plateau of Greenland might subside or be reduced in height, and the openings of Baffin's Bay and the North Atlantic might be closed. At the same time the interior plain of America might be depressed, so that, as we know to have been the case in the Cretaceous period, the warm waters of the Mexican Gulf would circulate as far north as the basins of the present great American lakes. In these circumstances there would be an immense diminution of the sources of floating ice, and a correspondingly vast increase in the surface of warm water. The effects would be to enable a temperate flora to subsist in Greenland, and to bring all the present temperate regions of Europe and America into a condition of subtropical verdure.

The Glacial Period.

We have in America ancient periods of cold as well as warmth. I have elsewhere referred to the boulder conglomerates of the Huronian, of the Cambrian and Ordovician, of the Millstone-grit period of the Carboniferous and of the early Permian; but would not venture to affirm that either of these periods was comparable in its cold with the later glacial age, still less with that imaginary age of continental glaciation assumed by certain of the more extreme theorists. These ancient conglomerates were probably produced by floating ice, and this at periods when in areas not very remote temperate floras and faunas could flourish. The glacial periods of our old continent occurred in times when the surface of the submerged land was opened up to the northern currents, drifting over it mud, and sand, and stones, and rendering nugatory, in so far, at least, as the bottom of the sea was concerned, the effects of the superficial warm streams. Some of these beds are also peculiar to the eastern margin of the continent, and indicate ice-drift along the Atlantic coast in the same manner as at present, while conditions of greater warmth existed in the interior. Even in the more recent Glacial age, while the mountains were covered with snow and the lowlands submerged under a sea laden with ice, there were interior tracts in somewhat high latitudes of America in which hardy forest trees and herbaceous plants flourished abundantly; and these were by no means exceptional "interglacial" periods. Thus we can show that while from the remote Huronian period to the Tertiary the American land occupied the same position as at present, and while its changes were merely changes of relative level as compared with the sea, these have so influenced the ocean currents as to cause great vicissitudes of climate. Without entering on any detailed discussion of that last and greatest Glacial period which is best known to us, and is more immediately connected with the early history of man and the modern animals, it may be proper to make a few general statements bearing on the relative importance of sea-borne and land ice in producing those remarkable phenomena attributable to ice action in this period. In considering this question it must be borne in mind that the greater masses of floating ice are produced at the seaward extremities of land glaciers, and that the heavy field-ice of the Arctic regions is not so much a result of the direct freezing of the surface of the sea as of the accumulation of snow precipitated on the frozen surface. In reasoning on the extent of ice action, and especially of glaciers in the Pleistocene age, it is necessary to keep this fully in view. Now in the formation of glaciers at present—and it would seem also in any conceivable former state of the earth—it is necessary that extensive evaporation should conspire with great condensation of water in the solid form. Such conditions exist in mountainous regions sufficiently near to the sea, as in Greenland, Norway, the Alps, and the Himalayas; but they do not exist in low Arctic lands like Siberia or Grinnel-land nor in inland mountains. It follows that land glaciation has narrow limits, and that we cannot assume the possibility of great confluent and continental glaciers covering the interior of wide tracts of land. No imaginable increase of cold could render this possible, inasmuch as there could not be a sufficient influx of vapour to produce the necessary condensation; and the greater the cold, the less would be the evaporation. On the other hand, any increase of heat would be felt more rapidly in the thawing and evaporation of land ice and snow than on the surface of the sea. Applying these very simple geographical truths to the North Atlantic continents, it is easy to see that no amount of refrigeration could produce a continental glacier, because there could not be sufficient evaporation and precipitation to afford the necessary snow in the interior. The case of Greenland is often referred to, but this is the case of a high mass of cold land with sea, mostly open on both sides of it, giving, therefore, the conditions most favourable to precipitation of snow. If Greenland were less elevated, or if there were dry plains around it, the case would be quite different, as Nares has well shown by his observations on the summer verdure of Grinnel-land, which, in the immediate vicinity of North Greenland, presents very different conditions as to glaciation and climate. If the plains were submerged, and the Arctic currents allowed free access to the interior of the continent of America, it is conceivable that the mountainous regions remaining out of water would be covered with snow and ice, and there is the best evidence that this actually occurred in the Glacial period; but with the plains out of water this would be impossible. We see evidence of this at the present day in the fact that in unusually cold winters the great precipitation of snow takes place south of Canada, leaving the north comparatively bare, while as the temperature becomes milder the area of snow-deposit moves further to the north. Thus a greater extension of the Atlantic, and especially of its cold ice-laden Arctic currents, becomes the most potent cause of a glacial age. I have long maintained these conclusions on general geographical grounds, as well as on the evidence afforded by the Pleistocene deposits of Canada; and in an address the theme of which is the ocean I may be excused for continuing to regard the supposed terminal moraines of great continental glaciers as nothing but the southern limit of the ice-drift of a period of submergence. In such a period the southern margin of an ice-laden sea where its floe-ice and bergs grounded, or where its ice was rapidly melted by warmer water, and where consequently its burden of boulders and other *débris* was deposited, would necessarily present the aspect of a moraine, which by the long continuance of such conditions might assume gigantic dimensions. Let it be observed, however, that I fully admit the evidence of the great extension of local glaciers in the Pleistocene age, and especially in the times of partial submergence of the land. I am quite aware that it has been held by many able American geologists that in North America a continental glacier extended in temperate latitudes from sea to sea, or at least from the Atlantic to the Rocky Mountains, and that this glacier must, in many places, have exceeded a mile in thickness. The reasons above stated appear, however, sufficient to compel us to seek for some other explanation of the observed facts, however difficult this may at first sight appear.

Transmission of Animal Life Across the Ocean.

With reference to the transmission of living beings across the Atlantic, we have before us the remarkable fact that from the Cambrian age onwards there were on the two sides of the ocean many species of invertebrate animals which were either identical or so closely allied as to be possibly varietal forms. In like manner the early plants of the Upper Silurian, Devonian, and Carboniferous present many identical species; but this identity becomes less marked in the vegetation of the more modern times. In so far as plants are concerned, it is to be observed that the early forests were largely composed of cryptogamous plants, and the spores of these in modern times have proved capable of transmission for great distances. In considering this we cannot fail to conclude that the union of simple cryptogamous fructification with arboreal stems of high complexity, so well illustrated by Dr. Williamson, had a direct relation to the necessity for a rapid and wide distribution of these ancient trees. It seems also certain that some spores, as, for example, those of the Rhizocarps, a type of vegetation abundant in the Palæozoic, and certain kinds of seeds, as those named *Ætheotesta* and *Pachytheca*, were fitted for flotation. Further, the periods of Arctic warmth permitted the passage around the northern belt of many temperate species of plants, just as now happens with the Arctic flora; and when these were dispersed by colder periods they marched southward along both sides of the sea on the mountain chains. The same remark applies to northern forms of marine invertebrates, which are much more widely distributed in longitude than those further south. The late Mr. Gwyn Jeffreys, in one of his latest communications to this Association, stated that 54 per cent. of the shallow-water mollusks of New England and Canada are also European, and of the deep-sea forms 30 out of 35; these last, of course, enjoying greater facilities for migration than those which have to travel slowly along the shallows of the coasts in order to cross the ocean and settle themselves on both sides. Many of these animals, like the common mussel and sand clam, are old settlers which came over in the Pleistocene period, or even earlier. Others, like the common periwinkle, seem to have been slowly extending themselves in modern times, perhaps even by the agency of man. The older immigrants may possibly have taken advantage of lines of coast now submerged, or of warm periods, when they could creep around by the Arctic shores. Mr. Herbert Carpenter and other naturalists employed on the *Challenger* collections have made similar statements respecting other marine invertebrates, as, for instance, the Echinoderms, of which the deep-sea crinoids present many common species, and my own collections prove that many of the shallow-water forms are common. Dall and Whiteaves have shown that some mollusks and Echinoderms are common even to the Atlantic and Pacific coasts of North America; a remarkable fact, testifying at once to the fixity of these species and to the manner in which they have been able to take advantage of geological changes. Some of the species of whelks common to the Gulf of St. Lawrence and Pacific are animals which have no special locomotive powers even when young, but they are northern forms not proceeding far south, so that they may have passed through the Arctic seas. In this connection it is well to remark that many species of animals have powers of locomotion in youth, which they lose when adult, and that others may have special means of transit. I once found at Gaspé a specimen of the Pacific species of Coronula, or whale-barnacle, the *C. reginæ* of Darwin, attached to a whale taken in the Gulf of St. Lawrence, and which had probably succeeded in making that passage around the north of America which so many navigators have essayed in vain. It is to be remarked here that while many plants and marine invertebrates are common to the two sides of the Atlantic, it is different with land animals, and especially vertebrates. I do not know that any fossil insects or land snails or millipedes of Europe and America are specifically identical, and of the numerous species of batrachians of the Carboniferous and reptiles of the Mesozoic all seem to be distinct on the two sides. The same appears to be the case with the Tertiary mammals, until in the later stages of that great period we find such genera as the horse, the camel, and the elephant appearing on two sides of the Atlantic; but even the species seem different, except in the case of a few northern forms. Some of the longer-lived mollusks of the Atlantic furnish suggestions which remarkably illustrate the biological aspect of these questions. Our familiar friend the oyster is one of these. The first known oysters appear in the Carboniferous in Belgium and in the United States of America. In the Carboniferous and Permian they are few and small, and they do not culminate till the Cretaceous, in which there are no less than 91 so-called species in America alone; but some of the largest known species are found in the Eocene. The oyster, though an inhabitant of shallow water, and very limitedly locomotive when young, has survived all the changes since the Carboniferous age, and has spread itself over the whole northern hemisphere. I have collected fossil oysters in the Cretaceous clays of the coulées of Western Canada, in the lias shales of England, in the Eocene and Cretaceous beds of the Alps, of Egypt, of the Red Sea, of Judea, and the heights of Lebanon. Everywhere and in all formations they present forms which are so variable and yet so similar that one might suppose all the so-called species to be mere varieties. Did the oyster

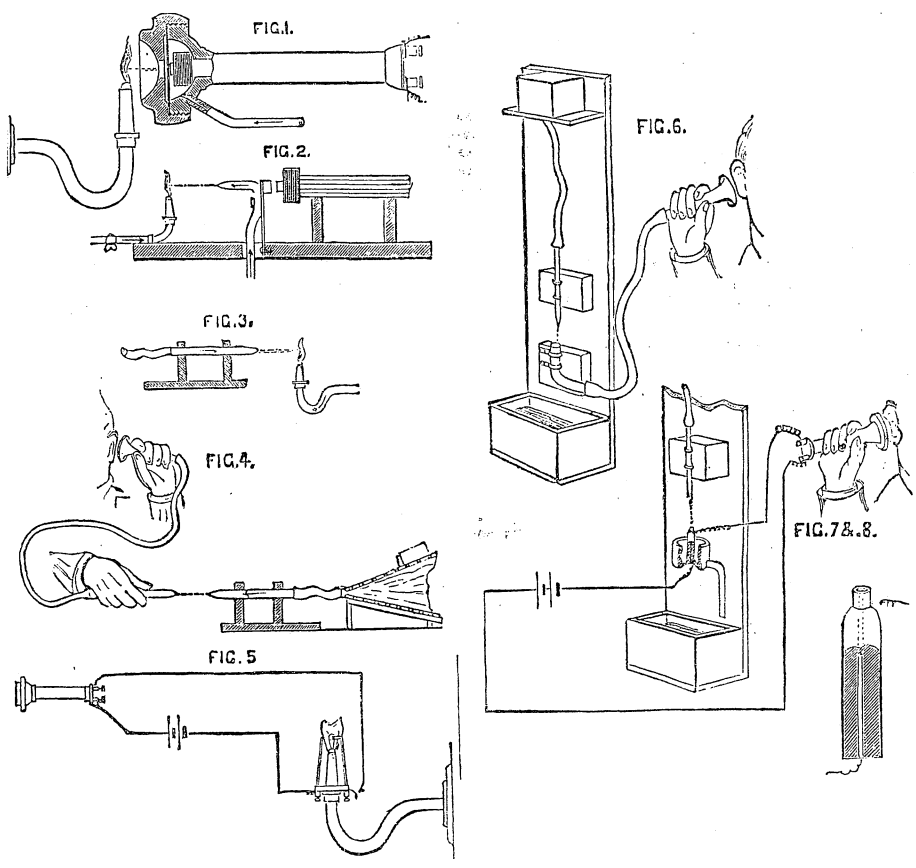
originate separately on the two sides of the Atlantic, or did it cross over so promptly that its appearance seems to be identical on the two sides? Are all the oysters of a common ancestry, or did the causes, whatever they were, which introduced the oyster in the Carboniferous act over again in late periods? Who can tell? This is one of the cases where causation and development —the two scientific factors which constitute the basis of what is vaguely called evolution—cannot easily be isolated. I would recommend to those biologists who discuss these questions to addict themselves to the oyster. This familiar mollusk has successfully pursued its course and has overcome all its enemies, from the flat-toothed selachians of the Carboniferous to the oyster-dredgers of the present day, has varied almost indefinitely, and yet has continued to be an oyster, unless, indeed, it may at certain portions of its career have temporarily assumed the disguise of a Gryphæa or an Exogyra. The history of such an animal deserves to be traced with care, and much curious information respecting it will be found in the report which I have cited. But in these respects the oyster is merely an example of many forms. Similar considerations apply to all those Pliocene and Pleistocene mollusks which are found in the raised sea-bottoms of Norway and Scotland, on the top of Moel Tryfaen in Wales, and at similar great heights on the hills of America, many of which can be traced back to early Tertiary times, and can be found to have extended themselves over all the seas of the northern hemisphere. They apply in like manner to the ferns, the conifers, and the angiosperms, many of which we can now follow without even specific change to the Eocene and Cretaceous. They all show that the forms of living things are more stable than the lands and seas in which they live. If we were to adopt some of the modern ideas of evolution, we might cut the Gordian knot by supposing that, as like causes can produce like effects, these types of life have originated more than once in geological time, and need not be genetically connected with each other. But while evolutionists repudiate such an application of their doctrine, however natural and rational, it would seem that nature still more strongly repudiates it, and will not allow us to assume more than one origin for one species. Thus the great question of geographical distribution remains in all its force, and, by still another of our geological paradoxes, mountains become ephemeral things in comparison with the delicate herbage which covers them, and seas are in their present extent but of yesterday when compared with the minute and feeble organisms that creep on their sands or swim in their waters.

Destiny of the Atlantic.

The question remains, Has the Atlantic achieved its destiny and finished its course, or are there other changes in store for it in the future? The earth's crust is now thicker and stronger than ever before, and its great ribs of crushed and folded rock are more firm and rigid than in any previous period. The stupendous volcanic phenomena manifested in Mesozoic and early Tertiary times along the borders of the Atlantic have apparently died out. These facts are in so far guarantees of permanence. On the other hand, it is known that movements of elevation along with local depression are in progress in the Arctic regions, and a great weight of new sediment is being deposited along the borders of the Atlantic, especially on its western side, and this is not improbably connected with the earthquake shocks and slight movements of depression which have occurred in North America. It is possible that these slow and secular movements may go on uninterruptedly until considerable changes are produced; but it is quite as likely that they may be retarded or reversed. It is possible, on the other hand, that after the long period of quiescence which has elapsed there may be a new settlement of the ocean-bed, accompanied with foldings of the crust, especially on the western side of the Atlantic, and possibly with renewed volcanic activity on its eastern margin. In either case a long time relatively to our limited human chronology may intervene before the occurrence of any marked change. On the whole the experience of the past would lead us to expect movements and eruptive discharges in the Pacific rather than in the Atlantic area. It is therefore not unlikely that the Atlantic may remain undisturbed, unless secondarily and indirectly, until after the Pacific area shall have attained to a greater degree of quiescence than at present. But this subject is one too much involved in uncertainty to warrant us in following it further. In the meantime the Atlantic is to us a practically permanent ocean, varying only in its tides, its currents, and its winds, which science has already reduced to definite laws, so that we can use if we cannot regulate them. It is ours to take advantage of this precious time of quietude, and to extend the blessings of science and of our Christian civilisation from shore to shore until there shall be no more sea, not in the sense of that final drying-up of old ocean to which some physicists look forward, but in the higher sense of its ceasing to be the emblem of unrest and disturbance; and the cause of isolation. I must now close this address with a short statement of the general objects which I have had in view in directing your attention to the geological development of the Atlantic. We cannot, I think, consider the topics to which I have referred without perceiving that the history of ocean and continent is an example of progressive design, quite as much as that of living beings. Nor can we fail to see that, while in some important directions we have penetrated the great secret of Nature, in reference to the general plan and structure of the earth and its waters, and the changes through which they have passed, we have still very much to learn, and perhaps quite as much to unlearn, and that the future holds out to us and to our successors higher, grander, and clearer conceptions than those to which we have yet attained. The vastness and the might of ocean, and the manner in which it cherishes the feeblest and most fragile beings, alike speak to us of Him who holds it in the hollow of His hand, and gave to it of old its boundaries and its laws; but its teaching ascends to a higher tone when we consider its origin and history, and the manner in which it has been made to build up continents and mountain chains, and at the same time to nourish and sustain the teeming life of sea and land.

SYMPATHETIC VIBRATION OF JETS —THE GRAPHOPHONE.

WE have already called attention to the investigations of Prof. Graham Bell and Mr. Chichester Bell, who, with Mr. Taintor, have recently obtained patents throughout the world for their "graphophone," as it is called, and we now give an abstract of the paper which Mr. C. A. Bell read before the Royal Society. Mr. Bell states that his attention was directed to the subject by the accidental observation that a pulsating air jet directed against a flame caused the latter to emit a musical sound. The pitch of this sound depended solely on the rapidity of the jet pulsations; but its intensity was found to increase in a remarkable way with the distance of the flame from the orifice. In order to study the phenomenon, air was allowed to escape against the flame from a small orifice in the diaphragm of an ordinary telephone, the chamber behind the diaphragm being placed in communication with a reservoir of air under gentle pressure (Fig. 1). Vibratory motions being then excited in the diaphragm, by means of a battery and a microphone or rheotome in a distant apartment, the discovery was made that speech as well as musical and other sounds could be quite loudly reproduced from the flame. Certain observations led the author to suspect that motion of the orifice, rather than compression of the air in the chamber, was the chief agent in the phenomenon; and, in fact, precisely similar results were obtained when a light glass jet tube was cemented to a soft iron armature, mounted on a spring in front of the telephone magnet (Fig. 2). Experiment also showed that an air jet at suitable pressure directed against a flame repeats all sounds or words uttered in the neighbourhood (Fig. 3). Except, however, where the impressed vibrations do not differ widely in pitch from the normal vibrations of the jet (discovered by Sondhauss and Masson), these effects are likely to escape notice, owing to the inability of the ear to distinguish between the disturbing sounds and their echo-like reproduction from the flame. In these experiments the primary action of the impressed vibrations was undoubtedly exerted on the air jet; but a singular and perplexing fact was that no sound, or at best very faint sounds, could be heard from the latter when the flame was removed, and the ear, or the end of a wide tube connected with the ear, was substituted for it. Suspecting, finally, that the changes in the jet, effective in producing sound from the flame, must be relative changes of different parts of it, the author was led to try a very small hearing orifice, about as large as the jet orifice (Fig. 4). The results were most striking. By introducing this little hearing orifice into the path of a vibrating air jet, the vibrations can be heard over a very wide area. Close to the jet orifice they are so faint as to be scarcely audible; but they increase in intensity in a remarkable way as the hearing orifice is moved away along the axis of the jet, and reach their maximum at a certain distance. Experiments with smoked air showed that this point of maximum sound is that at which the jet loses its rod-like character, and expands rapidly; it has been named the "breaking point," because just beyond it the sounds heard from the jet acquire a broken or rattling character, and at a greater distance are completely lost. The distance of the breaking point from the orifice diminishes as the intensity of the disturbing vibrations is increased, and also depends to some extent on their pitch and on the velocity of the jet. With orifices of from 1mm. to 1.5mm. in diameter, it usually varies from 1cm. to 6cm. The vibrations of an air jet may also be heard at points not situated on the axis; but they are always most intense along the axis, and become rapidly fainter as the distance from it increases.

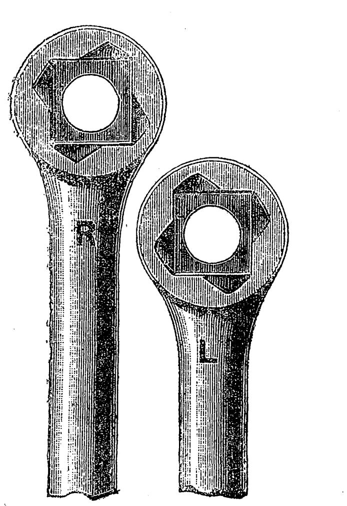


When a vibrating air jet plays against a small flame, the best sounds are heard when the stream strikes the flame just below the apex of the blue zone. At the point of contact an intensely blue flame ring appears, and this ring vibrates visibly when the jet is disturbed. The production of sound from it doubtless depends on changes in the

rate of the combustion of the gas. This may be proved by inserting into the ring a fine slip of platinum, connected in circuit with a battery and telephone shown in Fig. 5. When the jet is thrown into vibration, the consequent variations in the temperature of the platinum affect its conductivity, and hence a feeble reproduction of the jet vibration may be heard in the telephone. In order to assist the action of aërial sound waves on the fluid, it is advisable to attach the jet tube rigidly to a pine soundboard about ⅜in. thick. The surfaces of the board should be free, otherwise it may be supported in any way. The receiving membrane is formed by a piece of thin sheet rubber tied over the end of a brass tube about ⅜in. in internal diameter. A wide flexible hearing tube, furnished with an ear-piece, is attached to the brass tube. The jet tube is connected with an elevated reservoir by an india-rubber pipe, indicated in Fig. 6; with an apparatus of this kind and a tolerably wide jet tube, having an orifice about 0·7mm. in diameter, a pressure of about 15 decimètres of water is required to bring the jet into condition to respond to all the tones and overtones of the speaking voice (except hissing sounds) and those employed in music. At a somewhat higher pressure it will reproduce hissing sounds. To get an accurate and faithful reproduction of the jet vibrations, it is simply necessary to insert into the nappe two platinum electrodes in circuit with a telephone and a battery having an electromotive force of from 12 to 30 volts. Loud sounds can thus be obtained from a jet which is finer than the finest needle, and the arrangement constitutes a highly sensitive "transmitter," shown in Figs. 7 and 8. The foregoing are little more than the outlines of a new theory of jet vibrations. The author hopes to supply in the future further experimental evidence in support of it.

A WRENCH WITH LIFTING CAMS.

THE wrench shown in the annexed engraving has been recently patented in the United States by Mr. A. Wood, of Trenton, New Jersey, and has some features which will commend it to



the attention of those who have frequent occasion to use the wrench or spanner.

The opposite sides of the socket are, it will be seen, formed with cams to act against a nut to lift the wrench between successive turns, thus making a tool which can be used conveniently in place of a ratchet wrench. The square corners or faces which abut against the nut to turn it in one direction are adapted for making a right hand turn on one side of the tool, while the other side has these square corners adapted for making a left hand turn, the withdrawing or backward movement of the wrench being in each case aided by the cams at the corners of the socket adjacent to each angular face that bites on the nut. With this wrench it is only required to move the hand back and forth as the cams lift the wrench to the top of the nut upon the back stroke, and gravity causes it to drop again over the nut.

A BRITISH Iron Trade Association return of the production of Bessemer steel ingots in the United Kingdom during the half-year ending the 30th June, 1886, compared with that for the corresponding half of the previous year, shows a net increase of make in 1886 of 89,565 tons.

THE production of open-hearth steel ingots during 1885 was 583,918 tons; the production for the first half of 1886 is at the rate of 94,552 tons per annum in excess of the production of 1885. This increase has again, as in 1885, chiefly taken place in the Cleveland district.

SCIENTIFIC NEWS.

THE death is announced of Frederick Settle Barff, whose chemical works and Cantor Lectures have made his name widely known. The deceased, who was born at Hackney in 1823, was at one time curate of St. Nicholas, Leicester; but his religious convictions caused a complete change in his career, and in 1864 he took up the study of chemistry under Dr. Williamson at University College, at which institution he became assistant professor of chemistry, and subsequently Professor of Chemistry at the Royal Academy. He also filled the similar post in the Catholic University College at Kensington, and in the Jesuits' College, Beaumont. The late Prof. Barff made his name more widely known by the method of preventing iron from rusting by producing a coat of magnetic or black oxide on its surface, and his discovery of the antiseptic properties of boroglyceride has been of world-wide usefulness. The secret of kreochyle, we understand, has died with him; but it is known to be a solution of pure albumen, of great value in the sick-room.

The death is also announced of Alexander Krapotkin, at Tomsk, at the age of forty-five. He had translated into Russian "The Principles of Biology" of Herbert Spencer, Page's "Philosophy of Geology," Maxwell's "Theory of Heat," and for several years contributed to Russian periodicals reviews of the progress of physical astronomy, much prized by Russian astronomers. In 1874 he was exiled to Minusinsk, in E. Siberia, and there he helped Dr. Martianoff in organising a local museum, and carried on for several years meteorological observations. When at Minusinsk, and later on, at Tomsk, he busily worked at a great astronomical undertaking, in which he submitted to a strongly scientific criticism all our present knowledge on the structure of the stellar systems and the architectonics of the stellar groups. Every known source was ransacked for data, but Krapotkin was unable to bring his work down to a later date than 1879.

The death is reported from Kazan of the St. Petersburg Professor of Chemistry, A. M. Boutlerof, honourably known for his investigations on organic compounds, his papers in the *Annalen für Physik und Chemie*, the *Zeitschrift für Chemie*, &c., and his efforts in behalf of the higher education of women.

The eclipse of the sun seems to have been observed with a fair measure of success at Grenada. According to a telegram, good photometric observations were made by Prof. Thorpe. The light during the middle of totality was less than from the full moon. Good corona pictures were taken by Captain Darwin and by Dr. Schuster.

Dr. Dreyer has published a "Second Armagh Catalogue," containing the places of 3,300 stars determined from the observations of 1864—1883.

Dr. R. Engelmann, of Leipsic, has published in *Astronomische Nachrichten* a series of double-star measures, consisting mainly of those made by him in 1885.

With reference to the photograph of the lightning flash which we engraved and reproduced on p. 569, last week, we are requested by Mr. H. Schleusner, of Antwerp, to state that the negative was taken by Mr. E. B. Vignoles and himself.

Prof. Peters, of Clinton, N.Y., has named the small planet discovered by him on June 28 Aletheia. It is No. 259 in the general list.

Earthquakes and volcanic eruptions have apparently as much influence on the weather as sunspots. A curious result of the volcanic eruption in New Zealand (according to the *Colonies and India*) is alleged to have been found in the sudden breaking up of the drought in Australia. It is said that the great Java earthquake of 1883 was the immediate forerunner of a long spell of dry weather in Queensland in that year, and that a welcome fall of rain in the same colony followed immediately upon the eruption of Mount Tarawera.

In connection with the British Association, now in session at Birmingham, it may be mentioned that altogether twenty-seven excursions have been arranged for the Saturday and Thursday, Sept. 4 and 9. The most important of these will extend from the 9th to the 15th, and will consist of a geological excursion to the Lower Palæozoic district of Shropshire, under the leadership of Prof. Lapworth.

An important and remarkable discovery in synthetical chemistry has been made by Mr. Creswell Hewett, after many years of assiduous research. It seems that in 1869 the late Dr. Matthiessen suggested to Mr. Hewett the synthetical manufacture of quinine, and we understand that he has at length succeeded in producing the valuable alkaloid at a price of about four shillings a pound. Only about 2 per cent. of quinine is extracted from the bark of cinchona trees; but by Mr. Hewett's process it can be manufactured in a simple manner from materials which can be obtained in abundance in any part of the world.

M. Sibiriakov's steamer, the *Nordenskjöld*, has been forced to put back to Vardoe, after several ineffectual efforts to reach the mouth of the Petchora. The mouth of that river is in about 55° E. long., and is west of Kara Straits, so, if a steamer cannot rely upon making that voyage, it seems useless to attempt the still more arduous task of reaching the Ob or the Yenisei. It is thought that the currents and the E. wind combined had swept down an unusual amount of ice from Nova Zemlya and the Kara Sea, completely blocking the approach to the Petchora. After re-coaling, the steamer will make a fresh attempt to reach the mouth and ascend the river.

A marine and fresh-water observatory has been established at Lochbuie, Isle of Mull, a station which promises to yield useful results in connection with the movements of the Salmonidæ and herrings. The establishment is under the direction of the National Fish Culture Association.

Two or three examples of the transmission of energy by means of electricity are to be seen in Switzerland, where there are plenty of waterfalls supplying the requisite motive power; but a company is now being formed which in many ways will be a model for others. It will have its headquarters at Montreux, will work an electric tramway between Vevey, Montreux, and Chillon, and will supply current for all purposes to the public. The company has a concession of certain rights for fifty years, and as it will get its motive power for nothing, will probably be a profitable undertaking. The population of the district is not large; but there are thousands of tourists during the summer who are sure to patronise the tramway, and the current is to be supplied to private consumers at such a rate that a lamp of fourteen candle power will cost about a farthing an hour.

MM. Klein and Berg have communicated to the Société Chimique de Paris, a note in which they state that the internal corrosion of steam-boilers is greatly increased by the presence of organic matters in the waters employed. This is not exactly news; but organic matters are frequently placed in boilers to prevent incrustation, and it is necessary to discriminate between those which are injurious and those which are harmless. MM. Klein and Berg have discovered that sugars of all kinds intensify the action (they do that in ships), while glycerine and mannite have no effect.

In Cleckheaton gas is being manufactured from shale oil and steam by the Avery system, and it is stated that the Cleckheaton and Liversedge Local Boards contemplate the adoption of the new gas, which can be manufactured for about 6d. per thousand cubic feet, for the public lamps.

Mushrooms are attracting attention in the daily papers, and the dimensions of some remarkable specimens are duly chronicled. Mushrooms 3ft. or more in circumference are doubtless useful; but the statement that a grower for market has derived a profit of 120 per cent. from the cultivation of the tasty fungi should attract attention, as there are plenty of people who would be satisfied with much less than that. There certainly seems no reason why we should import mushrooms, when they can be grown readily in this country.

Eight new military aërostatical stations are to be established in France—at Belfort, Toul,

Verdun, Epinal, Grenoble, Montpelier, Arras, and Versailles, and within a short time every army corps is to be provided with a complete ballooning outfit and staff.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

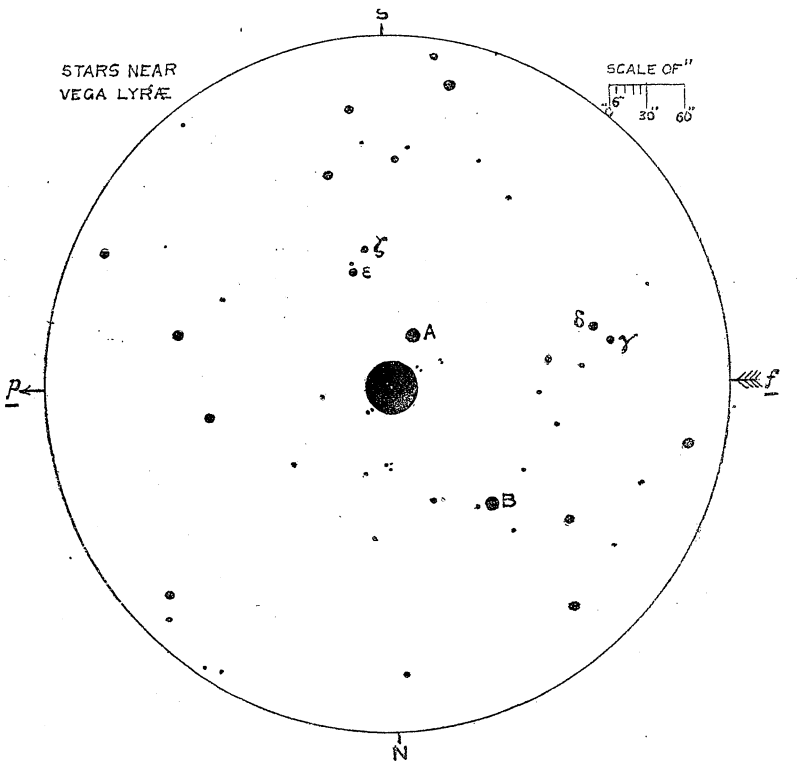
All Cheques and Post-office Orders to be made payable to PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

STARS NEAR VEGA ON ONE OF MM. HENRY'S PHOTOGRAPHS.

[26177.]—OWING to the unfavourable weather during the last few weeks, I have not, as yet, received any observations of the magnitudes of the stars near Vega. I inclose, however, a tracing of the photograph mentioned in letter 25971, page 437, showing Vega, its two bright *comites*, and fifty other stars within a radius of 4¾′ from Vega. The stars selected are those which appear brightest on the photograph, with the exception of two or three near Vega itself. The star marked A is the well-known *comes* at 155·5°, 48·6″ (1879·5.) Dawes found that the magnitude of this star when α Lyræ was in the field appeared about 11·2 in Struve's scale, but when the bright star was excluded by his eye-piece the magnitude of the small star immediately rose to 9·7 mag. Σ. B is the distant companion at about 40″ : 125″; this is No. 556 of Gore's Suspected Variables. I should imagine that the little pairs lettered γ and δ and ε and ζ should be seen with a 5in. or 6in. refractor; ε and ζ are brighter than γ or δ on the print, ε having a small star 5″ or 6″ south of it. In a note on the *comites* of Vega in the ENGLISH MECHANIC for October 19th, 1883 (Vol. XXXVIII. p. 147) I suggested that the principal star of the little pair H IV. 59 was possibly identical with Arg (+ 38°) 3235. This star is not included in the photograph in question; but I find that it is shown on another in my possession, and has a bright companion at precisely the same angle and distance as H.'s is, according to Mr. Burnham's measures. The place of H IV. 59 in Sir J. Herschel's synoptical catalogue in Vol. XXXV. of the *Memoirs* of the R.A.S. is, therefore, slightly in error. According to *Argelander* the principal star of H IV. 59 was in 1855 about 14·1sec. *p.* Vega and 5·2′ south; the place in Vol. XXXV. of the *Memoirs* being about 6·8sec. *p.* and 2·2′ south. I shall be glad to hear of observations of the magnitudes of the stars on the diagram, and of any others not shown thereon within 4′ 45″ of Vega. I presume that bad weather has prevented observations of those near ε Lyræ, shown in letter 25882, August 23rd. **H. Sadler.**



THE LAST OF COMET FABRY.

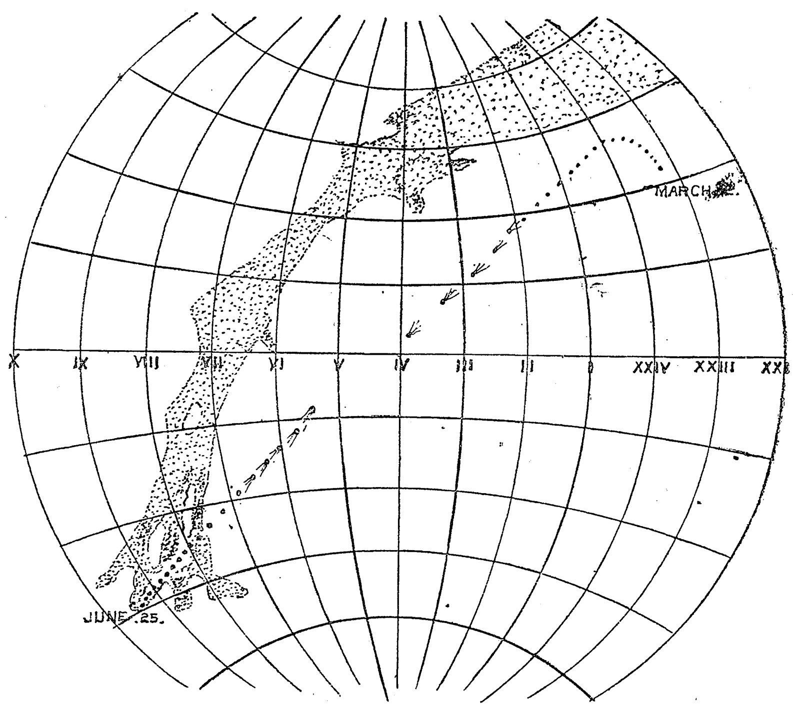
[26178.]—THE last observations of comet Fabry gave the following approximate readings:—

	R.A.	S. Dec.
June 18	9 7 10	42·3
19	9 8 20	42·7
21	9 11 30	42·30
25	9 17 20	43·1

After a week of unfavourable weather several evenings were spent in vain searching, so that I do not expect to see any more of it.

The southern path of the comet has been apparently a pretty straight line until these last four readings, which show a slight curve round λ Argûs. I inclose sketch of its whole indicated path, the northern portion being copied from your maps in "E. M." March 12th and 26th, and the southern from my notes. Its parallelism with the Galaxy is apparent.

Thames, N.Z., July 17th. **John Grigg.**



STELLAR PHOTOGRAPHY.

[26179.]—ADMIRAL MOUCHEZ has addressed a letter to the President of the Liverpool Astronomical Society calling attention to a remark made by Mr. Isaac Roberts in that capacity, and which he thinks is likely to cause a misapprehension as to the duration of exposure necessary to photograph small stars at the Paris Observatory. In a paper on stellar photography, read before the R.A.S. last January, Mr. Roberts is reported to have said: "The suggestion of Admiral Mouchez to allow an exposure of from one to three hours, would make the progress of the work extremely slow. Fifteen minutes exposure in a clear sky can often be obtained; but an exposure of three hours' duration would rarely be possible. Stars of small magnitude can be photographed by my reflector in 15 minutes; but it would be misleading to name photographic magnitudes by the side of those which have been determined by eye-observations until comparisons have been made between a large number of stars." This might be understood to signify that a star which takes an hour at the Paris Observatory can be photographed by Mr. Roberts in 15 minutes, though, of course, everything depends upon the meaning of the term "stars of small magnitude." If stars of the 8th or 9th magnitude are meant, they are photographed at the Paris Observatory in from 3 to 8 seconds.

The following table of the times of exposure which have been found necessary to obtain a photograph of stars according to their magnitudes, has been prepared by MM. Henry from the result of their long and varied experience in stellar photography. The time is understood to be only sufficient to obtain a distinct image upon the sensitive plate. If it is required to reproduce the image upon paper, the exposure would have to be from two to three times as long, according to atmospheric conditions.

Mag.	Minutes.	Seconds.
1	—	0·005
2	—	0·013
3	—	0·03
4	—	0·08
5	—	0·2
6	—	0·5
7	—	1·3
8	—	3·
9	—	8·
10	—	20
11	—	50
12	2	
13	5	
14	13	
15	33	
16	83	

W. H. Davies, Hon. sec.

METEOR.

[26180.]—WHILST observing the sun yesterday, about one p.m., I thought that I saw a meteor pass

near the sun's limb. After watching awhile my suspicions were confirmed, for I was able to follow one to a considerable distance with the telescope. Before long they were coming in two's and three's, then in showers. The majority appeared as bright as Venus does in the telescope in the daytime, and moved comparatively slow, so that they would be easily followed with the telescope. Occasionally some very large ones shot past with very great speed. The shower continued until sunset, the meteors seeming to move from south-east to north-west. This morning they were again visible whenever the sky was clear, and they continue whilst I am writing, coming as fast as ever, but in all directions. The shower surpasses any I ever saw at night, and if it lasts a few hours more will add an additional interest to the Solar Eclipse.

G. W. Middleton.

Mexborough, August 29th.

PLANETARY NEBULA G. C. 4373 (37 H IV. DRACONIS).

[26181.]—I HAVE been greatly interested reading Mr. Sadler's letter (26050, p. 504, Vol. XLIII.) giving results of observations by many astronomers on the remarkable planetary nebula H IV. 37 = General Catalogue 4373. I have observed this object many times with my 16in. refractor, and always with the result that the central star (if indeed it be a star) was well and constantly seen. The following notice of it, which escaped the search of Mr. Sadler, is by the late Prof. O. M. Mitchell, to be found in "Mitchell's Burritt's Geography of the Heavens," page 133, as seen by the 11in. refractor of the Cincinnati Observatory.

"This singular object is described in the 'Bedford Catalogue,' without any mention of a remarkably bright but small nucleus which occupies its centre. This point was detected by myself, July, 1847. When the eye and attention are attentively fixed on the central point, the nebula *fades from the view*, and the moment the attention is withdrawn from the nucleus, and a casual glance is directed to the nebula, the star fades, and the nebula brightens up in a most beautiful manner. This curious phenomenon was noticed by many persons in my company. No one can doubt the connection between this nebulous mass and the round central point of light. It is unlike a star, as it is round and clear, with a minute disc, and no radiance. I have discussed but one other object like it. Here is the connecting link between planetary nebulæ and nebulous stars; at least, such would be the opinion of those who still adhere to the nebulous theory."

My principal object in calling the attention of the readers of the "E. M." to this subject is the singular fact that in the same field (diameter 32′) is a new nebula, heretofore overlooked, discovered by me May 27, 1886. A single equatorial pointing gave its position for 1885·0, R.A. 17h. 59m. 45s. Dec. + 66° 35′ 25″, and "described as exceedingly faint, small, little, elongated, in field with H. 37, IV."

In whatever light this planetary nebula may be viewed, it is a marvellous object, the whole heavens affording but few examples of H, class IV., of equal interest. I am more interested, however, in H, IV., 73 = G.C. 4514, R.A., 1860, 19h. 41m. 8s., Dec. + 50° 10′ 18″, which has also a central star, and bears magnifying well. "G. C." calls it pretty large. I call it small. No person can look at this object with a large telescope without considering it equal in interest, if indeed it does not surpass its prototype in Draco.

Lewis Swift.

Warner Observatory, Rochester, N.Y., Aug. 18.

LIVERPOOL ASTRONOMICAL SOCIETY: CIRCULAR NO. 7.

[26182.]—(1) THE observations of 10 Sagittæ on 60 nights since 1885, Nov. 28, give P = 8·32134°. Epoch max.: July, 17·56. The following are the times of maxima and minima during September:—

Maxima.	Minima.
1886, Sept., 5·5	1886, Sept., 1·6
13·8	9·9
22·1	18·2
30·4	26·5

(2) The star D.M. + 17°, No. 3,940, announced as variable in the *M. N.*, Vol. XLVI., p. 293, was observed as 9·5 on April 26 last. From this date it increased, and on June 13 it was 8·3. Latterly it has diminished, and on August 20 it was 8·7. Vogel gives the spectrum as III. *b*! Dunér as III. *a*!! The star's place for 1885 is R.A. XIX. 16·33 + 17° 26·4.

T. E. Espin,
Observer to the Society.

Wolsingham, Aug. 26.

ASTRONOMICAL—A SUGGESTION.

[26183.]—SINCE there is just the probability that the temporary brilliant stars which appeared in the regions of the heavens between Cepheus and Cassiopeia in the years 945, 1264, and 1572, may be one and the same star, reappearing after an interval of about 315 years, I would suggest that careful photographs be at once taken of these regions, so that in the event of a reappearance about 1887, it might at once be ascertained whether the new star was really a new star, or an old small magnitude star, suddenly blazing forth with increased light.

H. P. Slade.

NOTES ON THE CHAMBER ORGAN.

[26184.]—IN my brief reply to the letter by "Organist," written while from home, and published in last week's issue, I allude to the specification of a "Chamber Organ," comprising about fifty speaking stops. The instrument was built as a "*Chamber Organ*" by one of our leading firms for an enthusiastic lover of the organ, in Yorkshire; and I think "Organist" will agree with me that it is a still more important specimen of organ-building than the one he kindly brought before the readers of the ENGLISH MECHANIC in his letter (26114). The specification is as follows:—

GREAT ORGAN CC TO a^3. 58 NOTES.
3IN. WIND.

1.	Double Dulciana.........	16ft.	58	pipes.
2.	Bourdon	16ft. tone.	58	„
3.	Large Open Diapason...	8	58	„
4.	Small Open Diapason...	8	58	„
5.	Salcional	8	58	„
6.	Höhl Flöte	8	58	„
7.	Stopped Diapason	8ft. tone.	58	„
8.	Harmonic Flute	4	58	„
9.	Octave	4	58	„
10.	Octave Quint	$2\frac{2}{3}$	58	„
11.	Super Octave	2	58	„
12.	Mixture	III. Ranks.	174	„
13.	Full Mixture	V. Ranks.	290	„
14.	Double Trumpet.........	16ft.	58	„
15.	Tromba	8	58	„
16.	Posaune	8	58	„
17.	Trumpet	8	58	„
18.	Clarion	4	58	„

SWELL ORGAN. CC TO a^3. 58 NOTES.
3IN. WIND.

1.	Double Diapason.........	16ft.	58	pipes.
2.	Geigen Principal.........	8	58	„
3.	Violin e Cello	8	58	„
4.	Voix Célestes	8	58	„
5.	Octave	4	58	„
6.	Wald Flute	4	58	„
7.	Piccolo	2	58	„
8.	Sharp Mixture............	III. Ranks.	174	„
9.	Contra Oboe..............	16ft.	58	„
10.	Oboe	8	58	„
11.	Horn	8	58	„
12.	Clarion	4	58	„

CHOIR ORGAN. CC TO a^3. 58 NOTES.
$2\frac{1}{2}$IN. WIND.

1.	Lieblich Bourdon	16ft. tone.	58	pipes.
2.	Cone Gamba..............	8ft.	58	„
3.	Dulciana	8	58	„
4.	Pierced Gamba	8	58	„
5.	Dolce	8	58	„
6.	Flauto Traverso	8	58	„
7.	Röhr Flöte	8	46	„
8.	Lieblich Gedact	8ft. tone	58	„
9.	Gemshorn	4ft.	58	„
10.	Lieblich Flöte	4ft. tone	58	„

ECHO ORGAN. CC TO a^3. 58 NOTES.
$1\frac{1}{2}$IN. WIND.

1.	Vox Angelica.............	8ft.	58	pipes.
2.	Still Gedact	8ft. tone	58	„
3.	Echo Oboe	8ft.	58	„
4.	Flauto Dolce	4	58	„
5.	Flauto Traverso	4	58	„
6.	Harmonia Piccolo	2	58	„
7.	Orchestral Oboe	8	46	„
8.	Clarinet and Bassoon ...	8	58	„

PEDAL ORGAN. CCC TO F. 30 NOTES.
4IN. WIND.

1.	Sub Bass	32ft. tone	30	pipes.
2.	Open Bass	16	30	„
3.	Violone	16	30	„
4.	Bourdon	16ft. tone	30	„
5.	Flute Bass	8ft. tone	30	„
6.	Violoncello	8ft.	30	„
7.	Super Octave	4	30	„
8.	Full Mixture	IV Ranks	120	„
9.	Trombone	16ft.	30	„
10.	Clarion	8	30	„

COUPLERS.

1. Swell to Great.
2. Swell to Choir.
3. Choir to Great.
4. Echo to Choir.
5. Great to Pedal.
6. Swell to Pedal.
7. Choir to Pedal.
8. Echo to Pedal.

Four Composition pedals to Great and Pedal organs, three Composition pedals to Swell. The pneumatic lever is applied to the Great, Swell, and Pedal organs, and to the manual couplers.

SUMMARY.

Great organ	18 stops	1,392	pipes
Swell organ	12 „	812	„
Choir organ	10 „	568	„
Echo organ	8 „	452	„
Pedal organ	10 „	390	„

Speaking stops 58. Total pipes 3,614

There can be no question as to the dignity and importance of the instrument above described, but, if we consider the manner in which such an immense organ has to be disposed in a *dwelling-house*, and the volume of sound it is capable of yielding—out of all reason in a room of common dimensions—we must hesitate to accept it as a *Chamber Organ*. I understand it has recently been transferred to a church, certainly a more appropriate place for it. Large Chamber Organs are huge mistakes, and this is generally discovered to be the fact sooner or later, judging by the proportion of them which find their ultimate resting places in churches or public concert-rooms.

G. A. Audsley

Devon Nook, Chiswick, W.

NOTES ON THE CHAMBER ORGAN.

[26185.]—I FEEL highly honoured that Mr. Audsley, p. 570, Vol. XLIII., should have noticed the few words I had to say on the above subject, and at the same time I apologise for having presumed to instruct him as to the merits of organ builders.

The organ I gave a specification of is a chamber organ, pure and simple, and "simply perfect," not on account of its size, nor of the accessories which are really necessaries, but on account of its structure and fascinating tone, which last is maintained throughout, even when the full organ is played.

The instrument is erected in a gentleman's drawing-room in Holland Park, but the exact dimensions of the organ and room I cannot at present call to mind. However, I will endeavour to obtain all the information required, from Mr. Gern, together with the details of another chamber organ not quite so large, but very effective both in variation and beauty of tone, and forward them to the Editor for the next issue, if possible.

Organist.

CHAMBER ORGANS.

[26186.]—MR. G. A. AUDSLEY, in his "Notes on the Chamber Organ," condemns the good old organs as "unworthy of notice." Surely he must be joking. If a chamber (?) organ is to have two manuals and pedals, and dear old Snetzler's one manual set aside, where are we artisans to get a 2 or 3 manual organ from, and when we have it, where are we to put it? Are we to hire them?—for I'm sure we cannot raise £400 for an instrument such as he suggests. For my own playing I have a 7-stop "Snetzler," and I wish every man could have one who has a taste for the beautiful tone of his organs; there is nothing to equal them now. He built "singing organs"; now we get "screamers," with a vengeance. It is my firm belief that thirty years hence the pure organ tone, such as the old builders gave us, will be forgotten, and the noisy instruments of our day, and those of future builders, will make as big a row as the Falls of Niagara.

Musicus.

THE SIZE OF THE LARGEST ORGAN.

[26187.]—REFERRING to the letters on the above subject, I think they are a waste of space, as little or no benefit will arise from them. The gentleman who formulated the query 60018 ought to have stated in what way he required to know the largest organ, whether in number of stops, or pipes, or the area it took up, for all these would most probably alter the answer. I certainly agree with "C." that a GG organ is larger both in area, weight, and number of pipes, than a CC organ. A CC open will contain, in ordinary, 56 pipes, from CC to G, or, if carried up to C, 61 pipes. A GG open will contain 61 pipes from GG to G, or, if carried up to C, 66 pipes.

Now will not, according to this, a GG to C open contain more pipes, be a greater weight, and require a larger area than a CC to G open.

Considered as so many pipes and weight of material, the GG organ must be the largest, stop for stop.

Taking a large GG organ, there is sufficient material in the five odd pipes at the bottom, GG to BB, to make a decent-sized instrument, then leave the original capable of performing any written organ music.

I question if anyone can say for a certainty which is actually the largest organ, certainly only a builder, as there are so many points to take into consideration. Lastly, the scaling of an organ makes a considerable difference. A Diapason of 7in. scale will be larger than one of 6in. scale, and this proportion carried throughout a large organ

THE SAFETY GOVERNOR.

[MACFARLANE'S PATENT.]

WITH THROTTLE VALVE AND STOP VALVE COMBINED.

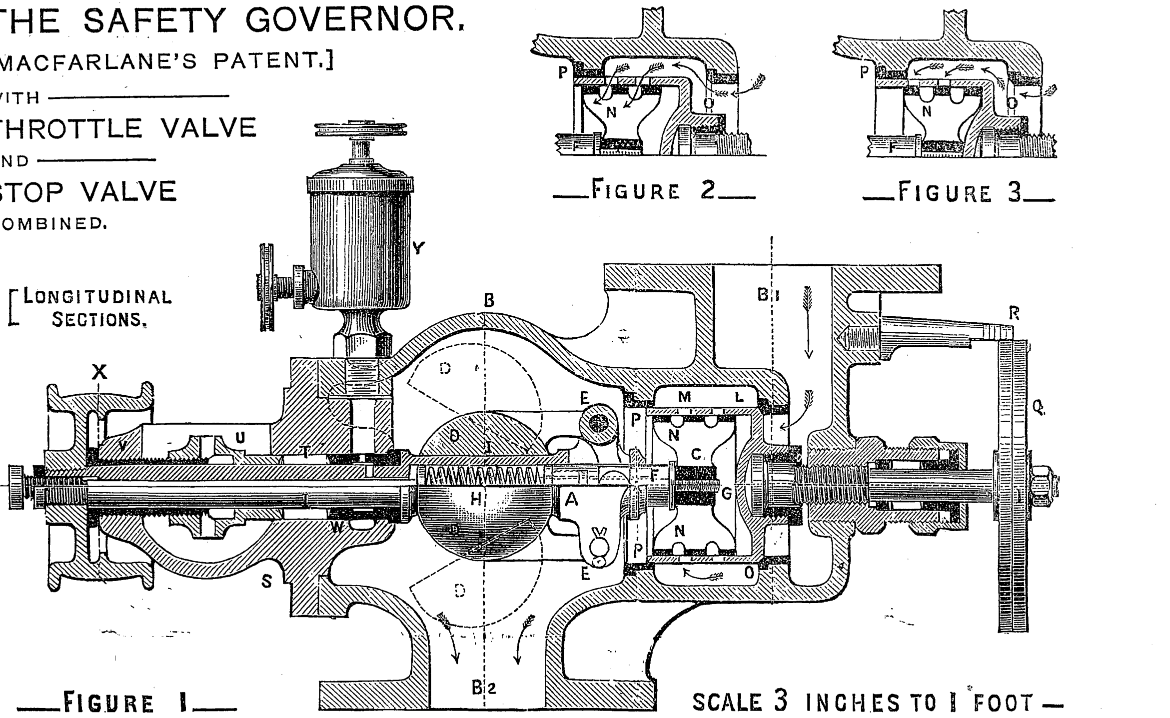


FIGURE 1 FIGURE 2 FIGURE 3

SCALE 3 INCHES TO 1 FOOT

makes a much greater difference than the majority would think.

Without taking all these points into consideration, any further discussion of this subject is worthless, and a waste of valuable space.

I noticed "Country Solicitor's" remark in one of his letters a number or two back, and I will answer him as soon as I can; but I am, and have been, so very busy, that I have had no time to write.

Uranium.

[26188.]—IN the letter 26165 please read in the thirteenth line from the top of the middle column of the page "CC," not "CCC."

In the ninth line from the top of the right-hand column, read "second-slides," not "seconds, slides, &c."

In the twenty-fifth line from the top of the same column, read "CC," not "C."

Some accident has befallen the setting up of the concluding sentence, the first part of which ought to read—"Granted the lower notes are superfluous, still there they are; and the pipes occupy space not required by a CC, and yield tones not forthcoming from a CC either."

C.

GOVERNORS.

[26189.]—SOME time ago a few letters on steam-engine governors appeared in your columns under the numbers 59581 and 25926. Under the latter number your correspondent, "W. J. R.," says: "When some other correspondents, who write so ably in the 'E.M.' on mechanical matters, have had their say (if they care to discuss the matter), I may venture to make a few more remarks upon this interesting subject." As none have thought it worth while to continue the discussion (and it looks as if the matter were to be allowed to drop), I take the liberty of sending you a few particulars regarding my patent governor, No. 7544/85, trusting it may be the means of bringing forth some valuable information on the subject of governors generally from your correspondent "W. J. R." and others.

Fig. 1 is a vertical section of governor on longitudinal centre line. The centrifugal part A is placed inside a casing or steam-chest B, and is connected direct to the throttle-valve C. A pair of hemispherical pendulums D working on centres E move a sliding piece F, with spindle G attached to the throttle-valve C. To balance the centrifugal force of the pendulums D, a helical spring H is placed in a chamber of governor spindle I, and is capable of adjustment by means of spindle J passing through the centre of the driving spindle I. The stop-valve K has a cylindrical part L cast on back of it, which forms an adjustable seat or sleeve for throttle-valve C, and is provided with two circumferential rows of portholes M, which correspond with two circumferential ports N in the throttle-valve. The stop-valve shuts against a conical seat O, and slides through a cylindrical guide-ring P, and is provided with the usual screw-spindle, stuffing box, and hand-wheel Q, which is divided on periphery, and shows by means of pointer R the amount of the opening of stop-valve. The driving spindle I is carried by the cover S of the steam chest B, which is provided with stuffing-box T, having a stuffing gland U with guide liners V and W. The outer end of driving spindle I has fixed to it the belt-pulley X. On top of governor casing B is fitted a lubricator Y for oiling the internal parts of governor, and also for lubricating the steam cylinders of the engine. Steam enters by the flanged branch B and leaves by B2 in direction of the arrows.

Fig. 2 is a section of stop and throttle-valves, showing their usual relative positions when working.

Fig. 3 is a section of stop and throttle-valves, showing their positions when the belt breaks or slips off.

In the designing of this governor three very important considerations were always kept in view—viz., safety, sensitiveness, and simplicity, and I shall endeavour in a few words to show how far these points have been, in this case, attained.

1. Safety. When the engine is working with the stop-valve full open, should the belt break or slip off, the throttle-valve would shut the ports the backward way and stop the engine, instead of, as in the ordinary governor, allowing it to run away and do damage. It will be observed that no extra attention is required to set this safety arrangement in gear, the mere fact of turning on the steam being sufficient, and that this important advantage is obtained without extra complication.

2. Sensitiveness. The centrifugal part of the governor being placed in the steam, it acts directly on the throttle valve, and without the variable friction due to stuffing boxes, joints, &c., and with a minimum of slackness of joints, &c., to be taken up before the effect of the centrifugal force is felt by the throttle valve. The elimination of these important defects enables the governor pendulums to be made considerably smaller for the work to be done—a circumstance which makes it very suitable for high speeds. In the construction of this governor the centres of the pendulum levers are so arranged relatively to the centres of gravity that the load on the spring due to the centrifugal force increases directly as the travel of the throttle valve, and as the compression of a helical spring increases directly as the loads it follows that the governor can be made practically isochronous, or, in other words, to have all the advantage that can be derived from the parabolic governor and with the simplest form of pendulums.

3. Simplicity. In the governor here illustrated, and which is suitable for a 2½in. steam pipe, the actual number of separate pieces (including even the bolts, split pins, &c.), is not more than 42—a number which I venture to think will be found to be less by 25 per cent. than any other governor of the same class presently in use. The parts are all easily to be got at, and, even in the smallest sizes, are sufficiently large to be easily made or repaired by the tools in use in any engineering works. In addition to the considerations above, the following advantages may be mentioned, viz.: The centrifugal part is entirely inclosed and kept free from dirt; the oil required for lubricating the governor passes afterwards to the steam cylinders, and, in fact, the whole of the lubrication required for the engine cylinders may be made to pass through the governor, keeping it practically running in oil. The speed of the engine may be varied within certain limits by the stop-valve when the engine is working.

J. W. Macfarlane.

EFFECT OF TIME ON CHANCES.

[26190.]—THIS is a table of the kind suggested by "J. M." in the reply 59842 (p. 582, Vol. XLIII.), and perhaps might serve to familiarise those who guess at chances with the effect of multiplied time, or "number of throws," in changing improbability into probability. The second column arises from merely squaring the fraction that expresses the "odds" in column 1. Thus the fraction two-thirds becomes four-ninths, the former being "2 to 1," the latter only 4 to 5 or ·8 to 1. The third column is the quotient on dividing logarithm of 2 by logarithm of the reciprocal of the first fraction; and column 4 is the quotient of 1 (the logarithm of 10) by the said logarithm.

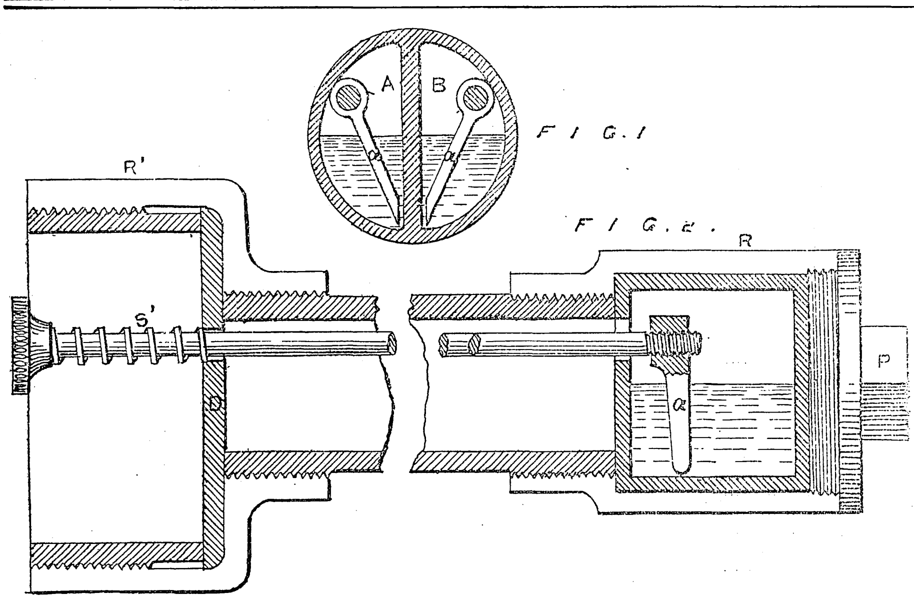
If the odds *against* a thing happening to-day are	The chance of its not happening in 2 days is	Time in which the chances become even.	Time in which they become 9 to 1 *for* it.	Time in which they become 20 to 1,
2 to 1	·8 to 1	1·71	5·680	7·509
3 "	1·286 "	2·41	8·004	10·584
4 "	1·778 "	3·11	10·319	13·645
5 "	2·273 "	3·802	12·629	16·700
6 "	2·769 "	4·498	14·937	19·751
7 "	3·267 "	5·192	17·245	22·802
8 "	3·765 "	5·885	19·550	25·850
9 "	4·263 "	6·579	21·854	28·898
10 "	4·762 "	7·273	24·160	31·945
12 "	5·76 "	8·561	28·767	38·038
15 "	7·259 "	10·740	35·678	47·176
20 "	9·758 "	14·211	47·195	62·403
25 "	12·257 "	17·669	58·709	77·629
30 "	14·756 "	21·139	70·223	92·854
35 "	17·255 "	24·605	81·737	108·079
40 "	19·754 "	28·593	93·251	123·304
50 "	24·753 "	35·003	116·277	153·75
60 "	29·752 "	41·935	139·304	184·20
70 "	34·752 "	48·867	162·330	214·65
80 "	39·751 "	55·800	185·356	245·10
90 "	44·751 "	62·730	208·382	275·54
100 "	49·751 "	69·661	231·408	305·99

Aug. 28. **E. L. G.**

FLUTE PLAYING.

[26191.]—DOUBTLESS, like myself, some of my brother amateurs who occasionally take up the flute find the instrument hard to blow and give it a drink of water; oil is better, but is apt to spoil the buffing of the keys. The best lubricant I have found is a spoonful of golden syrup; this at once awakens the silvery tone, the sound becomes easily clear, smooth, brilliant, and, of course, sweet.

E. B. Fennessy.



PYROMETER—MAX. AND MIN.

[26192.]—I HAVE much pleasure in bringing the following adaptation of the well-known fusing point of alloys under the notice of your readers. Some time since, being then in charge of the char-burning plant of a sugar-refinery abroad, I found the want of a simple and reliable pyrometer to be used by the furnace men a great drawback to the working of the kilns. I have, indeed, two pyrometers at my hands—one a mercurial one, and the other having a clay tube inclosed inside an iron pipe, both differing from one another in a most erratic manner, and when removed from the furnaces would never return to zero. What I required was a pyrometer indicating a minimum of 500° Fahr., and a maximum of 550° Fahr., or thereabouts, to be used by the men at intervals, as occasion might require. Procuring a piece of inch gas-piping 5ft. long, I screwed on one extremity a reducing coupling $1\frac{1}{4}$in. to 1in., and on the other end a reducing coupling $2\frac{1}{4}$inch to 1in. I next prepared a cylindrical box, divided in the centre into two compartments A and B (Fig. 1). A longitudinal section of this box is shown in Fig. 2, where it is shown in its proper position inside the small reducing coupling R; the pluck P holding it securely in its position. An alloy of tin and lead, the melting point of which lies at 500° F., is placed in compartment A, and a similar alloy, whose melting point lies at 550° F. in B. The agitators, *a a*, having eyes tapped to receive the ends of two wires, $\frac{3}{16}$in. diameter, are also placed in their respective compartments, in such a position that the tapped eyes are opposite two holes left in the end of box; the larger reducing coupling R 1 had a guide or division plate, D, fitted as shown in Fig. 2, and secured by piece of $2\frac{1}{4}$in. pipe, cut off flush with the outside of coupling. Two rods of $\frac{3}{16}$in. wire protruding through holes left in this plate, terminated into polished steel knobs, having 500° and 550° stamped thereon. A brass spring, S, between plate and knobs pushed the rods out whenever the alloy was sufficiently melted to allow the agitators to move. A second box, having alloys of 470° and 500°, as well as an extra knob with 470° marked thereon, completed the pyrometer. When about to ascertain the temperature of the kilns, the smaller of the couplings is thrust into the heated spot, both pushes having, when last used, remained right up to the plate by reason of a lead weight which acted as a lid, the instrument standing upright when allowed to cool. The springs being in compression, push out the spindles whenever the inscribed degrees of heat are reached. Those interested in this instrument will see that by interchanging of different capsules and knobs, this pyrometer, as a maximum and minimum indicator, is complete, moreover having no delicate moving parts, and is otherwise so simple that any mechanic can repair it. I am of opinion that it supplied a want felt, perhaps, by others.

Liverpool. **P. F. Otto.**

A PSYCHOLOGICAL PROBLEM.

[26193.]—"GARRISON GUNNER" seems to me to have conceived a very important truth; but he has, I think, stated it imperfectly in his interesting letter, p. 557, Vol. XLIII. He says:—"When the imaginative faculty is partly dissociated from the control of the will, it may co-exist with the reasoning faculty, which latter may not have escaped from the will, its ruler."

It appears to me that in the process of imagination the will is, to a given extent, metamorphosed. But the reason remains inherent all the while. How in such a case can the will be said to be the *ruler* of the reason?

Now, the reason is ratiocinative, and therefore it may be said to be coincident with the *operation* of the will.

In some respects both the reason and the understanding are, so to speak, superior to the will. By one of our English Philosophers the reason has been well called the "natural revelation."

The phenomena of dreaming cannot properly be explained apart from the full consideration of the function of sleep.

In regard to this subject I propose to submit certain remarks on some future occasion. It is quite possible "F.R.A.S." merely dreamt about the act of pinching. I once vividly imagined in my sleep that I had cut my fingers with a razor.

What of the interpretations of the dream-books? My small experience of them goes to show that there is some amount of method in their madness.

H. W.

[26194.]—IN reply to 26167, "An Inquirer after Truth," I beg to say that he will most likely alter his opinion after perusal of the appendix to "Mental Physiology," by the late Dr. Carpenter, or the notable works by Drs. Braid and Tuke on "Hypnotism." Much reliable information on mesmeric phenomena can be seen in the magazine called *Health*, where several articles on "Sleep-walking" are contributed by Dr. Andrew Wilson; the latest and most reliable information can be seen in the works of the Society for Psychical Research—viz., "Proceedings," part 5, price 2s. 6d. (Trübner and Co., Ludgate-hill); "Third Report of the Committee on Mesmerism," by Prof. W. F. Barrett, M.R.I.A.; E. Gurney, M.A.; R. Hodson, B.A.; A. T. Meyers, M.D.; F. W. H. Meyers, M.A.; H. N. Ridley, M.A., F.L.S.; W. H. Stone, M.A., M.B.; George Wyld, M.D.; C. Lockhart Robinson, M.D.; and F. Rodmore, M.A., hon. sec.

Joseph W. Hayes.

[26195.]—I WILL try to answer the queries of "An Inquirer after Truth" as briefly as possible (p. 579, Vol. XLIII.). First of all, public exhibitions are not places to study mesmerism at. Some of them may be mere second-class conjuring tricks, others real use of the mesmeric power to produce useless and, I fear in many cases, injurious effects. It is a power which I firmly believe should never be used save for some worthy purpose, such as curing a nervous disease, or as an anæsthetic in surgery.

As to the question about signing a cheque, the answer is simple. Most probably I should not be able to mesmerise the querist; but if once he were thrown into the mesmeric trance by me, I could undoubtedly make him sign a cheque in my favour for his whole fortune.

As to the use of mesmerism for surgical operations, there was a certain Dr. Esdaile in India, during the Governorship of Lord Dalhousie, who used no other anæsthetic. He employed a staff of native operators to mesmerise, and, to use the words of his report to the Government, "Out of 261 operations, 215 of which were extirpations of tumours of all sizes, varying in weight from 10lb. to 103lb., not one patient had died from the direct effects of the operation," &c. Lord Dalhousie made Dr. Esdaile Presidency surgeon. Mesmerism has been used again and again as an anæsthetic, with satisfactory results, but the fact is that doctors have no time to employ it. Chloroform is much handier and quicker. The only experiment I ever tried in this direction was when a lady, whom I had the power of mesmerising, cut a large vein in her hand by accident, and it was a question how to stop the hæmorrhage. By a few passes down the arm and hand they became stiff and rigid, and the circulation entirely ceased (doubtless by the contraction of the blood vessels owing to nervous action upon them). It was then easy to bind up the wound so that the bleeding would not recur when the circulation was restored. As there was no pulse at the wrist, I presume a wounded artery might have been dealt with in like manner.

As a short and concise book on the subject, I would recommend "Mesmerism, with Hints for Beginners," by John James, published by W. Harrison, 38, Great Russell-street, London, price about 3s. 6d. But I would strongly recommend "An Inquirer after Truth" to have nothing to do with the subject personally, unless to use it as a curative power. He will probably repent it if he does. Constant mesmerism of one person gives the mesmeriser a most undesirable power over the mind of the patient.

I believe the power of clairvoyance, by which I understand the faculty of the mesmerised person to see what is going on in places entirely out of the ken of the ordinary senses, to be rather rare, but undoubtedly to exist. Also, though here I am aware I am asking my readers to believe what no man can be expected to credit on any authority but his own eyesight, I have proved by experiment that it is possible to mesmerise from a distance (well understood that the subject must be a very good one, and have been frequently mesmerised before by the operator). However, I do not care to go into the subject further, nor am I at all anxious to set the readers of the ENGLISH MECHANIC investigating for themselves, any more than I should give a man who had not studied electricity a powerful induction coil and a battery to experiment with. The result in either case might be dangerous. Mesmerism is a powerful agent, and most imperfectly understood; but it is a *fact* that it exists—people might as well disbelieve in electricity as in it.

Garrison Gunner.

[26196.]—"AN Inquirer after Truth" (p. 579) asks the name of a book fully treating of the subject of mesmerism as an anæsthetic in surgical operations. There is a whole literature on this questionable subject; but should the inquirer be willing to invest any money in the purchase of such a volume—a thing I do not recommend—he will find what he wants in "Natural and Mesmeric Clairvoyance," by Esdaile, published by Hippolyte Bailliere, Regent-street, 1852—to say nothing of the "Dictionnaire Infernal" and other delightful gospels by the same publisher. Dr. Esdaile, it appears, was a presidency surgeon at Calcutta, and no doubt was able to "animal-magnetise" Hindoos and others and produce astonishing results. For the action of a resolute and fearless organisation on an inferior panic-stricken one is assuredly one of the commonest facts, and has been at all times known and turned to account, both in a legitimate manner and as part of the stock-in-trade of impostors. Why this action should be called "Magnetism," as if it had anything to do with one of the properties of iron ore, or why it should be the centre of such an enormous mass of lies, empiricism, and foolish literature are mysteries which perhaps are hardly worth solving. There is a legitimate, because metaphorical, use of the word magnetism in relation to humanity, as when Emerson speaks of the "Magnetism which all original action exerts." Carlyle in his "Latter Day Pamphlets," 1850, speaks in words well worth weighing of a certain notability whom he found in gaol: "I had seen him about a year before, by involuntary accident, and much to my disgust, 'magnetising' a silly young person; and had noted well the unlovely voracious look of him, his thick oily skin, his heavy dull-burning eyes, his greedy mouth, the dusky potent insatiable *animalism* that looked out of every feature of him: a fellow adequate to animal-magnetise most things, I did suppose—and here was the post I now found him arrived at." Here we see something of the nature of this influence, namely that it is intimately related with the lower part of man's being, not at all with the higher spiritual aad intellectual part. The healthy virile intellect will have none of such hysterics. Imagine—if you can—a person endeavouring to animal-magnetise the famous Dr. Johnson, and the kind of success he would have met with. On the other hand, given a patient of the weak-kneed, horribly-apprehensive, pseudo-intellectual sort, it is difficult to fix the limits of his delusions, or to say what surgical operation could not be performed on him whilst his poor mind is wholly comatose through fear. The horrible painless fascination which animals of prey can exercise, the epidemic delusions in assemblies, what are they but the turning of persons into "things," as Carlyle, with true instinct, writes it?

It is remarkable and highly significant that the manifestations of Mesmer—what would have been called in the phraseology of an older date, "Satan's Invisible World Displayed"—were contemporary with a rotten state of society, in which men, having no religion, eagerly sought after wonders and got them. The demand being great the supply was

kept up, and hence our "literature of spiritualism," &c. Gas lamps are known to give more light than planets, and are more wonderful to some people.

As regards making people sign cheques, or what amounts to the same thing, obtaining money under false pretences, the records of the Old Bailey would furnish the inquirer with valuable information. I was present at the trial of a famous spiritualist some years ago, who had by chicanery obtained a large sum of money from a dupe, and I had the chance of seeing what can never be gathered from printed reports—the demeanour of the principal actors in the drama. Though the prisoner was hopelessly beaten by the production of the facts of the case, and was palpably an accomplished swindler, a remarkable thing took place. A long string of witnesses *as to good character* came forward—witnesses of honesty and good social position. But the judge, endowed with even more of that shrewd antiseptic common-sense, which is the characteristic of English judges, at once saw through the business. *These also were dupes.* By a few questions, apparently harmless, but really suggested by a deep insight into human nature, he destroyed the value of their testimony.

After this, and knowing as I do the predatory nature of a hawk among sparrows, I could not doubt that there was such a thing as animal-magnetism.

E. W.

EGYPTOLOGY.

[26197.]—IN reference to the letter on "Egyptology" (26168), I wish to refer Mr. Smith to the works published by the Egyptian Exploration Fund, of which Miss Amelia B. Edwards, The Larches, Westbury-on-Trym, is an hon. sec. Much information may also be had from Prof. Maspero's official report on the Mummy, No. 5,233, also from Reginald Stewart Poole, Esq., LL.D., Keeper of the Coins in the British Museum. In a reported lecture of his on "Pithom," the following passage occurs:—"Very massive store-chambers, which must have been founded by Rameses II. about 1400 B.C. This identification of the Great Oppressor, who built those cities early in his reign, led to the conclusion that his successor, Manephtah, was the Pharaoh of the Exodus xxx., which would place the Exodus about 1320 B.C." The *Times* of June 18, 1886, has a good article on this subject. The explorer, Naville, who discovered Pithom, in the Wady Tumelat, identified his "find" as "one of the two treasured cities built by the Children of Israel for Pharaoh" (Ex., 1, 2, 3), which was proved to be Rameses II., as the temple, forts, and city were found to have his name inscribed upon them. In Brugsch Bey's "History of Ancient Egypt" the following lines occur in reference to the Shepherd Kings: "In the Hyksos Dynasty, supposed to be the *Twelfth*, King Amen-em-hat built a Pyramid called Ka-nofer."

It is impossible as yet to be quite accurate as to the time these kings reigned, for, as Principal Dawson says, the lists are "muddled," many of the "kings" mentioned by historians being merely "heads of local tribes"; however, with the aid of the mummies and inscriptions, a fairly authentic record may soon be expected. It is interesting to note that the king called "Sesostris," we are told by Herodotus in his book "Euterpe," "compelled his captives to make vast and numerous canals and other works" around the neighbourhood of the Pelusian Daphne, none other than the present Tel-Defenneh (the Tahpanhes of the Bible), where Jeremiah prophesied (Jer. 37 to 47). A good deal of information on the early Egyptian kings may be seen in Piazzi Smyth's "Our Inheritance in the Great Pyramid," especially on p. 449, chap. 21, headed "Hierologists and Chronologists"; but by far the most important information may be had in "Flavius Josephus against Apion," Book I. Josephus claims the Hyksos, or Shepherd Kings, as the ancestors of the Jews, and gives the testimony of Manetho and others to prove it—viz., Book I., Sec. 14: "This whole nation was styled Hyksos." "These people kept possession of Egypt 511 years." After several interesting circumstances about them, Josephus sums up thus: "It is evident that these shepherds (our forefathers) were delivered out of Egypt, and came thence and inhabited this country 393 years before Danaus came to Argos, or preceding the siege of Troy almost 1,000 years." This departure of the "Shepherd Kings" is supposed to have taken place "about 37 years before Abraham came out of Haran."—(C. Whiston).

Joseph W. Hayes.

LIST OF EYEPIECE POWERS FOR ASTRONOMICAL TELESCOPES RANGING FROM 1 TO 20½ FEET FOCAL LENGTH.

[26198.]—BEING very frequently asked to calculate the power for various eyepieces of varying lengths of focus, I have just thought it would not be a bad idea to publish in the "E. M." a table giving the power of an eyepiece at a glance with a given focus of object-glass or speculum. Such a list has never been before published in any astronomical work that I am aware of, either on the practical or the theoretical side. So here it is.

FOCUS OF SPECULUM OR OBJECT-GLASS IN FEET.

Focus of Eyepieces in Inches and parts of Ditto.	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½
3 inch...........	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
2 "	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
1 "	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
⅞ "	13	20	27	34	41	48	54	61	68	75	82	89	97	103	106	116	123	130	137	144
¾ "	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160	168
⅝ "	19	28	38	48	57	67	76	86	96	105	115	124	134	144	151	147	172	182	192	201
½ "	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240	252
⅜ "	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320	336
¼ "	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480	504
⅛ "	96	144	192	240	288	336	384	432	480	528	576	624	672	720	768	816	864	912	960	1008
1/16 "	192	288	384	480	576	672	768	864	960	1056	1152	1248	1344							
1/32 "	384	576	768	960	1152															
1/64 "	768	1152																		

Focus of Eyepieces in Ins. and parts of Ditto.	11	11½	12	12½	13	13½	14	14½	15	15½	16	16½	17	17½	18	18½	19	19½	20	20½
3 inch...........	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
2 "	66	69	72	75	78	81	84	87	90	93	96	99	102	105	108	111	114	117	120	123
1 "	132	138	144	150	156	162	168	174	180	186	192	198	204	210	216	222	228	234	240	246
⅞ "	150	157	164	171	178	185	192	198	205	212	219	226	233	240	246	253	260	281	274	295
¾ "	176	184	192	200	208	216	224	231	240	248	256	264	272	280	288	296	304	312	320	328
⅝ "	211	220	230	240	249	259	268	278	288	297	307	316	326	336	345	355	362	394	384	413
½ "	264	276	288	300	212	324	336	348	360	372	384	396	408	420	432	444	456	468	480	492
⅜ "	352	368	384	400	416	432	448	464	480	496	512	528	544	560	576	592	608	657	640	689
¼ "	528	552	576	600	624	648	672	694	720	744	768	792	808	840	864	888	912	936	960	984

Supposing the focus of a speculum is 10ft. say, and focus of the eyepiece is ¼in, look along the top column for 10ft., then look down the left-hand side of table for ¼in. focus; then run the eye along even with the top column, and under 10ft. you will find 480 marked as the power of the eyepiece.

Again, if you should require to know the focal length of any eyepiece marked, say, for 2½ft. focus of object-glass, powers 60 and 120, look under the column for 2½ft. until you come to 60, where you will find marked on the left-hand side ½in. focus; look still further down until you come to 120; on the left you will see ¼in., and so on.

G. W. Valentine.

156, High-street, Southampton.

THE TARAWERA ERUPTION.

[26199.]—THE following is a description of the recent eruption, received from a lady friend of ours who resides not far from the district. Divested of a few details, which are private, the information the letter conveys is as follows:—

"Tauranga, N.Z., 14th July, 1886.

"We all retired as usual on Wednesday, June 10th. I usually wake at one o'clock, not being a first-rate sleeper. I woke up as usual, feeling as if I had been shaken; but passed this over. Presently I felt the bed shake lengthwise to and fro, and heard the windows rattle; I was getting surprised. In a minute there was another shake; in half a minute another shaking. I roused everybody. We then had a much stronger shock of earthquake than previously. Some impulse moved us to go and look out towards the Hot Lakes district in S.E. direction, some thirty miles as the crow flies, and there was an extraordinary spectacle before us. Every star was shooting forth a lightning of its own, which made the sky look like a gigantic kaleidoscope. Presently vivid flashes of lightning over the whole sky were added, and then we heard a tremendous thundering boom, and a huge ball of fire, looking as big as the sun, rose up in the S.E. and burst. Then a frightful, though grand, spectacle, began. For about two miles apparently, on either side of the ball of fire flames appeared looking like a gigantic bush fire, and at the place where the ball of fire burst forth we could see immense pieces of red-hot rock and stones being thrown up and frightful forked lightning coming out of the fire, and occasionally a loud boom. The shocks of earthquake continued the whole time, and were more or less severe. It was really awful; but, strange to say, none of us were frightened exactly, but were excited and interested. The first earthquake we felt was about one o'clock; these shocks continued till about three; then the eruption came, and earthquakes lessened slightly. At four the eruption nearly stopped. We then retired; but the shocks became so frequent that we could not sleep. At 4.30 a tremendous shock, which turned us out again. It lasted a minute—we thought the house would come down. We dressed, and lit the fire, as it was of no use trying to sleep. The house creaked and the doors swung; it was like a ship at sea. Shortly a couple of friends arrived from a short distance up the road; they being rather lonely, and thinking there was safety in numbers. We went outside again to look what was doing, and during the flashes of lightning, which kept up the whole time, we could see a heavy pall of what appeared to be smoke stretching to the east for about 50 miles. We waited, and about 5.30 we had fourteen friends more who were afraid to stay in their own houses any longer. At about six the day dawned, and for about ten minutes we had a little light. Suddenly the wind changed, and blew from the S.E., and in a second almost the whole place was in darkness, and a suffocating smell of sulphur came. We shut the doors immediately, and went to the back of the house to look out, and there mud was raining hard on us, and after that fine volcanic ash came down. This continued falling until 11.30—five hours; utter darkness the whole time. We now began to feel frightened, as we did not know what was coming next, and in the darkness and the suffocating dust if anything happened, we could not have left the shelter of the house. From nine till ten a frightful thunderstorm raged; but no one seemed to heed it. There were 26 of us in the house, and we had to prepare breakfast for all. Luckily we had oatmeal and plenty of milk, but no sugar. At 11.30, after the ashes had stopped, it began to get light. A light ash fell all day and part of the next. Our cousin rode to the township, and brought back news that it was the Mount Tarawera and seven other smaller hills had become eruptive, and where a lake was there is now a new volcanic mountain. The ashes are 4in. deep on our land, and every scrap of feed is covered. It looks miserable—everything dressed in grey. Just a month after the eventful night we were at a friend's house for the evening, and at 9.30 we were startled by a big shock. It sobered us for a moment; but we are getting used to them now. Several others occurred—this evening a big one. They are having shocks all over the south island. In the direction of Tarawera now there is always an immense column of steam like a huge white cloud, and about 600ft. high.

"We are already getting irreverent, and call the earthquakes 'wobblers,' and the volcanoes 'puffing Billy,' or 'spouting Billy.'

"There is a variety of opinion as to whether the land will ultimately be spoilt or enriched. At present we are bound to keep two cows for our own use, for milk and butter, and also the horses. There is no grass; we have to feed them with hay and carrots. Food for stock is at famine prices. We all think the grass will grow through the deposit."

Other parts of the letter I have omitted as not bearing much on the subject.

A. W. Lambert.

THE COMPOUND NON-CONDENSING ENGINE FOR YACHTS AND LAUNCHES.

[26200.]—"INGENIERO" (letter 26132, p. 556) is in error in supposing that I claim greater economy for the compound non-condensing against the compound surface condensing engine; in fact, if he will refer to my letter he will find that I make no mention of the latter. I advocate the compound non-condensing engine in yachts and launches for this reason, that it possesses the advantages of a high rate of expansion, though in a lesser degree, than in the compound surface condensing engine, whilst the condenser, air, and circulating pumps are dispensed with; it can therefore be taken as a medium between the high-press. and compound surface condensing engines. I do not think I am far wrong in stating that the consumption of coal in the compound non-condensing is as two to three against the high-press.

As a theoretical illustration, suppose we have a

double-cylinder high-pressure engine: diameter of cylinders, 5in. by 6in. stroke; steam press., 80lb.; number of revolutions, 200 per minute; cutting off steam, say $\frac{1}{2}$ stroke; this will give an average mean-pressure of 67lb., and a total mean load on one piston of 1273lb.; cubic feet of steam used per hour = $\cdot125 \times \cdot25 \times 2 \times 200 \times 60 = 750$ in one cylinder = 1,500 used in both cylinders.

Let us take a compound engine having cylinders 6in. diameter and 12in. diameter by 7in. stroke with the same steam pressure and number of revolutions as the high-press. engine. The average press. in the h.p. cylinder to equal the load on the high-press. engine piston will be about 46lb., and in l.p. cylinder $11\frac{1}{2}$lb.; cubic feet of steam used per hour = $\cdot16 \times \cdot2 \times 2 \times 200 \times 60 = 768$ against 1,500 in the high-press. engine. In this case steam is cut off in the h.p. cylinder at $\frac{1}{4}$ stroke; but in practice a later cut-off would be required to develop the same power as in the high-press. engine, which would bring the ratio of coal consumption as two to three; that is, if the high-pressure engine use 3lb. of coal per H.P., the compound non-condensing would use 2lb., and do the same amount of work. Surely this is worthy of consideration, even in small boats. I am of opinion that the compound non-condensing type will be much used in launches eventually. I quite agree with the remarks of Mr. Seaton (letter 26162, p. 579) on the compound surface condensing engine: it is undoubtedly the best, as is proved in the mercantile marine, but it is likely to have a rival in the triple expansion engine. In reply to "R. N.," I have not yet been to the Exhibition, but intend doing so, when I shall no doubt be better able to reply to him on the engine referred to—viz., the single-crank compound. At the same time you will admit that it is not so handy in starting as the double-crank engine, which is a vital point in launch engines. Is not the condenser in danger of getting damaged by being placed outside? The ratio of cylinders appears to be very large; although there is no necessity to divide the work equally in the single crank, at the same time I think it is better to do so. The coal consumption of 20lb. per hour is very low—is this taken from actual work? Also at what speed did the engine drive the boat?

Engineering Manchester.

LOCOMOTIVES, &c.

[26201.]—I RESERVED my reply to Mr. W. J. Grey, as he had referred to Mr. Stretton to decide the question about the data he requires. I am much obliged to Mr. Duncan for his letter, and trust that this confirmation of my opinion on the subject will satisfy Mr. Grey. As to repeating the dimensions of the G.N. engines, I still fail to see the necessity of so doing, especially as Mr. Grey complains in the "E. M." of March 5, 1886, p. 18, of being "fairly deluged with dimensions." I may add that Mr. Stroudley made a number of very interesting experiments on the Brighton line with his express engine, Gladstone, of which I have full particulars. If these would be of any interest to Mr. Grey, I will with pleasure lend them to him if he will give me his address.

I am very glad to see, from Mr. Thompson's letter, that the M.R. 900 class are being rebuilt. Can he say what cylinders and boilers they are to have?

I certainly agree with "G." in thinking the Great Britain class very economical engines, and as far as I can judge they seem quite powerful enough. I returned with one from Swindon a few weeks ago with an exceptionally heavy train, and the speed never fell below 60 miles per hour till nearing London. The G.W. engines, especially the single expresses, are very economical engines, and reflect great credit on their superintendent.

In reply to "Gorton" *re* the Crewe compounds, I fail to see that I credited "P." with an *unduly* high appreciation of the Webb engine. I intended my remark to convey the idea that "P." thought better of them than most people. I do not think it possible for anyone who knows them (even a little) to *appreciate* them. Especially should I be surprised if "P." does, as he says he lays great stress on economy. With their enormous first cost, their amazing coal and oil consumption, their peculiar tendency to lose time, and their habitual breakdowns, they have the unenviable reputation of being the most expensive engines running. As an instance of their losing time, I may mention the following amusing incident:—On asking a friend how the Compound had done with the 10.15 into Euston, he replied, "We were 15 minutes late at Warrington, and we have lost time all the way." "P." evidently is *disposed* to think well of them; but I can assure him they will not improve on acquaintance. The Precedents are much better engines; they do as hard, if not harder, work on less coal and oil, and keep time much better, and I should say cost but little more than half the cost of a Dreadnought to build. It is curious to note that two of our best loco. superintendents are quite decided against compounding—they are Messrs. Stroudley and Stirling. Indeed, Mr. Stirling has said he would as soon think of compounding with his creditors as he would of compounding his engines. And can anyone say—much less prove—that these two gentlemen are wrong? I think not. The most successful application of the compound system to non-condensing engines has, I think, been seen in the portable engine, in which it has been adopted with considerable success according to experimental trials. But as yet we have no experience in actual work to confirm this. However, if we examine the compound portable engine of a leading maker, we find a great many reasons why it should be very economical. The piston speed is low as compared with an express engine going 60 miles per hour, the number of revolutions being 90—135 according to the power of the engine, the stroke varying from 18in. to 24in. The boiler pressure is 140lb. to the square inch, and an efficient automatic expansion gear, controlled by a high-speed governor, is fitted to the h.p. cylinder and last, but by no means least, some of England's best engineers are making them a speciality. The apparently good results obtained from these engines lead me to believe that a compound goods-engine stands a fair chance of success, and I have before now advanced this opinion. Two papers on "Compound Locomotives" have been read before the Mechanical Engineers, from which it appears that compounding locomotives working goods and mixed trains has been attended with some success. I hope the engineering press will freely criticise these papers. It would be interesting also to hear how the Webb bogie-engine, ordered by the Paulista Railway, Brazil, is doing. Perhaps "Gorton" can enlighten us.

G. D. Seaton.

RAILWAY RETURNS.

[26202.]—THE accompanying table is compiled from the reports for the half-year ending June, 1886. The train mileage includes work over foreign lines:—

	No. of Engines.	Miles worked.	Train mileage.	Net receipts.
Great Eastern	685	1,104	7,425,711	£749,963
Great Northern	775	919	8,696,616	730,009
Great Western	1,597	2,610	14,523,817	1,793,223
L. and N.W.	2,323	2,554	18,230,304	2,261,897
L. and S.W.	541	837	5,515,411	587,919
Midland	1,750	1,855	16,316,459	1,614,639
North Eastern	1,506	1,707	11,101,289	1,249,218

G.

BRAKE TRIALS.

[26203.]—YOUR readers may like to know that there have just been some brake trials at Burlington, U.S.A. The brakes tried were the (1) American; (2) Eames; (3) Rote; (4) Westinghouse; and (5) Widdifield. Some of the trains consisted of fifty goods or freight cars, and experiments were made with these very long trains on severe inclines. The results show that the Westinghouse brake was perfectly successful on fifty vehicles; but not one of the other systems could efficiently work upon this length of train. The Westinghouse train consisted of fifty freight cars, of 20 tons each, running full speed down a bank of 1 in 95, and was stopped and regulated with the greatest ease.

U. S. A.

BRAKE BLOCKS.

[26204.]—IN reply to a letter from our worthy friend, Mr. Ghilleasbuig McTomae (26161), regarding "Brake Blocks," I may say that his statements are entirely wrong as regards the Caledonian Railway Company working the vacuum brake on their stock. They do nothing of the sort; they work the Westinghouse throughout all their railway district. That is, from Carlisle to Aberdeen both the Westinghouse and vacuum brake are fitted on the West Coast carriages, which run from Euston to the North by Caledonian Railway route, only for the accommodation of the L. and N.W. Railway Company, which have adopted that brake (the vacuum).

Several of the Caledonian vehicles are fitted with the Westinghouse and vacuum brake for the purpose of giving the use of such to either company which works the different brakes. Had both companies adopted one of the brakes, it would have been the means of a considerable deal less expense to the companies concerned.

I am inclined to think Mr. Ghilleasbuig McTomae has not travelled across the Border, or the smallest boy porter could have given him the correct information he so much requires.

But for the Stranraer carriage, it is a joint-stock carriage, and has both vacuum and Westinghouse brakes.

Caly. Ry.

BRAKES.

[26205.] — YOUR correspondent, Ghilleasbuig McTomae, p. 578, is in error with reference to the brakes used on the Caledonian Railway. This Company, some years ago, adopted the Westinghouse Automatic Brake, and it has been fitted to nearly all the rolling stock. Some vehicles have been fitted with the vacuum apparatus in addition, for use when required to run south of Carlisle over the London and North-Western Railway.

The West Coast Joint Stock, and some North-Western vehicles, are also fitted with double system for exchange at Carlisle.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
306 City-road, London, E.C.

MIXED TRAINS.

[26206.]—FOR several years past the Amalgamated Society of Railway Servants has strongly condemned the running of mixed passenger and goods trains, and has urged that if such trains are run the passenger carriages should at least be placed in the safest place near the engine and in front of the waggons; and at the last meeting of the committee, held at this office in July, it was resolved:

"That this Committee condemns the working of mixed passenger and goods trains, as fraught with danger through the breaking of axles or couplings, and interference with the working of a continuous brake on the passenger portions of such trains. Also on account of the difficulty experienced by drivers and guards in stopping the carriages at the platforms of stations where passengers have to alight. It was further resolved that a copy of this resolution be sent to the Board of Trade."

Several accidents have recently occurred to mixed trains, and it is very satisfactory to find that the following circular has just been issued upon the subject:—

R. 4,163. [COPY.]

"Board of Trade Railway Department,
London, S.W., 25th August, 1886.

"SIR,—The attention of the Board of Trade has been specially directed by some of the reports which have recently been received from their inspecting officers to the practice of running mixed trains in which passenger carriages have been attached to goods waggons. The facts brought to their notice in these reports have borne out the opinions expressed in previous reports as to the dangers arising from the running of mixed trains, especially when goods or other waggons are placed between the engine and the passenger carriages. The inspecting officers report that the risk of so placing the passenger carriages outweighs the advantages which may in some cases of accident to the front of the train have resulted from the waggons taking the worst of the shock. In these circumstances the Board of Trade wish to call the attention of the directors of the ——— Railway Company to the desirability of avoiding as far as may be such a practice. If the running of mixed trains is not altogether avoidable care should be taken that any waggons attached to such trains are specially constructed for the purpose, and fitted with such appliances as are generally adopted in the case of passenger carriages. The Board of Trade trust that, when the condition of the traffic necessitates the running of mixed trains, the passenger carriages will, as far as possible, be placed in front and not to the rear of goods waggons, and that all other precautions will be taken to lessen the risk of conducting traffic on such a system.—I am, Sir, your obedient servant, COURTENAY BOYLE.

"To the Secretary of the ———
Railway Company."

We can only hope that the railway companies will give the subject immediate attention and alter the dangerous system of working, but unfortunately so many circulars and requests have been disregarded in past years that probably little will be done until Mr. Channing's Railway Bill becomes law.

Clement E. Stretton.
Consulting Engineer Amalgamated Society of Railway Servants.
306, City-road, London, E.C., 27th August.

RAILWAY SIGNALS.

[26207.]—IF "Libra" will be good enough to refer again to my letter (p. 529) he will find that the quotation from Major Marindin's report states that the committee on signals is formed by the "Associated Companies." If he applies to the association, probably he will obtain the list of the various representatives.

In reply to the second question, in cases where there are four lines, the signals for the two lines in each direction can conveniently be placed side by side upon the "proper" or left hand of the railway. In some instances girders over the line are used to carry the signals, which can then with advantage be placed over the left hand of the line to which they refer.

I am unable to agree with "Libra" that cost has nothing to do with the question. An efficient system is more expensive than an inefficient one, and in the course of interviews and communica-

tions with railway officials, I am constantly reminded of the *cost* of improved systems and appliances. During the past twelve or fourteen years I have examined a very large number of signals, and I find that in every case which has come under my notice of a driver mistaking a signal, the signal itself has been found to be badly placed or fixed on the wrong side. **Clement E. Stretton.**

Consulting Engineer Amalgamated Society of Railway Servants.

Glen Magna, August 28th.

MIDLAND EXPRESSES.

[26208.]—I HAVE found that the principal cause of main line trains on the Midland failing to keep time is the numerous excursions.

Twice in one month I travelled by the Scotch express due at St. Pancras at 8.30 a.m. On each occasion we had an excursion in front of us, the result being that we were blocked at several stations, and arrived more than 30 minutes late. Surely this should not be. I travel a great deal on the Midland, and when away from the excursion traffic, find the time kept as nearly perfect as can be expected. **E. G. H.**

AUTOMATIC ACTION.

[26209.]—I NOTE that "Libra" says at the end of letter 26146, p. 577, that the Government Inspectors have set their faces against anything "automatic." There must be an error here. All signals are weighted so as to automatically fly to danger. The Board of Trade will not allow a non-automatic signal. Then, again, look at brakes. Does not the Board of Trade keep trying for automatic action? **Anti Vac.**

EARLY PRIMROSES.

[26210.]—IT may, perhaps, be worth noting that the common primrose (Primula vulgaris) has been in bloom in my garden here since August 16th, and that at the time of writing 17 flowers are fully out and numerous buds are in a forward state. The roots were transplanted from Kent at the end of November, 1885, most of them at the time being in flower and continuing to produce blooms through the winter until April. All appear to be in a very healthy condition. They are growing along the border of a narrow bed in front of the house, facing due south, and thus receive the whole of what sunshine there is to be had, as well as the reflection from the red brick wall. Soil, clay. (The political atmosphere of the district is strongly Conservative.) **R. T. Lewis, F.R.M.S.**

Ealing, W., August 27th.

THE WONDERFUL LAMP.

[26211.]—I MUST again disclaim all interest in this lamp. There is evidently an idea that I am "pushing" the sale of some particular lamp, so that while, on the one hand, Messrs. Bowron, Caplatzi, and Mag. est Ver, try to pooh-pooh the existence of such a lamp, Messrs. Paul Ward and Cherrill now say there is nothing wonderful in its performance.

Granted; I never said there was. All I said (and my statement has been abundantly verified by Mr. Carter, Prof. Cheshire, and others) was, that with two cells of a *chromic acid* battery, exposing 32 square inches of negative surface, I was able to light well a certain 5c.p. lamp.

My knowledge of the difference between the cold and hot resistance of lamps has nothing to do with the question; as a matter of fact, in the article which I quoted, special mention is made of the "hot resistance" of the lamp.

As we were discussing 5c.p. lamps only, I was quite correct in making the watts consumed the measure of "efficiency." In conclusion, may I be allowed to congratulate the readers of "Ours" on the appearance of a letter from Mr. Nelson K. Cherrill in its pages? In all matters connected with photography this gentleman is *facile princeps*, and will, I am sure, be of great benefit to all in need of information. **S. Bottone.**

ENGLISH VERSUS FOREIGN MICROSCOPES.

[26212.]—AS an Italian (and consequently without national bias), I may, perhaps, be permitted to say a few words on this subject. There can be no doubt that the English lens-makers are capable of making as good (if not better) objectives as any made by their Continental brethren. But owing to the enormous disparity in the price of labour and of food, the English maker cannot compete with his Continental rivals in point of price.

Having had occasion to deal pretty extensively in microscopes and their accessories, I have had considerable experience on this subject, and I find that the price charged by the English workman for the delicate and accurate brasswork of a microscope is generally equal to the entire charge for the complete instrument abroad.

Owing to this disparity in the prices of labour and food here and on the Continent, we may safely say that for a given sum one can at present obtain a better microscope from certain German and French firms than from the English ones. And on the other hand, if one be content to pay the tip-top prices of the best English makers, he may be sure to obtain an instrument which will fear no rival. **S. Bottone.**

[26213.]—IN reply to your correspondent, "Briton," p. 580, Vol. XLIII., I do not know much about the microscopes in use in medical schools, but I am an enthusiastic worker with that instrument myself, and if your correspondent is correct that foreign microscopes are largely recommended by science teachers in preference to English instruments, I think it is a matter that is worth the attention of anyone interested in this instrument, and that the superiority which I have always considered as appertaining to English instruments should not be allowed to be extinguished by a lack of sufficient demand to stimulate the enterprise of our English opticians. I would, therefore, suggest that some recognised authority should take the matter in hand—say our Royal Microscopical Society. Perhaps Mr. Crisp, the energetic secretary, might be induced to give the movement his aid, and at one of their winter meetings the whole of the opticians in London be invited to show the special forms of instruments they consider most useful to students. It would then give anyone who cared to have it the opportunity of seeing what English manufacturers can do; and I for one have sufficient faith in my countrymen to believe that when they come to be compared, it would be detrimental to the foreign instruments.

I shall be very interested to hear that something of the sort might be arranged, and that the greater number of London microscope-makers would worthily represent themselves at the meeting. **Another Briton.**

[26214.]—IT is a pleasure to many, besides myself, to find your correspondent, "Briton," taking up the cudgel on behalf of English mechanics. It is simply discreditable to all concerned to supply foreign brass, glass, or steel goods to our institutions. Every English workman who takes the trouble to examine those samples that fall into his hands knows that *none* of the foreign productions excel English in quality, very few equal them, and as to price—well, I should indeed be sorry to find *our* workers producing some of the horrible work that finds its way here at any price. Undoubtedly such trash is palmed off wherever there is an opportunity, and there are certainly very great chances for a certain class of buyers to get a series of "tips" out of foreign makers and their agents, which not only hide the bad places in the work, but really glazes defects so cleverly as to make almost advantages out of them. Your "industrious foreigner" and his agents can get off their hands such work as no English maker would pass; indeed, I have, in my own experience, seen a large quantity of different classes of optical goods of foreign make, and I can truly say if an apprentice under my instructions for six months, dared to bring me such work as is constantly sold, I would put the work under the hammer, and make every effort to get the apprentice to change his vocation. One great evil is growing out of this *free* trade. A few years ago many makers of small *good* goods could live in this country; whereas now his place is taken up by the "industrious" and his agents, who have thus the field, and dispose of heaps of small *bad* goods. Of course they can do this to pay, simply because common stuff is cheaply produced, and, after a succession of "tips" and profits, can be sold at a cheaper rate than good work, whether English or foreign. I have always found that the *best class* instruments of foreign make are certainly a long way behind ours for "fit" and "finish"; taking the difference of cost in most cases, you are scarcely getting 9d. worth for your 1s. when you buy a foreign instrument. With such makers in our midst as Ross and Co., Powell and Lealand, Beck and Beck, Crouch, Swift, and the host of English makers besides, the first being in the van of the micro. army of the world, both in glass and metal-work, it is an insult to common sense to attempt an apology for the presence of a foreign instrument of that sort. The same may be said of surgical, mathematical, and musical instruments.

This part of the subject shows the English mechanic a wily, although an open, foe, by comparison with the English makers (?). Who brands with a good old English name the foreign trash he buys and sells? Who has an empty workshop and a full wareroom? Whose very existence means the starvation of x families of the artisan class? Whose practical knowledge of the trade is only that which is learned behind the counter? How *we* thank *these* thousands of destroyers of the "back-bone," the "sinews" of the country, the British artisan. Would that the time-honoured request, "buy of the maker," retained its old truth and efficacy. **Prismatique.**

LIMITED EXPRESSION OF CHAMBER ORGANS.

[26215.]—REFERRING to the articles on chamber organs, by Mr. Audsley, I find him, in speaking of the limited power of expression possessed by organs, saying that "every expedient that can be devised to increase the flexibility of the instrument in this direction will be of the highest value from a musical point of view." Seeing that in all his subsequent remarks he gets no further than the "balanced" swell pedal, I wish to point out to him that the power of "swelling" is now at perfect command of the player without requiring either feet or hands to produce it, by means of a contrivance invented by Mr. Jno. Morland, organist of Waterford Cathedral. In this the weight of the player on the stool is so utilised that whilst he has *both feet* engaged in pedalling and *both hands* occupied in the manuals, he can with ease and certainty open the swell to any extent and keep it open as long as he wishes at any particular point; indeed, that power of expression, or gradual swelling, or diminishing of the tone is now to be had at *constant command* of the player, and thus for the first time in the history of the organ a player can indulge in accent or emphasis as freely or as sparingly as the character of the piece being performed may require, and all this without any discomfort or inconvenience to his manual or pedal playing.

I cannot help thinking that this will prove a great boon to all organ-players, whether professional or amateur, and hence my desire to acquaint Mr. Audsley of it, and your numerous readers, who must, like myself, find his articles so exceedingly interesting and useful. **Charles Melross.**

CURATIVE POWER OF MAGNETS.

[26216.]—THOUGH Mr. E. Willmore protest against my leaps, I do not see that at present his views on this subject differ very much from mine. From his admissions the *suggestions* I make follow quite rationally. His simile of his Mansion House proves more in my favour than in his. The connection between clairvoyance and mesmerism on the one side, and the magnetic plate of the body on the other, is beyond a doubt.

These two faculties have been proved to be the effects of *animal magnetism*, not in one, but in a whole pile of books. Surely Mr. Willmore does not deny the influence of the physical man on the intellect, and vice versâ? And if he admits it, a wide and rational bridge is at once established between the state of the body and the productions of the mind. Consider a man in danger, in terror, in ill or good health, or in love, and how these states react on each other, how they affect his mental creations, his physical achievements, and my *suggested* explanation at once loses its absurdity. I should have been glad to hear simpler and more natural ones from E. Willmore or any other psychologist, and it is with that view only that I threw out mine, and by no means because I had made up my mind that it was the right one. **A. Caplatzi.**

"BIG BEN" BEATEN.

[26217.]—THE writer in *La Nature* (p. 579 Vol. XLIII.), evidently knows little of the subject he writes about, or he would never claim that the clock at Avignon has beaten the famous Westminster timekeeper because of its four seconds' pendulum of only 132¼lb. weight. Such pendulums are no novelty, vide "Clocks and Watches and Bells," sixth edition, p. 168, where the author states: "The fashion of extravagantly long pendulums has very properly gone out, as their inconvenience and liability to be affected by the wind overbalances any advantage from them in a moderately good clock. There were several in Yorkshire until lately as long as 56ft. or four seconds." As the total weight of "Big Ben's" pendulum is about 700lb., of which the bob alone weighs 4cwt., he may still be said to hold his own against all competitors, and a few more particulars of the escapement, variation of rate, &c., of the Avignon clock must be forthcoming before it can be even said to approach the performance of the famous production of Sir Edmund Beckett (now Lord Grimthorpe) and the Messrs. Dent. **H. D. A.**

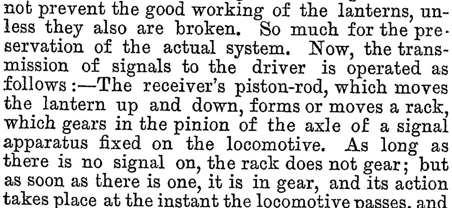
ELECTRICAL INERTIA.—Erratum.—P. 554, 3rd column, top two lines, should be: "Where the *induced* current existed for *two seconds* after the inducing current had ceased."—PAUL WARD.

THE Oak Lawn poultry ranche, of California, hatched 2,500 chickens, and has 3,000 eggs in course of hatching and 1,200 more to begin. The incubators, hatching houses, brooding houses and runways have a capacity to keep 5,000 eggs in process of hatching all the time. The superintendent has invented and built an incubator with a capacity of 400 eggs, which has just turned out 80 per cent. of live chickens.

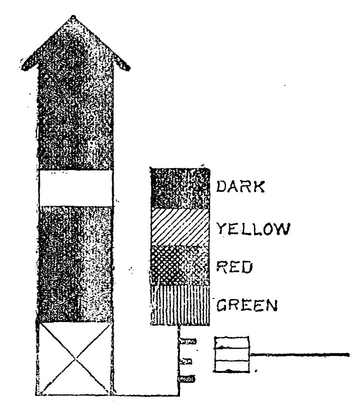
REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[59610.]—**Railway Signals.**—No. 1,116, p. 531, Errata:—Column 2, line 4. . . . Allow a *pointsman*, read a *Frenchman*. Third column, . . . that they (the signals) are not conveyed to their *distance*, read *their destinée*. By this expression I meant the driver to whom they are destined. Now for my system. I have slightly modified it in order to preserve and improve the actual sight or optical mode, as its mechanical parts may vary at the engineer's will and wish. I will not detail them, and will limit myself to the description of the principle. The system may be divided into two parts, the first one extending from the signalman's box to the signal-stand on the line as usual, and the second one from that stand to the driver's place on the locomotive. The signals are transmitted from the signalman's box to the signal-stand by hydraulic, or, rather, liquid pressure, produced by a cylinder and piston in a tube, the diameter of which may be that of a quill pen, carried in the ground to avoid accidents. Each end of the tube is terminated by a cylinder with a piston, the first one of which I call the sender, the second one the receiver. Supposing the signals to be three in number, the piston stroke is divided in three parts, each one corresponding to the sound, colour, number, and signification of the signal. I suppose the signals to be:—No. 1, "*on*," one whistling, yellow; No. 2, "*stop*," two whistlings, red; No. 3, "*back*," three whistlings, green. The piston moves are produced by a hand-lever at the signalman's command. Of course as the sender's piston is pressed down, the receiver's rises up. This effect, which can be obtained at any distance, is instantaneous. In order to avoid freezing, the liquid used in the tube is glycerine, petroleum spirit, or any other non-freezing liquid. The receiver's objects are two: (1) to move up and down a lantern in coloured glasses; (2) to command, by means of a rack, the pinion of an axle placed on the locomotive which moves the driver's signal apparatus. The signal-stand consists in an opaque box or pipe, in the centre of which there is a lighted lamp or gas-burner. The centre part of the box or pipe is glazed so as to permit, in every direction, the sight of the coloured light existing therein. This coloured light is produced by the lantern coloured glasses, which are superposed horizontally. When the sender's piston is at rest or standstill, its opaque top faces the box's glazed part, and no light is transmitted. When pressed down to No. 1, the yellow glass part of the lantern faces the box's glazed part, and a yellow light is transmitted all round, which means "on." If the piston be pressed down to No. 2, red is in sight, and means "stop." Finally, if pressed to No. 3, green is seen, and means "back." Thus far the usual optical or sight system of signal is preserved, and it is improved in this respect, that the colours are seen in every direction, and there being double glasses, as the lantern is inside of a glazed box or pipe, the chances of breaking are greatly diminished. The breaking of the box glass would not prevent the good working of the lanterns, unless they also are broken. So much for the preservation of the actual system. Now, the transmission of signals to the driver is operated as follows:—The receiver's piston-rod, which moves the lantern up and down, forms or moves a rack, which gears in the pinion of the axle of a signal apparatus fixed on the locomotive. As long as there is no signal on, the rack does not gear; but as soon as there is one, it is in gear, and its action takes place at the instant the locomotive passes, and gives accordingly the signal No. 1, 2, 3, in number, in



colour, in print, and in sound, in the following manner:—On the driver's stand there is a small apparatus consisting in a fixed flat dial on which there is an aperture; behind this dial is a rotating disc divided in three coloured sections—yellow, red, and green. Each section has a cam, and bears No. 1, 2, 3, and the words "on," "stop," "back." The cam's object is to act upon the hand of the bellows of a whistle placed behind, so that when the piston stroke is at No. 1 division, the yellow section of the disc appears before the dial's aperture showing No. 1, and the word "on," and one whistling is heard. When at No. 2 it is "stop," red, No. 2, and two whistlings, and when at No. 3, "back," green, No. 3, and three whistlings are heard. The whistlings cannot fail to call the driver's attention to the dial, the indications of which are imperative. Of course the driver obeys the order; but in the mean time the train advances, and passes the post; but, in consequence of the signal being seen all round, he has only to look back to see it. As I before said, the mechanical contrivance of the system can vary



at the engineer's pleasure. I merely indicate its principle and mode of acting. I hope, however, that what I have said is sufficient to prove to the interested that by such a system, signals infallibly and unmistakably reach the driver as well as the signal-post, and this without any trouble for him to look after it on whatever side it may be; that they are transmitted to him by sounds, colours, numbers, and meanings; that he cannot fail to hear and see them both at his stand and on the post; that all the informations now given are preserved and improved; that new ones are added; that the distance and the side of lines are of no consequence; that there is no wire, and, therefore, no breaking, contraction, or expansion to be feared; that the spectacles are safer; that the signals are seen in every direction; that the working is simple and easy, requiring but little power. Perhaps it is not useless to add that this system is not patented, and that all I claim is the paternity of my child. The same system may be applied so as to have at two stations the automatic information of the train's progress on the lines, and also to form a telegraph.—CH. RABACHE, Morchain, Somme, France, 23rd August.

[59842.] — **Mathematical Probabilities.**—TO "ALIOTH."—The table you require may be calculated in the following way:—If the odds be n to 1, divide log. $(n + 1)$ by the first three figures of M—that is, by ·434; the quotient to three figures is the number required. Take, for instance, even odds (the fraction you know to be $\frac{7}{10}$), $n = 1$ and $\frac{\log.(n + 1)}{M} = \frac{\cdot 30103}{\cdot 434} = \cdot 069$, which is very nearly $\frac{7}{10}$. In the same way the number for odds 10 to 1 is found to be 2·40. Your example can now be easily solved. Opposite to 10 to 1 in the table is 2·40; multiply this by 20 (the original odds), and the result, 48, gives the number of throws required. I did not intend my letter to be "savage," but if I have hurt your feelings in any way, I can only express my deep regret.—R. E. F.

[59854 & 60050.]—**Shot Paradox and Boxes of Spheres.**—Why "paradox," I should like to know? What is there paradoxical in n inch balls going into a closed box containing $< n$ cubic inches, seeing that a spherical inch is only ·5236 of a cubic one? And what does "E. L. G." mean by his answer (p. 583) to "J. K. P.'s" question of the closest way of packing a very great number of balls, which I had answered incidentally in the same paper in which it was asked, that the triangular and the rectangular modes of packing leave exactly the same minimum of empty space —viz., ·26 of the whole mass, if large enough to neglect the margins, which vary a little with the shapes and sizes of the piles? "E. L. G." professes to contradict that by saying that "the base must be neither like that of a honeycomb (meaning the common triangular setting), nor square, but like the alternate squares of a chessboard." He does not give the relative sizes of the balls and squares, but I suppose he means the balls to touch or their diameter to equal those of the squares, for otherwise there would clearly be not less, but more, space left empty. But if he does, that is simply the common square set pile looked at diagonally instead of directly. Again, what is the use of his confessing that his 38 was a mistake for 32 when I had shown that it involved no less than 14 mistakes, for that 14 numbers less than 38 will go into a box containing fewer cubic inches? The fact is, he had invented a formula which is evidently wrong for any kind of pile, and it naturally led him to a multitude of wrong results, as he must be well aware by this time, but seeks to cover his retreat by a display of utterly irrelevant fireworks about cubes and "oblong tubes" (as he is pleased to call my boxes, which were nearly as wide as they were long, and nobody had said anything about cubes), and "bishops and rooks moves on a checker layer" (which most people would spell chequer, but, of course, he knows better), and "cleavage directions," all in the most uncleavable direction of all—viz., right through the centres of the planes of balls; and says that "of course he was not considering a single layer." But if not, why wasn't he, seeing that it is a fundamental and à fortiori ingredient in the problem? And he certainly did not exclude it. That implies, too, that I had dealt with single layers only, whereas I had given 3 and 5, which was his own maximum for his 38 balls. Anybody may make mistakes in calculations or in inferences from them; but these methods of trying to conceal mistakes are not creditable. "E. L. G." is always writing as if his dicta were sufficient to correct anybody, whereas it is clear that they are quite as likely to be wrong as right. To be sure, "it may only be his fun," as "F.R.A.S." says about him on another subject of which he knows a hundred times as much as "E. L. G.," but it is rather poor fun, and hardly worth even laughing at. I may as well now drop the word "Another," though I cannot supply another initial without risk of confusion, and so I sign simply—G.

[59870.]—**Carnation Disease.**—The following, which I take the liberty of extracting from an article by Mr. Worthington G. Smith in the *Gardeners' Chronicle*, will throw further light on carnation diseases:—"During the last few years a destructive brown mould has been very common on carnations. In bad cases whole collections have been destroyed. The name of the fungus which causes the mischief is Helminthosporium echinulatum. The fungus was first described, with a small illustration, by the Rev. M. J. Berkeley in the *Gardeners' Chronicle* for March 19, 1870, since which time the attacks of the parasite have greatly increased both in frequency and intensity. The superficial appearance of the fungus as it grows on both sides of the leaf is very distinct, and may be immediately recognised by its correspondence with the accompanying figure. [Mr. Smith gives a drawing, which I do not copy.] The mycelium or spawn of the fungus, the threads of which are comparatively very thick, creeps in a radiating fashion inside the leaf immediately below the leaf epidermis. From the inside of the leaf the fruiting threads burst through to the outside in a series of black concentric circles like minute fairy-rings. When a fragment of one of the miniature fairy-rings is removed with the point of a lancet, and examined under a microscope with a power of 400 diameters, the fungus is seen as in the lower part of the illustration. The mycelium is very thick and lumpy, and the supporting stems of the spores are also very irregular in shape, and jointed. The spores themselves, which are borne on the top of, or at the sides of the fruiting threads, are very handsome, and are either without articulations, or have from one to five joints or septa, as illustrated. The spores are very finely and beautifully echinulate; they are slightly constricted at the joints, and each spore is furnished with a very minute but perfectly distinct footstalk, as shown. When spores are jointed, as in the examples before us, each joint is capable of reproducing the fungus on germination. As the fungus vegetates between the two membranes of the leaf it cannot be reached by any sulphuring process without destroying the leaves; the only mode of action that can be taken, therefore, against the fungus is to very carefully pick and destroy every infected leaf. Dr. Cooke has described, under the name of Helminthosporium variabile, a fungus not to be distinguished from H. echinulatum. H. echinulatum sometimes leaves carnations, sweet Williams, &c., amongst the Caryophyllaceæ, and infests Ornithogalum; when on Ornithogalum the fungus is named (for a change) Heterosporium ornithogali. Three years after Mr. Berkeley had published the plant before us under the name of Helminthosporium echinulatum, he republished it in the *Annals and Magazine of Natural History*, May, 1873, under the name of H. exasperatum! The fungus, therefore, has four names—two given by the same author, and two which must be regarded as synonyms."—SAML. RAY.

[59983.]—**Consecration.**—I do not know what I have done that such a question as this should be directed to me. At any rate, I can't answer. I don't know how a house could be "left on will for Divine worship." The proper place for divine worship is a church where all the seats are free.—LIMB O' TH' LAW.

[59985.]—**Sleeplessness.**—The best remedy for sleeplessness in those advanced in years who cannot take active exercise is mental work of a kind

that is likely to tire the brain. To many people the endeavour to reckon up how much they have spent during the day, or during the week, accounting for every item, is often a capital soporific, and so, I should think, would be the endeavour to solve some problem in electrical engineering, involving the calculation of resistances and weights of wire, &c. It is impossible to criticise the method of "Bionomist," because, like the Spanish fleet, it is not yet in sight; but there is too much mystery about it to induce a belief that it is a real remedy for insomnia.—SAML. RAY.

[59989.]—**Problem in Chances.**—The whole number of possible payments in one day is $35 \times 12 = 420$, of which 418 payments are odd and only two even; the probability, therefore, of an odd payment on any one day is $\frac{418}{420}$, of an even payment $\frac{2}{420}$, or $1 - \frac{418}{420}$. The probability of there being odd payments on 10 days is $\left(\frac{418}{420}\right)^{10}$, of even payments, on 8 days, $1 - \left(\frac{418}{420}\right)^{8}$. But the probability that two independent events will both happen is the product of their respective probabilities, and as the above events are practically independent, the probability that there will be odd payments on 10 days and even on 8 is $\left(\frac{418}{420}\right)^{10} \times 1 - \left(\frac{418}{420}\right)^{8}$, or about $\frac{65,456}{6,302,060}$, which is, roughly, one chance in a thousand. But we have next to consider the probability that the eight even payments would be divided in the manner stated in the query, viz., six payments of £2 and only two of £3, the most likely division being, of course, four payments each. The numbers are so small that the result can only be approximate; by a rather long calculation, which would occupy too much space, I find the probability to be $\frac{104}{1,000}$, say, $\frac{1}{10}$ roughly. The probability found above, being multiplied by $\frac{1}{10}$, gives a result of ·000104; that is to say, there are only 104 chances in a million, or about one in ten thousand, that the toll-keeper's return is correct. I may observe that while his veracity is a moral question, the measure of his veracity is strictly mathematical, and such questions have been treated at great length by Poisson in his great work on "The Theory of Probability." It looks very much as if the toll-keeper were rather fond of annexing the odd coppers.—R. E. F.

[59990.]—**Walnut Fittings.**—Tallow mixed with umber of a suitable colour; otherwise size.—E. G. M.

[59991.]—**Water Supply.**—This querist should procure Molesworth's Pocket-book, which will be found to contain the requisite information.—T. P.

[60003.]—**Aerated Water.**—Quite possible for animalcules to exist in aërated water. Carbonic acid will destroy all forms of life which breathe oxygen to keep them in existence; but not germs.—T. J. S.

[60014.]—**Fly for Gravity Escapement.**—Why does not "Duffer" refer to Lord Grimthorpe's book ("Clocks and Watches and Bells," by Sir E. Beckett), and discover that he has very correctly named himself?—VIDEO.

[60017.]—**Electro-Motor.**—How can anyone say whether such a motor is in existence without more particulars of that designed by "Magneto."—J. T.

[60038.]—**Dynamo.**—If the iron be soft and good, you should be able to get about 50 volts. 30 amps. out of your machine at about 1,500 revolutions. Of course you must have a laminated armature if you want to run the dynamo continuously. Put about 7lb. of No. 12 on the armature, in one length, and about 50lb. No. 18 on the fields. Connect as a shunt machine.—S. BOTTONE.

[60040.]—**Strains on Arches.**—I think I do include all, and only all, the forces acting on the structure; while "M.I.C.E." includes more than all on one side, and less than all on the other side of the point O. This seems even clearer in the case (page 582) than in the former case. Surely the whole 30 tons at B act downwards at 10ft. (in the 17th line the 10 is evidently intended to be 20) to the left of the new point (call it O^1), just as the other weights to the left of O^1 act at their respective distances from O^1, and surely no part of the weight at B can have any moment at any point between O^1 and the right abutment. The equations would then be—$P \times 27{\cdot}6 = 87\frac{1}{2} \times 160 - (30 \times 10 + 30 \times 40 + 30 \times 70 + 30 \times 100 + 27\frac{1}{2} \times 130)$, and $P \times 27{\cdot}6 = 87\frac{1}{2} \times 50 - 27\frac{1}{2} \times 20$, which give the same value for P. We cannot expect to have quite exact results, because the arm at which P acts is taken to the centre of the depth of the arch, while the line of thrust is a funicular polygon which does not coincide with the centre curve.—J. S. C.

[60050.]—**Shot Paradox.**—I have been hoping to see a methodical solution of "E. L. G.'s" problem (which he now owns is not a paradox); but his last letter, p. 583, beyond giving a few hints, does not give a solution. It is a consolation to solvers to know, as "E. L. G." tells us, that the arrangement is confined to chess-board order—i.e., the spheres standing on the red squares of a chess-board, and touching at the angular points of the squares. I had seen that the cube which contains 500 must be on this arrangement: The base must consist of ten rows of five, and there must be ten such layers. This does not sound like a cube; but anyone by drawing a figure may see that it is so, and that its dimensions are $(1 + 4{\cdot}5\sqrt{2})^3 = 399{\cdot}18$. The box to contain 501 must have its layers either all equal or differing by one. In the first case, since the total number of balls is odd, there must be an odd number of balls in each layer, and there must be an odd number of layers. Using expressions containing x to represent the number of balls in a layer, and expressions containing y to represent the number of layers, we have—

$(2x + 1)(2y + 1) = 501$ .... (i.)

In the second case, the layers are alternately odd and even, in which case there must always be an odd number of odd layers, and either an odd or an even number of even layers, or algebraically—

$(2x \pm 1)(2y \pm 1) + (2x)(2y) = 501$...... (ii.)

or—

$(2x \pm 1)(2y \pm 1) + (2x)(2y \pm 1) = 501$ (iii.)

Solving i., ii., iii. in positive integers, we obtain the following arrangements:—

(a) 9 layers of 29 and 8 layers of 30
(b) 7 layers of 39 and 6 layers of 38
(c) 5 layers of 45 and 6 layers of 46
(d) 3 layers of 71 and 4 layers of 72
(e) 3 layers of 83 and 3 layers of 84
(f) 3 layers of 167
(g) 1 layer of 501

The two last need hardly be considered, so we have now to arrange the layers so that they shall contain the above numbers thus:—

(a) 29 and 30 cannot be arranged in alternate layers except in two straight lines
(b) 39 must be in 6 rows of 4 and 5 of 3
38 „ 6 „ 3 „ 5 of 4
(c) 45 „ 3 „ 7 „ 4 of 6
46 „ 4 „ 7 „ 3 of 6
(d) 71 „ 5 „ 7 „ 6 of 6
72 „ 6 „ 7 „ 5 of 6
(e) 83 and 84 cannot be arranged in two layers except in two straight lines.

We are thus reduced to three arrangements, viz., b, the bottom layer of 6 rows of 4 and 5 of 3; the next layer of 6 rows of 3 and 5 of 4, and so on alternately for 13 layers, the upper one being the same as the lower. c and d will be seen to be the same arrangement, but turned on its side and end respectively. The dimensions of this box will be $(1 + 3\sqrt{2})\ (1 + 5\sqrt{2})\ (1 + 6\sqrt{2}) = 401{\cdot}316$, that is greater than the cube by $2{\cdot}136$, so that the arrangement is not so economical as the cube, the addition of unit volume to the contents increasing the capacity by 2·136. Without being sufficiently at home with mathematics to prove my assumption, I would venture to ask "E. L. G." whether I am right in assuming that that arrangement which is the nearest approach to a cube will be the most economical. I have worked at the problem in several different ways, but regret having mislaid my calculations; but I fancy I arrived at six or seven results, but cannot remember whether I confined myself to square order; but the results were all greater, some considerably greater than 401·36. Will "E. L. G." inform us whether there is any rule for working out such problems? The formula he gives on p. 533 will, I think, only hold for chessboard order. How can it be shown that chessboard order is the most economical?—LINKUM DODDIE.

[60073.]—**Battery.**—TO MR. E. CONRY.—Many thanks for your reply. I have, as you suggested, unsealed the top of the cell, and it appears to me to be simply a Leclanché with agglomerate plates. The pole in the centre, which I mistook for the negative, is the carbon plate cut narrow where it comes through the top; below it has solid black blocks (manganese and carbon I suppose) on each side; outside these is coarse canvas, and all kept together with rubber bands. The zinc plate quite covers the four sides of the cell, and all fit so closely together that there is not much space for the sal-ammoniac solution. The cell is made of vulcanite, or some similar material, and the copper strap is not attached to it, as I supposed, but is riveted to a strip of the zinc plate, which comes through the top. Are they in any way superior to the ordinary agglomerate Leclanchés besides their portability? Is there greater quantity of electricity from zinc plates which surround the carbon than from zinc rods?—G. D.

[60137.]—**Marking Ink—Nigrosine.**—A letter addressed to Mr. F. Carter, High-street, Carshalton, would probably elicit the desired information. This gentleman has long made these dyeing materials an object of study.—S. BOTTONE.

[60137.]—**Marking Ink.**—I fancy the marking-ink sold under the name of "Jetoline" would answer "Maschera's" purpose; it is supplied in cases with two separate bottles containing albumen in one, and (I think) some kind of aniline dye in the other. Equal quantities are to be mixed just before use, and it is very readily applied by stamps of any kind; a small quantity of the mixed ingredients being poured on a pad of indiarubber, and this covered with a piece of cambric or thin calico stretched tightly over it, and kept in place by elastic rings, forming a convenient mode of application.—GAMMA SIGMA.

[60137.]—**Marking Ink.**—In reply to "Maschera," nigrosine can be obtained of dealers in chemicals and dyestuffs under the name of aniline black. Aniline dyes are obtainable of oilmen, &c., in small packets for domestic dyeing, but the black generally turns out on examination to be simply a mixture of powdered logwood extract and green vitriol. Shirt-makers usually, I believe, employ coal-tar thinned with turpentine, though the following is much used:—Heat 9 parts Venice turpentine with 4 parts oleaine till thoroughly incorporated. Place 10 parts of soft soap on a slab and work in above mixture. Now add 6 parts ground and sifted lampblack, mix well, and finally, to improve the colour, add 1 part neutral extract indigo. Above can be used with metallic types. For an indelible cancelling ink nothing I have met with equals Richmond's, of New York). I am not aware whether this has as yet been placed on the London market, but shall have pleasure in sending the formula free to anyone desiring it.—PERCY W. STANLEY, 119, Manchester-road, Poplar, London.

[60141.]—**Differential Galvanometer.**—You require, not a differential galvanometer, but a Wheatstone bridge, and a sensitive galvanometer of ordinary make. To make this latter, get an oblong card box 2in. by 1½in. by 1½in. (such as serves to cover the small "tandstickor" matches). Cut a central slot out of the top, about $\frac{3}{16}$in. wide, to admit the pivoted needle. Now wind this neatly from one end to the other (not covering the slot) with No. 30 silk-covered copper wire. Tie the ends down neatly. Soak in melted paraffin wax. When cold, glue down to a base board 4in. by 4in. Bring out the ends of the wires to two binding screws, inserted at two corners of the board. Drive a fine needle point upwards in the centre of the slot. Now make a glass pivot from a bit of glass tubing, and fasten thereto a well-magnetised lozenge-shaped piece of steel spring, about 1¼in. long. Poise this on the needle. Glue a graduated circle, about 3in. in diameter, having a central hole punched, to admit the passage of the head of the pivot, on to the coil of wire. Now take a light, straight piece of straw, about 2½in. in length, and as thin as possible, and glue it by its centre to the top of the pivot, taking care that it remains exactly parallel with the magnetic needle below. When dry, knock the bottom out of a glass capped box (such as used by mineralogists), about 3in. diameter by 1½in. deep, and glue it over all, to serve as a cover, to protect from currents of air, &c. Full instructions for making bridge were given at p. 286, Vol. XLIII of the "E. M." See also my advertisement in Sale Column.—S. BOTTONE.

[60158.]—**Induction Coil.**—Through illness and overwork, I have not been able to comply with "Telephonist's" request, and even now can only give him a few rough hints (diagram to follow on when I have opportunity of preparing drawing). However, if he cuts his eb. tube into 6½in. lengths, that will do. The ends are secured by screwing them on to tube and the discs are all in their places, separated by distance rings before the coil is begun to be wound.—PAUL WARD.

[60159.]—**Stevenson's Thermometer Screen.**—I beg to express my best thanks to Mr. W. Marriott for the very intelligible instructions given on p. 583. I cannot comply with conditions *re* positions; it will have to be fixed either on a platform on the housetop or in a yard about 60ft. square, surrounded by buildings of various heights. To which would Mr. Marriott give the preference?—TELEPHONIST.

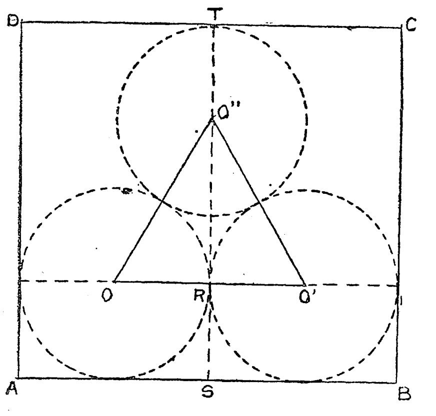
[60174.]—**Photography—Intensifying.**—Do the photographic readers let pass such an answer as that by our learned correspondent, Mr. C. E. Allen, in last week's without some deep criticism? It is by such ridiculous answers that the amateur English Mechanics are led astray and taught the wrong principles of this magnificent art-science. He proffers, I may say, a reducing agent for an intensifier. Can this be an error of unthoughtfulness or of utter ignorance? Be it as it may, but he must remember that the unique toning solution he suggests for an intensifier does in reality reduce instead of intensify. It may strike him that a print, after toning, is very much reduced in intensity

—that is, if he has any photographic knowledge. One particle of gold replaces three of silver, as is known to the merest dabbler in ceramic photos. To more fully illustrate my ideas, we have, say, a negative which we wish to transfer to porcelain, and to obtain the design we employ a gold toning bath to displace the silver particles, leaving the gold *in situ*. The intense image we have before this operation (formed of finely-divided particles of metallic silver held *in situ* by the inert gelatine) is reduced greatly in "pluck" by this replacement of minute particles; hence reduction, and not intensification. Referring to the two following replies by Mr. R. A. R. Bennett and "Citrus," hyposulphite of soda and cyanide of potash are nasty things to play with when inert ammonia stands by. They are not only difficult to eliminate from the film, but do not produce permanent results.—A. TREYER EVANS, Newport, Monmouthshire.

[60177.]—**Electric Time Ball.**—TO MR. BOTTONE.—I am obliged for your reply to my query; but you have mistaken my difficulty. I can manage to drop ball at any time; but I am in a fix how to raise it again ready to receive current. I thought of dropping ball similar to the way clocks are synchronised now—by electric current. Will you kindly send sketch how I can raise it?—W. J.

[60185.]—**L.B. & S.C. Engines.**—No. 4; name, Mickleham, D class: cylinders, 17in. by 24in.; diameter leading and driving wheels (coupled), 5ft. 6in.; trailing, 4ft. 6in.; total wheel base, 15ft.; total length engine, 31ft. 7½in.; total heating surface, 1,040 sq. ft.; firegrate area, 15 sq. ft.; number of tubes, 229; total weight, 38tons 10cwt.; total gallons in tank, 860. E class: 85, also 86 Geneva; cylinders, 17in. by 24in.; wheels—trailing, leading, driving (coupled), 4ft. 6in.; total wheel base, 15ft. 3in.; total length engine, 32ft. 4½in; heating surface, 1,037 sq. ft.; number of tubes, 229; total weight, 39tons 10cwt.; total gallons in tank, 900. Am sorry I cannot supply particulars of L.S.W.R. locos.—G.N.R.

[60186.]—**Mathematical Problem.**—Let A B C D be a section through the middle of the cube containing the spheres.



The side A D = S T

And S T = R S + R O″ + O″ T

But R S = 3 (diam. = 6)

And O″ T = 3

And $O''R = \sqrt{O O''^2 - R O^2}$

$O O° = 6$ and $R O = 3$

$O'' R = \sqrt{36 - 9} = \sqrt{2F}$

$\therefore S T = 3 + 3 + \sqrt{2F}$

$S T = 3 + 3 + 5{\cdot}2$

$S T = 11{\cdot}2$in.

—TOODLES.

[60186.]—**Mathematical.**—The reply of "T. C., Bristol," gives neither the smallest box "cubical in shape" (as "Adam" required) nor the smallest oblong box. The smallest cube to hold three—namely, that of 10·242641 (say 10¼in.)—will equally well admit a fourth ball; but as the third cannot shift from its allotted place when the box is shut, this may fulfil "Adam's" condition of "fitting." If we neglect the condition of being "cubical in shape," the smallest rectangular one is less than two-thirds of the above cube, and less than three-fourths of "T. C.'s" box—namely, one of 6 by 6 by 18—taking the three balls in one row instead of each touching every other. The smallest number to go into a cube less than their own number of cubes is 32. The fewest to go into less space than in a single row is 11 in one layer of 3 rows; and any number under 38 occupy less in one layer than in several layers.—E. L. G.

[60192.]—**Electroplating Bath.**—Silver may be recovered from an old plating solution by any one of the following methods. 1. Use a platinum anode, and deposit all the silver on a cathode of copper foil. 2. Evaporate the solution to dryness, mix the residue with an equal weight of dry sodium carbonate, and fuse on charcoal. 3. Evaporate to dryness, mix the residue with an equal weight of plumbic oxide, fuse the mixture in a clay crucible, and cupel the button of silver and lead on bone ash to remove copper and other base metals. If you wish to get pure silver nitrate the last method will be preferable, as you will only have to dissolve the silver in nitric acid, and evaporate all the free acid, to get silver nitrate crystals. From these any of the other salts may be made. If you only wish to get silver chloride, dissolve the metal obtained from either process in nitric acid, drive off all the free acid by heat, dissolve the crystals in distilled water, and add dilute muriatic acid until all the silver has been thrown down as silver chloride in the form of white curds. If these are stirred with a piece of zinc, the chlorine will leave them to combine with the zinc, and pure metallic silver will be left in the vessel in the form of a grey powder. This should be washed in dilute sulphuric acid to remove all traces of zinc before it is fused, or dissolved in nitric acid.—G. E.

[60194.]—**Strawberries.**—I would inquire of "A Lady Gardener" whether she has had her strawberries taken up each year, the roots and tops cleared of all dead vegetation, the runners cut off, and such divisions made as are natural and easy. If this has not been done, they will grow weaker each year, until they assume the appearance and power of production of wild ones. Plant on a rich high bed, with good drainage, about the end of February. Water liberally in dry weather; when the flowers begin to appear, water them once a week with guano water.—GARDENER.

[60207.]—**Disinfectants.**—In answer to "Zero," I think the most useful classification of disinfectants to give him will be into gaseous and non-gaseous ones. The chief gaseous ones are the following: Chlorine, bromine, and sulphurous acid, which comprise the most powerful disinfectants that can be found; but they have the disadvantage of destroying colours and some of the metals very readily. Among the principal non-gaseous forms are the following:—Perchloride of mercury, sulphate of iron, permanganate of potash, carbolic acid, and most essentials, besides resin and other vegetable products, including an important one—namely, freshly-burnt charcoal, which has the remarkable property of taking up and storing in a condensed form many deleterious gases. Nearly all disinfectants act either by oxidation, or by acting as a poison to organic life. The gaseous ones are the most reliable; but for certain purposes, as disinfecting excreta, carbolic acid or sulphate of iron, or, better, perchloride of mercury, are preferable, as it remains in contact. I must not omit to mention superheated steam, or heat of any kind in fact of over 300° Fahr, continued for some time, according to the size of the articles to be disinfected.—MICROTOME.

[60221.]—**Spanish.**—First, as to the "bones of words." The explanations given are respecting those letters that differ from the English pronunciation, and the examples refer to English words and letters. B, pronounced much as English V. C, pronounced as TH in "theft"; before O and U as K. CH, as in "chess." D, when following a vowel either in same or preceding word, as TH in "though"; when coming after a consonant is pronounced as in English. At the end of a word, however, D is almost mute. G, before E and I has a guttural sound, nearly resembling the aspiration of the English H; before other vowels as in English. H is silent. J has a guttural sound as G, but before *all* vowels. LL is pronounced as if written LH. N as NY in "banyan." S is always sounded S in "sing," and never as S in "muse." V, as in English. X formerly had two sounds, KS and as Spanish J; now in all words where previously employed with latter sound X is replaced by J. Y, as a consonant, rather stronger than Y in "yes." Z, as TH in "thank." A, as in "ark." E, as in "ell." I, as in "ill." O, as in "ode." U, as in "full." Y, as a vowel, as I Spanish.—F. DESPREZ.

[60227.]—**Covering Outdoor Steam Pipes.**—I can from experience recommend "Leroy's" composition, which has now stood the test of many years.—ACHELL.

[60230.]—**Ebony.**—I have been both amazed and amused at the six replies to 60230 query which appeared on p. 587. What can have possessed six estimable correspondents to air their absence of knowledge on the subject passes all comprehension. I did not notice the original query, but probably the following facts will meet the wants of the querist:—There are in commerce several well-known varieties of black ebony coming from different localities, and each having some well-known peculiarities—viz., Ceylon, Mauritius, Gaboon, Zanzibar, &c. Each produces a distinctive kind. The wood is both hard and heavy in all cases, but the various kinds differ in degree in both these qualities. The best is a dead black in colour; that of a brownish hue is not so valuable. Occasionally, but very seldom, amongst the Ceylon variety a piece is found having a number of small, orange-coloured spots intermixed; such pieces are used for making small fancy articles, such as work-boxes, paper-cases, cabinets, &c., and fetch from £30 to £40 per ton when really fine; but I have never seen a piece of this kind weighing above a few hundredweights. The ordinary black pieces range in value from, say, £5 to £15 per ton, according to size of the pieces, colour, and quality. For pianoforte keys the African sort is preferred; and though this is always found in small sizes, it is large enough for that purpose. Much is consumed for knife-handles, especially on the continent of Europe. For furniture but little ebony is employed; it is too heavy and in too small sizes to allow of its being much used; in addition to which the supply is insufficient and price too dear. *Ebonised* furniture is quite a different affair; it is made of some close-grained, fairly hard wood, and stained before being polished. Green ebony comes from the West Indies; it is very little used—occasionally for some turnery purpose, but chiefly as a dye wood. The whole importation of this kind, however, is a mere bagatelle.—WOOD BROKER.

[60245.]—**Sodic Sulphite Developer.**—No. 1 pyro solution: Boiling water, 2 fl. oz.; sodic sulphite, 2oz. When this is cold, add sulphurous acid, 2 fl. oz.; pyrogallic acid, ½oz. No. 2 potash solution: Carbonate of potash, 3oz.; sodic sulphite, 2oz.; water, 7 fl. oz. Dissolve sulphite in the water, and then add the carbonate of potash. For half-plates use a 4oz. measure, take 3 drachms No. 1, and (if plate is correctly exposed) 2 drachms No. 2, and fill up to 3oz. with water. If plate is under-exposed, use more No. 2; if over-exposed, less No. 2. Use alum bath both before and after fixing. This is called Beach's potash developer. I have developed over 100 plates this week with this developer, and it has worked admirably.—J. T. G., Leeds.

[60245.]—**Sodic Sulphite Developer.**—Formula given in Marion's book is—

Pyrogallic acid	¼oz.
Am. bromide	150 grains.
Sodic sulphite	1oz.
Citric acid	15 grains.
Water	3oz.

He gives double this quantity, but this is quite enough to make at a time. First dissolve the sodic sulphite and citric acid in 2oz. of hot water. Pour this solution over the ammonium bromide and pyro, which will dissolve immediately. Make up the solution to 3oz. with cold water. I generally add 5 drops of nitric acid, which I believe helps to keep it. Filter the solution at intervals, or a sediment is apt to settle, which causes pinholes in the negatives by settling on them while being developed. I have developed hundreds of plates with this developer, and in my opinion, and that of all my friends, it beats all the others I have tried hollow. The negatives produced by the "ordinary pyro. developer" are weak and melancholy in the extreme by the side of those produced by this developer. If "E. G. H." can't succeed with this, and will write to me, I will give him more details.—R. A. R. BENNETT, Walton Manor Lodge, Oxford.

[60245.]—**Sodic Sulphite Developer.**—"E. G. H." has undoubtedly failed owing to a bad sample of the sulphite; its instability is only too little known amongst photographers. It is oxidised to the corresponding sulphate by the absorption of oxygen from the atmosphere, although its deportment with oxygen is increased manifold by being kept in solution, than when in crystals. I have had several samples of this salt, some good and some bad, which appeared as if mixed with flour. I should put this down to its partial oxidation and conversion into sulphate. Always reject the small when not pure, and use the larger crystals. Leon Warnerke's sulphite developer is exceedingly good (at least in my hands); it has these advantages, that only two small bottles are needed, and the obnoxious fumes of ammonia are dispensed with, whilst the finished negative has the delicacy and tone of a ferrous oxalate developed plate. The formula is as follows:—

A		B	
Pyro	12 grains	Carbonate of potash	45 grains
Citric acid ...	2 "	Sodic sulphite	12 "
Sodic sulphite	24 "	Water	2 oz.
Water	2 oz.		

Equal portions of A and B are mixed together and poured over the exposed plate. For an under-exposed negative use more of B, an over-exposed use a few drops of a 10 per cent. solution of bromide of potash to restrain, whilst to produce density a greater quantity of A may be used.—A. TREYER EVANS, Newport, Monmouthshire.

[60245.]—**Sodic Sulphite Developer.**—Your querist, "E. G. H.," asks if this developer produces better negatives than the ordinary pyro (by which I presume he means the pyro ammonia)

formula. I answer, so far as amateurs are concerned, unhesitatingly in the affirmative. The slowness of its action would be a great drawback in a professional studio, where a sitter has often to wait until it is ascertained if a good negative has been produced; but for an amateur the great range of its developing power is invaluable—that is to say, it will produce a good negative, if the plate is rightly exposed, if it is under-exposed, and if it is over-exposed. Under-exposure is corrected by giving plenty of time (up to an hour in some cases), and over-exposure by an ample dilution with water. He also asks for a good formula. Their name is Legion, but underneath he will find some of the best. Beach's (President of the New York Society) developer. No. I.—Distilled warm water, 2oz.; sodic sulphite (pure), 2oz.; dissolve, filter, and add—sulphuric acid, 2oz.; pyro (avoirdupois), ½oz. No. II.—A. Distilled warm water, 4oz.; pure potassium carbonate, 3oz.; dissolve, and add—B. Sodic sulphite, 2oz.; dissolved in 3oz. distilled warm water. Combine A and B. For use, take one drachm of No. I. and ¾ of a drachm of No. II. to every ounce of developer required. Note.—There is some difficulty in dissolving the 2oz. of sulphite in 2oz. of hot water; but this is a test of its purity. Put the sulphite in a cup, pour on the hot water, immerse the cup in hot water, and stir with a glass rod. Rau's Developer (for contrast):—A. Water, 14oz.; sodic sulphite, ½oz.; potassic carbonate, 1oz. B. Water, 10oz.; sodic sulphite, 2oz.; sulphuric acid, 1 drachm; pyro, 1oz.; make up each to 16oz. For use, take one drachm of each to every ounce of water required, and 15 drops of (20grs. to oz.) solution potash bromide per oz. of developer. Allen and Rowell's (to imitate wet plates):—No. I. Distilled water, 4oz.; sulphuric acid, 24 drops; bromide of ammonium, 50 grains; pyro, 190 grains. For use, add 1 part to 20 water. No. II. Water, 4oz.; sulphite soda crystals, 240 grains; dissolve and add—bromide potassium, 180 grains; liq. ammoniæ (strong), 4 drachms. For use, add 1 part to 20 water. To make developer, use equal parts of diluted solution Nos. I. and II.; add No. II. slowly; only half of it at first, then quarter, which is usually enough. New York Society's standard:—Water, 2oz.; dry pyro, 4 grains; sodic sulphite, 22 grains; sodic carbonate, 11 grains; potassic carbonate, 11 grains; potassic yellow prussiate, 11 grains. Each of these developers has been found to suit all trade plates in general use. For my own use I have found the latter as good as any.—B.SC., Plymouth.

[60246.]—**Heating Conservatory.**—A friend of mine heats one during the winter by means of 2in. wrought pipe connected in the usual way by ⅝in. pipe to a boiler made of tin. The boiler is similar to the letter T—the top portion of the T being a dome with flat bottom connected by two ½in. tubes to stem of T—which forms the chimney of the lamp, and has an annular space round it, filled with water, into which return pipe flows, the flow pipe being taken from dome.—T. C., Bristol.

[60246.]—**Heating Small Conservatory.**—Have a hot plate in the middle of your conservatory heated by a gas flame or lamp flame applied to the under side, and have a ventilator in the topmost part of the conservatory (so formed that cold air cannot readily blow in—see chimney cowls) to allow of the hot air circulating. There should not, however, be any direct communication between the flame and the interior of conservatory, as it would vitiate the air and spoil the plants; it should be altogether outside, as underneath an iron plate forming part of the floor.—E. CONRY.

[60247.]—**New Caledonian Single Engine.**—The leading dimensions of the engine are as follows:—Cylinders, 18in. diameter, by 26in. stroke, and boiler-pressure 150lb. per square inch; driving wheels, 7ft.; trailing wheels, 4ft. 6in.; and bogie wheels, 3ft. 6in.; total wheel base, 21ft. 1in. The distributed weights, when in working order—bogie, 13·5 tons: driving wheels, 17 tons; trailing-wheels, 11·4 tons; total, 41·9 tons. The tender is six-wheeled, 4ft. diameter; wheel base, 13ft.; has a capacity of 2,850 gallons, and when loaded with coal and water, weighs 33·5 tons. Total of wheel base of engine and tender is 42ft. 6in.; and total weight when loaded 75·4 tons.—HENRY VERNON.

[60252.]—**Gravity.**—It is well known that the body would reach the Antipodes in one hour and return in another; but it is a common error to suppose it could pursue a straight line. It could only do so from a pole. Elsewhere, its eastward rotational velocity being retained, would compel it to describe an ellipse whose major axis is the earth's diameter, and its minor axis (if falling at the equator) 95ft.; and away from the equator only as much less as the cosine of latitude. Thus your well would have to be oblong, and in England some 60ft. wide, or the body would strike against its eastern side. The velocity of passing the centre is about 28 furlongs per second = that of a satellite just above the surface.—E. L. G.

[60253.]—**Vacuum Brake.**—I cannot give a full explanation; but it is, as you say, frequently difficult to obtain a vacuum for a time. I think it is probable that some of the heated air from chimney enters the pipes, and so causes the same difficulty as is experienced with injectors when they miss, and the steam blows back; it takes some time to start them again—at least, that is my experience—and a bucket of cold water is frequently a cure if thrown over an injector.—T. C., Bristol.

[60254.]—**Tricycle Driving Gear.**—Gut bands do not answer well for tricycle driving, as they stretch and deteriorate rapidly on exposure to wet. It might do very well for a tropical country where fine weather can be depended upon.—E. CONRY.

[60255.]—**Hydrostatic.**—If I understand you correctly the rod is simply kept vertical in the water and is immersed to a depth of 4ft. The c.g. of the water displaced is, therefore, 2ft. from surface, but c.g. of rod is only 1ft. from surface, and practically there is a turning movement existing, and which tends to lay the rod horizontally. In other words, it is simply a state of unstable equilibrium, there being no actual turning moment until the two c.g.'s are out of the vertical, however small in amount.—T. C., Bristol.

[60256.]—**Multitubular Boilers.**—It depends whether you go in for economy of fuel, or for quickness of heating power. The most economical boilers are those that expose the greatest amount of heating surface to the action of the hot air and gases from the firebox, without requiring artificial aid to create a draught. The quickest heating kind is a matter of opinion; but engineers seem to favour the horizontal multitubular, and these certainly get up steam with wonderful rapidity. One of these, for 40 H.P., will get up steam to 100lb. in half an hour after lighting fire, and this after standing 16 hours or so.—E. CONRY.

[60257.]—**Curative Power of Magnets.**—In answer to "Florian" I would say that it is a difficult matter to select a book among the many that treat on the subject of his query. Most that I know of are writers in French, German, or Italian, and only treat more or less fully one side of the theme. Still, here are a few:—"Animal Magnetism: Physiological Observations." Translated from the German by C. Woodbridge, with Preface by Romanes. London, 1880. Kegan Paul, 2s. 6d. Lee (Edwin's), "Animal Magnetism." 1866. Longmans, 7s. 6d. "Experiments on the Direct Power of Magnets." Airy and Stuart, 1872. "Traité Complet de Magnetism Animal." 4th éditio. 1879. Baillère, Paris. "Des Facultés Magnetiques de l'Homme, des Services, qu'on peut en attendre.' Bacot, Paris.—A. CAPLATZI.

[60258.]—**Magnetism.**—(1) Yes. (2) It is not the same; take two similar poles, of strengths 10 and 6 units respectively. Suppose, for the sake of illustration, that they are separated by unit distance, then the force exerted between them will be $\frac{10 \times 6}{1^2} = 60$ units; but, now, dividing $(10 + 6)$ units equally between them, each pole will be of strength 8 units. Now the force exerted between them will be $\frac{8 \times 8}{1^2} = 64$ units. It is only when there is great difference between the two strengths that the stronger pole induces any magnetism in the weaker. In the above case, the 10 units will induce 10 units of opposite magnetism in the 6-unit pole, so that pole will then be equivalent to one of $(-10 + 6) = -4$ units, and the force exerted between them will be $\frac{10 \times -4}{1^2} = -40$ units, so there is a loss of 20 units of force. (The $-$ sign simply shows that the force is one of attraction.) (3) It will be half the sum of their separate forces on the iron, thus: Let 10 units be the strength of each of the dissimilar poles, the force of attraction between them will be $\frac{10 \times -10}{1^2} = -100$ units. (Supposing them to be separated by unit distance.) The N. pole of 10 units will induce 10 units of opposite magnetism in the iron, therefore the force exerted on the iron equals $\frac{10 \times -10}{1^2} = -100$ units. Similarly the S. pole also exerts a force of -100 units, so that the total force equals -200 units.—MAX.

[60259.]—**Magnet "Pole-Piece."**—To get maximum efficiency, the connector of the two cores must be about the thickness of the cores.—E. CONRY.

[60260.]—**The Aneroid.**—If "X." will procure a "table of heights" from a good optician, he will see that the answer to his first query must depend on whether the readings of the barometer are high or low, and having obtained such a table, his last query will also have received an answer. I do not understand the inquiry as to "the best measure of 20ft." Does it not indicate that "X." is at sea as to the principle of a vernier? I fail also to see how a vernier can be of use, as in a good aneroid the graduations vary in size, so that it could not subdivide correctly all round the dial, unless the instrument has an extremely small range.—D.

[60261.]—**Mercurial Pressure Gauge.**—Is this exposed to the weather or to damp? If either, rainfall or condensation would probably be the cause.—T. C., Bristol.

[60268.]—**C.G.S. Unit.**—It is the French unit of force, and is equivalent to the "foot-pound" of the English scale. It means 1 gramme lifted 1 centimètre high in 1 second; but does not actually equal the foot-pound.—E. CONRY.

[60268.]—**C.G.S. Unit.**—"Centimètre-gramme-second-unit"—i.e., the unit of heat or whatever you want on the centimètre-gramme-second system of units. If it is the unit of heat that you want, it is the heat required to raise one gramme of water through one degree Centigrade.—R. A. R. BENNETT.

[60268.]—**C.G.S. Unit.**— They refer to the centimètre-gramme-second system of units, the centimètre being the unit of length, the gramme the unit of mass, and the second the unit of time. As an illustration, the C.G.S. unit of force is "that force which, acting for one second on a mass of one gramme, generates in it a velocity of one centimètre per second." For a full description of the C.G.S. units, see S. P. Thompson's "Elementary Textbook on Electricity and Magnetism."—RED LIGHT.

[60268.]—**C.G.S. Unit.**—In this system of units the centimètre is taken as unit distance, the gramme as unit weight, and the second as unit time. A C.G.S. unit of velocity is therefore a velocity of one centimètre per second. A C.G.S. unit of force is a force which, by acting on a mass of one gramme for one second, would generate in it unit velocity. It is called a dyne, and is represented by $\frac{1}{981}$ of a gramme. A C.G.S. unit of work is a force of a dyne, overcome through a distance of one centimètre, and it is called an erg. A foot-pound is equal to $1{\cdot}356 \times 10^7$ ergs; and a horse-power is $7{\cdot}46 \times 10^9$ ergs per second. In this system the prefixes mega and micro are used to denote multiplication and division by a million. Thus a megadyne is a million dynes, and the ordinary atmospheric pressure is pretty nearly a megadyne per square centimètre. Similarly, a microhm is the millionth part of an ohm.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60270.]—**Lacquering.**—Get some light lacquer from the shops; they can generally make it better than non-professional lacquerers. Then take the bedstead to pieces, slightly warm the several pieces of brass to blood warmth, dip in the lacquer, and then set to drain and dry in a tray before a stove or fire, in a rather less heat. Parts that you cannot dip may be painted with a large soft brush; but lacquering is work that cannot be learnt from any description: it requires skill of hand and practice.—E. CONRY.

[60270.]—**Lacquering.**—Prepare the article to be re-lacquered by washing off the old lacquer with a strong solution of soap lees. When this is thoroughly done, dip the article in a solution of nitric acid and water, strong enough to remove the dirt; then wash immediately in clean water, and dry well. Heat the article till it can be held in the hand without burning, and with a camel-hair brush apply the following mixture, which gives a beautiful rich gold lacquer:—1 pint spirits of wine, 3oz. shellac, ½oz. turmeric, 2drm. saffron, 2drm. annotto.—W. F. GILCRIEST.

[60271.]—**Retouching Photographs.**—Spots in photos are filled in with Indian ink. If the tint is warm, add a little carmine or crimson lake. The colours most used for painting are: For skin, chrome No. 3 and Indian red; for shadows of face, crimson lake; for shadows in dress, gum arabic; other transparent or semi-transparent colours at discretion. The photo. must be mounted, and before colouring it must be well licked over with saliva; ox. gall. sours many of the colours, and must be sparingly used; gum arabic cracks up after lapse of time, and must also be sparingly used.—B.SC., Plymouth.

[60273.]—**Effervescent Drinks.**—"Puzzled" has become so from misapprehension of the term "neutralise" as applied to the action of tartaric acid and carbonate of soda upon each other; they are not destroyed, but converted into a new substance, in the case supposed into a solution of tartrate of soda in water, the carbonic acid being set free and producing the effervescence.—GAMMA SIGMA.

[60273.]—**Effervescent Drinks.**—When bicarbonate of soda and tartaric acid are mixed with water, the following reaction takes place:—$2\,(NaHCO_3) + (C_4H_4O6)H_2 = Na_2\,(C_4H_4O_6) + 2CO_2 + 2H_2O$, sodium tartrate, carbon dioxide, and water being formed. The carbon dioxide acts as a sedative to the stomach, and the sodium tartrate is an aperient.—R. E. F.

[60273.]—**Effervescent Drinks, Seidlitz Powders, &c.**—Seidlitz powders are composed of bicarbonate of soda (not "carbonate," as it is so frequently and incorrectly termed), tartaric acid

and the acid tartrate of potash, which latter is the active ingredient, acting as a saline aperient. Bicarbonate of soda and tartaric acid mutually react on one another, setting free carbonic acid gas, and leaving tartrate of soda in solution. The gas merely renders an otherwise nauseous draught more palatable.—MAX.

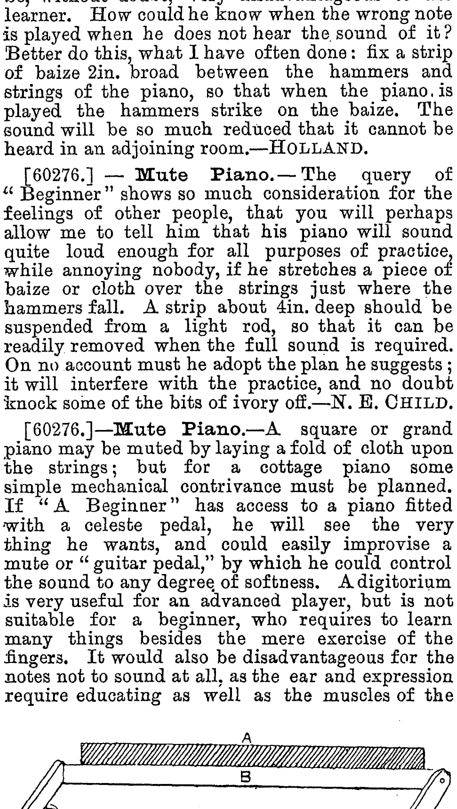
[60274.]—**Mushrooms and Salt.**—This statement is evidently intended to be taken with a good many grains of salt. That useful article has been credited with extraordinary virtues in the way of bird catching, but I have never heard of its application to mushroom culture before. If the spores are in the ground, I suspect the mushrooms will come up in spite of the salt; but, if not, all the salt in the ocean will not raise a single one.—R. E. F.

[60274.]—**Mushrooms and Salt.**—As mushrooms do not contain so much as a particle of chloride of sodium, it is difficult to give a "scientific explanation" or a "theory" (which is much the same thing) of the statement referred to by "Agaric." But inasmuch as the statement is not true, it is scarcely worth while seeking for an explanation. It seems far more likely that a meadow sown with salt in the spring would not yield even the minimum quantity of A. arvensis, and it is certain that, with suitable weather, any meadow containing spores or mycelium will produce a crop of horse-mushrooms without the aid of salt.—SAML. RAY.

[60276.]—**Mute Piano.**—Your proposal would be, without doubt, very disadvantageous to the learner. How could he know when the wrong note is played when he does not hear the sound of it? Better do this, what I have often done: fix a strip of baize 2in. broad between the hammers and strings of the piano, so that when the piano is played the hammers strike on the baize. The sound will be so much reduced that it cannot be heard in an adjoining room.—HOLLAND.

[60276.] — **Mute Piano.** — The query of "Beginner" shows so much consideration for the feelings of other people, that you will perhaps allow me to tell him that his piano will sound quite loud enough for all purposes of practice, while annoying nobody, if he stretches a piece of baize or cloth over the strings just where the hammers fall. A strip about 4in. deep should be suspended from a light rod, so that it can be readily removed when the full sound is required. On no account must he adopt the plan he suggests; it will interfere with the practice, and no doubt knock some of the bits of ivory off.—N. E. CHILD.

[60276.]—**Mute Piano.**—A square or grand piano may be muted by laying a fold of cloth upon the strings; but for a cottage piano some simple mechanical contrivance must be planned. If "A Beginner" has access to a piano fitted with a celeste pedal, he will see the very thing he wants, and could easily improvise a mute or "guitar pedal," by which he could control the sound to any degree of softness. A digitorium is very useful for an advanced player, but is not suitable for a beginner, who requires to learn many things besides the mere exercise of the fingers. It would also be disadvantageous for the notes not to sound at all, as the ear and expression require educating as well as the muscles of the



hand. It would not do at all to place a slip of wood under the projecting front of the ivory, as that would interfere with the touch, which is of great importance, and would, besides, tend to break off the ivories. A simple form of mute-pedal consists of a light slip of pine (B), called a celeste rail, about an inch in width, to which is glued a slip of thick cloth or baize (A). The slip of pine is centred to each end of the piano by two short arms, so that the rail may be raised and lowered by pedal action. When not in use the top edge of the baize rests just under the hammers; but when the soft pedal is pressed down it raises the bass end of the rocker, and the motion is communicated to the rail by the pedal rod, so that the slip of baize rises between the hammer and the strings, and regulates the quality of the tone according to the thickness of the baize. I think the best instruction book for a learner is Charles Hallé's "Practical Pianoforte School," published by Forsyth Brothers. The method of progression is very pleasant and thorough. After the first book or two the student is led into pieces of gradually increasing difficulty, and each lesson is carefully prefaced by finger exercises which are specially adapted to the technique to follow. If the exercises are carefully studied, it is quite possible for a student to attain a concert proficiency from this "school" alone.—W. H. DAVIES.

[60277.]—**Salicylic Acid.**—Tests for salicylic acid. When heated in a dry, open test tube, a crystalline sublimate forms. Ferric chloride (Fe_2Cl_6) produces a deep purple coloration; disappears on addition of alkalies. Bromine water gives a white precipitate. When heated with lime gives a smell of phenol (tar).—C. M. X.

[60279.]—**Travelling in America.**—With regard to the above, having been in America some time, (1) I should recommend "Scotsman" to go into Virginia. I found the climate as good there as anywhere; it is hot in summer, but on the whole it is very healthy. (2) As to the trade you mention, I am unable to give you any reliable information on it; but I have no doubt you stand as good a chance in such cities as Richmond, Lychburg, and Petersburg, Va., as anywhere. (3) As to travelling, either railway or steamboat is good. The latter is the least expensive, perhaps, but the former is very convenient, as you can book through from New York to Philadelphia, and thence to Baltimore and on to Washington, and from there to either of the towns mentioned above; and as to luggage, the less you can do with the better, as you can obtain most things as cheap out there as you can here; and lastly, I may add that a steady, sober man, not afraid of hard work, may get along very well there. Any other information that "Scotsman" desires I shall be pleased to answer through these pages.—F. R. LONGMORE Walthamstow.

[60279.]—**Travelling in America.**—(1) The climate generally all over the U.S. is very good; but down South it is pretty hot, and on the coast line round about Florida and below there is, I believe, considerable miasma. (2) It is very difficult to advise as to the best place there for work; but I can counsel you, on good reliable authority, to go West. Englishmen are thought a good deal of in the Western States, on account of the thoroughness of their work and their steady application; but in the great cities and Eastern states they are considered not to work quick enough. Most American manufactures partake of the quick, cheap style of work, which will not afford good, thorough, high-priced work. I should suggest going to some small agricultural town in the great farming districts (W. and Central U. S.), where there are plenty of agricultural machines (which abound in the States), and which have to be repaired on the spot. Travelling in the U.S. is very convenient. There are railways everywhere, with, on the average, far better accommodation for third-class passengers than here, and quite as cheap. The particular mode of travelling, however, depends on the locality. There is considerable depression of wages and labour in the U.S.; but I do not think it can be as bad as it is here. The excess of labour-supply arises from the incessant streams of foreign emigrants, who all make for the towns, preferring to obtain work by underbidding those already there, rather than strike out into the less crowded States and open up new lines and resources there. There is also among the U.S. employers of labour a constant "ring" to keep down the price of labour, and owing to the inefficient state of trades-union organisation, and the Republican form of government, which makes the large employer of labour ex-officio a legislator, so to speak (there being no other classes to choose legislators from), the employers have it all their own way.—E. CONRY.

[60280.]—**Water Passing through Pipe.**—To calculate the quantity of water discharged through a pipe, it is necessary to have the length as well as the diameter of the pipe. The following formula gives the number of cubic feet discharged per minute—

$$W = 4{\cdot}71 \sqrt{\frac{D^2 H}{L}}$$

W = number cubic feet discharged per minute, D = diameter of pipe in inches, L = length of pipe in feet, and H = number of feet head of water. The number of cubic feet multiplied by 6·24 will give the quantity in gallons.—W. F. GILCRIEST.

[60281.]—**Bottle Stopper.**—"Happy Jack" should put a drop or two of paraffin oil round the stopper, and let it stand for a day. If not successful, renew.—PONTO.

[60281.]—**Bottle Stopper.**—Five or six weeks since there was published a list of the usual methods of undoing these sometimes obstinate stoppers. Send to the Editor for the No.—T. C., Bristol.

[60281.]—**Bottle Stopper.**—Dip a cloth in boiling water; apply the cloth to the neck of the bottle, thus causing the neck to expand slightly, so that the stopper can easily be removed.—C. M. X.

[60281.]—**Bottle Stopper.**—Put your bottle for a short while in warm water, so as to expand just the bottle's neck, but not the stopper, and knock, after heating constantly with the back of a knife against the stopper. I believe you will thus be able to open your bottle.—HOLLAND.

[60281.] — **Bottle Stopper.** —Apply a little paraffin oil round the junction of stopper and neck, and let it have time to find its way down. By gentle side taps on the stopper it will no doubt soon yield to persuasion, and when it is out, smear a little paraffin-wax over the surface of the stopper. It will not stick again in a hurry.—SAML. RAY.

[60281.] — **Bottle Stopper, Removing.** — Unless the bottle has contained solution of potash or soda (either of which dissolve the glass and thus cement the stopper), the stopper may be removed by one or other of the following processes:—First. Pour a few drops of methylated spirits round the stopper, then placing the thumb of the left hand against the narrow side of the stopper, tap lightly on the opposite side with a wooden rod. If that does not move it, get a stout string, tie one end to firm post, pass the string once round the neck of the bottle. Hold the free extremity of the string tight in the right hand, and with the left work the bottle briskly up and down the string so that the neck becomes quite hot from friction. If that does not move it, put a few drops of olive oil round the neck of the stopper; allow it to stand all night, then plunge the neck of the bottle, held upside down, in a basin of hot water.—S. BOTTONE.

[60281.]—**Bottle Stopper.**—Take the bottle in one hand, upside down, and a knife in the other; knock the stopper of the bottle at irregular intervals, it will possibly fall out. If this doesn't do, dip a feather in some olive oil, and anoint the top of the bottle round the stopper. Leave it for a short time till the oil has soaked in, and see if the stopper will come out; if not, go through the tapping performance again, which may be more successful this time; if not, plunge the bottle, if empty, into a vessel of hot water up to the neck, which will possibly eject the stopper by the expansion of the air. If not, twist a bit of string once round the neck of the bottle where the stopper is; get someone to hold one end, and tie the other end to the knob of a chest of drawers; move the bottle as fast as you can backwards and forwards, so that the string, rapidly twisting round the bottle, heats the neck just above the stopper, which may loosen it; if it does not, *smash the bottle!*—R. A. R., BENNETT.

[60282.]—**Air Valve.**—I think it is very probable the seat of valve is too wide—have it like a dull knife-edge and grind valve in; pressure in receiver should make it tight.—T. C., Bristol.

[60286.]—**Spangled Tin.**—This effect is produced by dipping the tin plates in acid, and then washing them in abundance of water, to remove the acid. Peculiarly fine designs may be obtained by directing a blowpipe flame for a few seconds against different parts of the plates previous to immersion in the acid. The ordinary coloured spirit varnishes so often described in "Ours" serve to give the different tints.—S. BOTTONE.

[60286.]—**Spangled Tin.**—This has been answered several times in back numbers (see Vol. XXXVII., page 320) under the head of "Moire Metal." It is done by washing the surface of tin, first with alcohol to remove grease, and then with a mixture of 1 part hydrochloric acid, 1 part nitric acid, and 5 parts of water. It is coloured by being coated with coloured varnish, lacquer, &c.—R. A. R. BENNETT.

[60289.]—**St. Sampson.**—E. Dale will find a notice of St. Sampson in "Parker's Calendar of the English Church," which says he was a "bishop, and died A.D. 565. He is said to have been a native of this island, of 'royal British blood,' and a scholar of St. Dubritius, who consecrated him Bishop of York. When the Saxon invaders reached that part of the kingdom he was obliged to flee, and the saint then considered where he might be most useful, and resolved at length to attempt the conversion of Bretagne. On his way thither he stopped some time in Cornwall, converted many of the natives, and erected a church and monastery there. He fixed his residence in Bretagne at Dol, under the auspices of King Childibert, where it is said he erected a bishop's see, and converted many

thousands of the inhabitants, and died there in his 85th year. He is commemorated in the old English calendar on July 28th. The churches of Southill and Tolant in Cornwall, Cricklade, Wilts, and one in the city of York are named in his honour alone; and Milton Abbas, Dorsetshire, in the joint names of SS. Mary and Sampson."—J. PLACE.

[60293.]—**Iron Cartes, or Ink Photos.**—It is perfectly possible to produce a veritable ink picture. This was done so far back as 1842, and is described by Robert Hunt in his "Photography." You will find a fairly accurate account of the mode of procedure in last week's ENGLISH MECHANIC, page 573, second column, under the heading, "Dark Violet Black Lines upon a White Ground."—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

59801. To Mr. Eaves, p. 380.
59804. Organ Pipes. To "Uranium," 380.
59826. Simple Apparatus for Limelight, 380.

59993. Smoke Consumer, p. 470.
60002. Vinegar, 471.
60005. To Mr. C. E. Stretton, 471.
60008. Retort Furnace, 471.
60010. Civil Service, 471.
60011. Model Gun, 471.

The Krotophone.—The krotophone is a new form of telephone receiver which has been patented by Mr. E. S. Spaulding, of New York, but which appears to be in reality a modified form of microphone receiver. It is well-known, and has been proved by several experimenters years ago, that the carbon, and also the metal microphone, will act as a receiver, and give out sounds, which as a transmitter it so effectually transmits. The effects as a receiver are, however, comparatively feeble. So far as we can see, the only improvement on the earlier receiving microphones constructed by the experimenters we have referred to is the use of a carbon diaphragm instead of a mica or other mechanical diaphragm. Mr. Spaulding places a pencil of carbon against the back of a carbon diaphragm surrounded by a metal ring, and the received current, after traversing the carbon pencil, enters the carbon plate and spreads to its edges, the ring forming the electrode. This arrangement, we gather from the inventor, gives a good effect. The external form of the apparatus is that of an ordinary Bell magneto telephone, the carbon plate taking the place of the ferrotype diaphragm in the mouthpiece, and the carbon pencil the place of the bar magnet in the stem.—*Engineering.*

Coal Gas.—Notwithstanding the fall in the value of what are known as "residuals," gas-making is still a very profitable business where there is a large demand to supply. Although the South Metropolitan Gas Company have reduced the price to 2s. 6d. per thousand cubic feet, they still make the handsome profit of 10s. per ton of coals, in spite of the loss of about 1s. per ton in the value of the residuals this year as compared with 1884-5. The coal cost a trifle less, and the value of the coke falls in proportion about 4d. per ton; but owing to improvements in the manufacture, either in utilising waste or in the use of more economical devices, the actual cost of manufacturing the gas has been reduced by nearly 1s. per ton of coal carbonised. Tar has fallen to less than half its value a year ago, and the other residuals also show a decline; but, notwithstanding, the profit per 1,000 cubic feet is only 1½d. less than for the year ending June 30, 1885, while for six months of the present year the price received has been 2d. per 1,000 less.

A Collection of Buttons.—Mrs. H. C. Harris, of Harlem, New York, fondly shows the work of 20 years in 8,000 buttons, collected from every quarter of the globe. The work began on a wager in Portland directly after the war, when the people believed there were not more than 999 different kinds of buttons in the world. In less than a year the 999 had been collected, and in four years 5,000 buttons, all different, many of them beautiful in design, and many brilliant and beautiful in colour. Some have come from old wars and famous battlefields, some from gold mines and poorhouses, some have been brought half around the world to the collector by sea captains, some from shipwrecks, some just from the button counter, and some are dignified old buttons that have seen life in a previous century. The collection is arranged in eight strings of 1,000 each.

QUERIES.

[60294.]—**Action of Steam.**—To "GLATTON," OR "T. C., BRISTOL."—Will you be so kind as to explain to me the action of steam in the two diagrams marked 1 and 2. Dia. No. 1—Is it the 4lb. at A that goes to 2½ at C on dia.

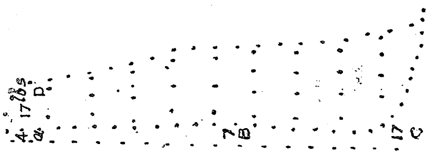


FIG. 1

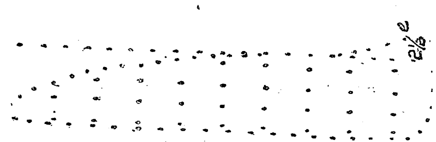


FIG. 2.

No. 2, and, if so, where does the 7lb. at B, and the 17lb. at C, and 17lb. at D on diagram No. 1 go to? They are compound engines at ¼ centre. Ought the condensing engine to cut steam off at the same time as the high-pressure cylinder does, there being no receiver, only pipes from one cylinder to the other?—YOUNG ENGINEMAN.

[60295.]—**To Mr. Bottone.**—Would a 6c.p. incandescent lamp light a room which is 14ft. by 11ft. by 8ft. high, and would a bichromate battery of six cells 7in. by 7in. by 3in. light the lamp? If so, would Mr. Bottone tell me the proportions of the acids, the amount of bichromate, &c., and the best way to cut carbons, as I have a great deal of carbon of a curved shape from a gas retort, which would cut some large plates ⅜in. thick or more? I suppose zinc would be the other plate, and the battery I intended to use would be a strong box with six divisions, each one lined with pitch.—CYCLOPS.

[60296.]—**Black Stain for Wickerwork.**—Will any correspondent tell me of a very cheap mixture of black stain, such as is suitable for the first coating of the wickerwork of perambulator bodies, and the best and cheapest method of using it? There is a stain that is used cold, and with a brush; but a cheaper article is required.—W. W.

[60297.]—**Testing for Faults.**—Will any reader of the "E. M." kindly tell me how to test for faults in dynamos and circuits with the lineman's detector, and how the detector will show a fault?—J. L.

[60298.]—**Norway and Sweden—Outfit, Cost of Living, &c.**—Can any reader oblige me by giving some information as to what outfit I should require for Norway and Sweden, between 66 and 68 degrees of latitude, cost of same, and is it best to procure outfit in England or Sweden? What is cost of living comfortably and well, what kind of food can be procured? Particulars regarding climate, temperature, seasons, route to get there, and time, &c., &c.; also names, &c., of books relating to that part.—TERRA INCOGNITA.

[60299.]—**Locomotives.**—To "CARSTAIRS," OR MR. STRETTON.—Can you oblige me with boiler dimensions of M.R. 1327 and 1740 classes? Also of N.B. express engines built by Mr. Holmes before the present class (592)? They have, I think, 17 by 26 cylinders and 7ft. coupled wheels.—G. D. SEATON.

[60300.]—**Battery for Lamp.**—Will someone kindly inform me with what solution to charge a battery composed of two pint cells, containing carbon plates, porous pot containing amalgamated zincs with mercury, zincs always to remain in solution? I want it to light a small incandescent lamp.—J. H. M.

[60301.]—**Electric Lighting.**—Will someone kindly assist me by giving me a simple method for calculating dimensions of electric light wires? I am only a learner, and not well up in algebraical formula; therefore all the books published are so much Sanskrit to me.—RULE O' THUMB.

[60302.]—**Pigmy Motor.**—Will Mr. Bottone kindly tell me the size of castings for the ring-magnet and armature of a Griscom's pigmy motor? Also the quantity and size of wire for both to make the armature revolve at the rate of 5,000 per min., running loose, with from 4 to 6 chromic acid quart cells? I should like it to be, if possible, 4in. long and about 2½in. or 3in. dia., and work well with two quart cells and full power with four or six cells.—J. H. G.

[60303.]—**Captive Balloons.** — Under the above heading, I noticed a paragraph by Eric S. Bruce (25657, April 30th), in which he says that a huge captive signalling balloon was to be exhibited at the Crystal Palace during the whole of the summer season, commencing from July 1st, and that it should be illuminated at night with the electric light by means of his patent apparatus. I should like to know why the balloon is not let up, because, as far as I know, it only ascended twice, the first being on July 6th, and then not up to the proposed height? I am not sure that the telephonic communication he spoke of was established, but the electric light was not used either times. I am told that it proved to be a failure; and, if so, will Mr. E. S. Bruce kindly inform me of the cause of the failure?—PALACE.

[60304.]—**Circular Valves.**—Will someone kindly give dimensioned sketch of a circular valve and ports for a 20in. cylinder?—TRIANGLE.

[60305.] — **Bending Thin Weldless Steel Tubing.**—Will some brother reader be good enough to instruct me how to do this without flattening the tube, as I am making a tricycle, and cannot manage the bending without spoiling the looks of the tube?—GRATEFUL.

[60306.]—**Photographic Engraving.**—A descriptive appendix on this process, invented by Hy. Fox Talbot, is added to Thomson's "Handbook of Photography." I have carefully followed out every instruction, but the results are not satisfactory. I shall be glad to know of any reasons for my failure. Also if there are any other processes of producing the photographic image upon copper and of etching it wholly by mechanical means?—C. B. ROPER.

[60307.] — **Quantitative Analysis of Silver Alloy.**—I wish to take a wet assay of some electro-plated copper small goods. A fire assay of the goods shows a deposit of silver varying from 1·50 to 3·00 per cent. As there is always a loss of silver in assaying by this method, I wish to check the loss by means of a qualitative analysis of the goods. I have tried the following method: Dissolve 100 grains in nitric acid, evaporate until the solution crystallises on cooling, dissolve in distilled water; heat this solution, and add from a burette a quantity of decinormal solution of sodium chloride. 1. I fail in rendering the mixture of nitrate of copper and of silver neutral to litmus paper. When this solution is evaporated to dryness to dispel the acid, the copper salts will not dissolve in distilled water. If I add a solution of sodium carbonate to neutralise the acid, a pale blue precipitate is thrown down. 2. I fail in throwing down all the silver from the solution of copper nitrate and silver nitrate. Even after a large excess of sodium chloride solution is added, the chromate of potassium indicator shows a quantity of silver left in solution. Will Mr. W. J. Grey, or some other competent analyst, oblige me with advice calculated to lead to success? If so, please give weights and measures in grains.—G. E.

[60308.]—**Sound Proof Doors.**—Wanted, the best means to prevent sound passing through folding doors from room to room without bricking up.—BETA.

[60309.]—**Legal.**—Some years ago, I advanced a widow £100 on the security of her contingent life interest in her dwelling house, shop, and garden, the property being of a long leasehold tenure, with no head rent. The contingency referred to is that by the terms of her late husband's will, under which she holds the property, should she marry again, the property goes to her daughter. Now the daughter has married an unprincipled man, and he has written to me offering £30 if I will relinquish my charge on house, &c., which they want to sell, threatening, if I refuse, that his mother-in-law will go through form of marriage with some penniless object, whom he will suborn with £5. His excuse for this audacious proposal is that the interest paid has more than equalled the sum advanced. Would such an arrangement destroy my claim? If I could prove (by securing the good offices of the "penniless object" aforesaid) no consummation to the marriage, could I get it annulled? Could I institute proceedings for conspiracy to defraud? Supposing I got the "penniless object" to agree to bringing a suit to annul the marriage, could he do so on the grounds of no consummation, and, if successful, would this reinstate my security? How long a time must elapse after a marriage to bar proceedings for its annulment on any of the foregoing grounds? Would my not being able to personally serve the mortgagor with any proceedings make any difference, as she intends going abroad directly after the form of marriage; her friends to follow directly after settling the business?—SHYLOCK.

[60310.]—**Field Tubes.**—I should be pleased to hear from some reader who has tried the above in small launch boilers—what results they give, and their disadvantages, if any. I have never seen any at work, although I have had plenty of experience with other types of boilers, and I am told they are very easy to fix, the ends having a slight taper, and being simply driven into the tube plate or furnace crown. Also that the circulation is so good that salt and dirty water may be used without their stopping up. If this is so, why are they not more often used? Launch engines, as usually made, look squat and snug, low down in a boat; but it seems to be forgotten that an inch of leverage on the crank is worth several sq. inches on the piston while easing the supply of steam from the boiler and allowing easy firing. The generality of small launches cannot go full speed continuously for any number of miles with the best stoker that ever handled a shovel. As to compounding without condensing, my opinion is not worth much, but I think it is a fact, in many cases, if the big cylinder was unshackled, and the shaft turned by the high-pressure one alone, the speed would result, and perhaps a few turns more. I believe in expansion in one cylinder, and therefore advocate longer strokes, but think the loss from back pressure, friction, and radiation neutralizes any advantage from a separate cylinder, unless a vacuum pull is obtained also. For very small boats, lightness is the great desideratum, and a surface condenser, even if outside the boat, would be better dispensed with by adding a trifle more heating surface in the firebox and raising the pressure 10lb. or 12lb. Of course, when economy of coals is of any account, surface condensation is everything; but a boiler may be kept tolerably clear of salt and deposit by a frequent and judicious blowing down at an expenditure of a little extra fuel. Some years ago, I saw an account, in an American journal, I believe, of small boats having very light steam generators. Spray was pumped through a hot tube and raised into steam quickly, fresh water being a *sine qua non.* If not working in clear water, the exhaust had to be condensed and returned again and again. Does anyone know anything about these? Many would be glad to know of something light enough to be hauled on a yard when not in use. Anything with steam in it, no matter how small, must be left afloat; and in a tidal river when left to the tender mercies of bargemen and other frequenters of large rivers, leaves very much to be desired.—TUBE PLATES.

[60311.]—**Slide-rest.**—In taking light finishing cuts on metal—an iron rod, for instance,—I am often bothered by ribbed markings, which wind screw-fashion along the whole length of the work, being, in fact, a faint copy of the screw of the upper slide. Sometimes the little ribs are palpable to the touch; at other times you have to hold the work up endways to the light to see them at all. I have tried tightening and loosening the screws of the loose V in a variety of ways, but cannot hit upon anything that is quite reliable as a cure. Will some kind reader, who is up in lathe matters, tell me what is in fault, and, if possible suggest a remedy? My lathe is a 5in. Britannia Co.'s.—W. A. S.

[60312.]—**Lubricating Oil (Mineral)**.—Is there any way of discovering the presence of adulteration by chemicals (say alum) other than by chemical analysis—for instance, by spectroscope, or polariscope?—J. B. G.

[60313.]—**Ozone.**—TO MR. S. BOTTONE AND OTHERS. —Kindly inform of best way to make ozone for commercial purpose on the largest possible scale. What apparatus are required, and how much capital is wanted? I have use for ozone if it can be obtained in large quantities at a moderate price. Are there any books on manufacture and use of ozone? I may state that in experimental way I have been successful in making ozone, but can get no further.—ROSE CULTURE.

[60314.]—**Pollak's Battery.**—How is a Pollak's regenerative battery constructed, and is it of great value for lighting purposes?—HOLLAND.

[60315.]—**Salt in Steam Tubes, &c.**—The water used in a 16 H.P. engine contains some salt, which forms a hard coating, 1½in. thick, around the taps and inside the exhaust pipe for heating water. I have tried to burn it off and out of pipe, but cannot do so. Will some reader give a remedy for getting off the salt coating and for totally taking the salt out of the water.—THOMAS PLUNKETT.

[60316.]—**Electric Time Ball.**—TO E. CONRY.—Being also interested in making of time ball (for shop window), I should feel obliged for some suggestion for raising ball, either by electricity or by clock at its basis. Would like it to rise and fall every hour.—WATCHMAKER.

[60317.]—**Specimen Fish.**—Can any reader of "E. M." oblige by giving directions for preserving and stuffing fish?—NO SIG.

[60318.]—**Probability Query for "Alioth."**—If mortality tables make the yearly death-rate of boys of 12 as low as ·005, and if this low rate (which is confined to some two years) were to last for ever, what would be the age to which a boy would have the same chance of living that he has of dying within a second? Also within the minute, or within the hour?—E. L. G.

[60319.]—**Chemical Salts.**—What method is recommended for restoring deliquescent salts which have become moist from exposure to air? For example, NH_4CNS. Should this salt be dried by heat? Will it keep indefinitely in strong solution?—B. A.

[60320.]—**Fossils.**—When in Wales lately, I got some fossil ferns in one of the slate quarries there. The line of cleavage of the slate is at right angles to the bed, and I cannot understand how a complete fern can be found on a piece of thin slate, as the block cannot be split on the line of the bed as originally laid down. Perhaps some of your geological friends can enlighten me.—SPES.

[60321.]—**Mathematical.**—A ship sailing directly towards a harbour in lat. 51° 40′ N., and long. 55° 30′ W., at the rate of ten knots an hour, is found by observation after 12 hours sailing to be in lat. 50° N., long. 57° 49′ W. The estimated place is in lat. 49° 43′ N., long. 52° 15′ W. Find the direction and rate of the current which has acted on it during this time. Also, supposing the same current still to act, find the course she should now steer to reach the harbour, and the time in which she will reach it. What book do you recommend on "Spherical Trigonometry" for a sailor's use?—H. B.

[60322.]—**S.E.R.**—Can any of your readers inform me what brake is used by the S.E.R. on their Granville express, there being only a single hose pipe between the carriages? I am almost sure it is not Smith's vacuum. For what purpose is this brake used? I believe it is only fitted to two of their old single-wheel locos.—viz., Nos. 83 and 85. Are they fitting this brake to any more of their trains besides the Granville express?—G.N.R.

[60323.]—**G.W.R. Engines.**—Can anyone inform me for what purpose the eccentrics are placed outside on G.W.R. loco. No. 9? Is this the only one built, and are any more going to be built?—G.N.R.

[60324.]—**Terrestrial Telescope.**—TO "GARRISON GUNNER," OR OTHERS.—I use a telescope principally for making out flag signals on ships, and should be grateful for any advice as to the most powerful glass for the purpose that would be portable. I use at present a glass 2⅛in. clear aperture, and 42in. long when focussed (not including sunshade). I don't know the power. It is rather unwieldy, on account of its length; but is superior to most cost-guard glasses I have tried. I think the above-named officer once said he had a 3in. glass with a power of 50 or 55. Would he kindly say what length it is when open? I presume 3in. is the largest size that would be portable. Assuming my glass to be a good one, can I do better? Should I gain much by an additional ⅞in. of aperture? About what would be the cost of a good 3in. glass for my purpose?—D. G.

[60325.]—**Polishing Celluloid.**—Artificial ivory, or celluloid, is now extensively used for piano keys. I bought a piano two years ago, the keys of which, though quite white when new, are now quite yellow. I find that if I scrape and glass paper them I remove this yellow stain, leaving them a pure white, equal to when new; but I cannot restore the polish. All the usual means, as used for ivory, have failed. Will some of "ours" kindly help me?—LIFE BOAT.

[60326.]—**Weak Ankle.**—I should be obliged if any gentleman can assist me in the following: A girl, 13 years of age, of rather delicate constitution, has so weak an ankle that the sole of her left foot turns outwards when she walks. I have noticed it coming on for about three months.—J. H. A.

[60327.]—**Electro-Motor.**—Would Mr. Bottone kindly assist me with the following? I wish to construct an electro-motor of 2 H.P., of the Gramme type? What size of forgings shall I require for the fields and armature? Also, what size and quantity of wire, and what current will be required?—J. G.

[60328.]—**Spirit Level.**—Will some of "ours" say how to adjust a spirit level accurately in passing in a new tube?—H. H.

[60329.]—**Fire without Smoke.**—I should be pleased to know if there is any correspondent who can tell me of any article by which I can get a blaze without presence of smoke—that is, a blaze that smoke will not blacken any article I might put before it?—X. Y. Z.

[60330.]—**Engine Filling.**—Can any of "ours" give me information as to the filling used by the painters? Engines from the Glasgow and other loco. works appear to be filled with a mixture of glue and whiting, and I think gold size. I have tried this, and also with dry white lead; but find it blister in rubbing down with water. I wish to know what it is made of, quantities in proportion, manner of using and rubbing down, and any other useful information connected.—COACH PAINTER.

[60331.]—**Signals by Means of Electric Currents of High Potential.**—Would some of your readers kindly inform me if it is possible to communicate by telegraph or telephone through a conductor charged with, say, 100 ampères, at a potential of 250 volts, and, if so, what protection could be employed?—E. C. Y.

[60332.]—**Ferments.**—I want to study the action of ferments. Can any of your readers give the name of some good works on this subject, and also what power of a microscope would be needed and the probable cost?—IGNORAMUS.

[60333.]—**Electro-Motor.**—TO MR. S. BOTTONE.—I am making an electro-motor of about ¼ horse-power to drive a fan. I wish to know the size of wire for magnets and armature. Also the quantity to suit about 2 amperes and 55 volts?—PUZZLED.

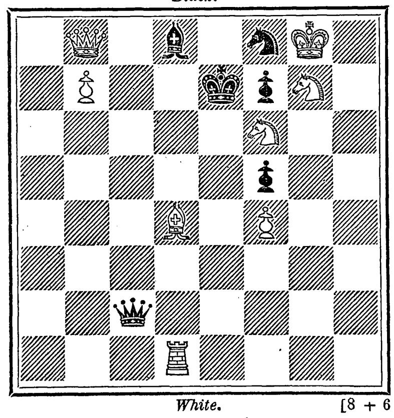
[60334.]—**Falling Bodies.**—At what angle to the horizon do bodies begin to fall, and, in the latitude of London, what is their motion in the first thousandth of a second? How far down, and how far eastward?—E. L. G.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MVII.—BY G. J. SLATER.

Black.



White. [8 + 6

White to play and mate in two moves.

SOLUTION TO 1005.

White.	*Black.*
1. P-K R 5.	1. K-Q 5.
2. Q-B 3 (ch).	2. K takes Q.
3. Kt-Q 5 mate.	

This problem has other solutions, which, the author informs us, can be avoided by removing W B to Q R 6, and the P which is at K R 4 to K R 5; thus making the first move 1. B-Kt 5.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,004, by J. Mackenzie, M. Blackmore, F. W. S., G. T. Stringfellow; to 1,005, W. Rayner, (5), A. Dean, J. Mackenzie, G. A. A., Walker (8), I. M. Brown (2), J. A. M., A. Beginner (2).

C. J. B. (Blackheath).—If in 1,005 1. $\frac{\text{Q-Kt 2}}{\text{Kt-K 6 (ch)}}$

A. DEAN.—If 1. $\frac{\text{Kt-Q 5 (ch)}}{\text{P-B 3}}$, and how does Black mate in two?

J. M.—Your second letter respecting 1,002 came too late.

G. A. A. WALKER.—Thanks for your letter and for slip. We have referred to the solutions to 995, and find you are correct; scoring accordingly.

F. W. S.—How do you mate in 1,004 if 1. $\frac{}{\text{Q checks at B 5,}}$ or Kt 6?

W. R.—Thanks for your letter; a true bill, and something more!

MR. ALFRED E. FLETCHER states, in his latest report as chief inspector under the Alkali, &c., Works Regulation Act, that in one establishment where lead rich in gold and silver is treated, he found, on testing the fume escaping from the chimney, that the value of the metals passing away in this form in a year was £3,000. The larger portion of this escape is now saved by arrangements for causing the fume to settle. In a lead smelting works in Wales, a flue or culvert three miles long has been erected to give the fume an opportunity of settling, yet a considerable quantity finally passes from the top of the chimney into the air. Metallic fumes from copper, zinc, arsenic, and other works also escape. Much of this can now be prevented by electrical means, as explained by Dr. Lodge.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 1, and unacknowledged elsewhere:—

E. P. ALEXANDER.—W. H. P. Scourfield.—Lt.-Col. O'Hara. —Rev. J. Lamont.—King, Mendham, and Co.—Sphere. —Hyperborean.—M. Isader.—J. Low.—Brass.—Inquisitive.—T. Wilson.—A. Craggs.—Pharmacist.—R.—North-Western.—A Fellow of the Royal Astronomical Society. —R. L. Readdie.—B.Sc., Plymouth.—H. D. Taylor.—Triple Valve.

APPRENTICE. (See indices. An ink is made from logwood and sulphate of iron; but it is usual to add some galls. The other ink mentioned has, we believe, bichromate of potash in its composition.)—PIPE-MENDER. (Ordinary pins or the spelter sold at the shops. See indices.)—LONDONER. (If the matter is "perfectly clear and simple," procure the forms at any law stationer's, and fill them up. There is no "red tape" about it. The "Rules" published at the Patent Office, price sixpence, contain all necessary information.)—RELIEF SIGNALMAN. (Langdon's "Application of Electricity to Railway Working," Macmillan and Co., is a work that will probably suit.)—H. B. (See indices.)—BRASS. (Fully explained recently. See No. 1,079, p. 267, or any elementary textbook. It is incorrect to speak of a "current of 6 volts.")—SUFFERER. (It is a matter for personal experiment.)—F. A. (What is known as 21oz. glass will do.)—J. T. S. (For Sundials, see No. 1,058 (p. 394), 924 (p. 316), 933 (p. 525). If you have a dial, and mean only "mount," then you must give details of its construction.)—IGNORANT. (We described and illustrated it on p. 429, as mentioned in the article referred to. It is in No. 1,112, and is there entitled "Maquay's Battery.")—M. D. EWELL, Chicago. (Chambers's "Descriptive Astronomy" is published by the Oxford Press, price 28s. Chambers's "Astronomy" is published by the firm of Chambers, Paternoster-row, or Edinburgh. We do not know price. 2. Latimer Clarke's "Treatise on the Transit Instrument" is published by Spons, who have an establishment in Murray-street, New York. The price here is 5s. He has also a "Manual of the Transit Instrument," published at 1s.) —GEO. H. HEAVEN. (If you cannot refer to back volumes, watch for replies to query 60246, p. 587.)—FRIGA. (The colours for working drawings have been frequently given; but Maxton's "Manual of Engineering Drawing," Lockwood and Co., will suit you.)—BACK PRESSURE. (There are Reynolds's books published by Crosby Lockwood and Co., and Sinclair's "Locomotive Running and Management," an American work, published here by Trübner. See the catalogue of scientific and technical books, which has been compiled by G. Philip and Son, 32, Fleet-street. We do not think, however, that you will find such information as you require.)—TERRA INCOGNITA. (Unsuitable. See a little book entitled "Weather Warnings for Watchers," Houlston and Sons.)—W. SANTO CRIMP. (There is a recipe for dead black in No. 1086, p. 401; but you do not state whether the lacquer is wanted for outside work.)—DIRTY FINGERS. (Take the greasy marks out with benzoline, a bit of blotting-paper, and a warm flat-iron.) —F. C. S. (You want much more than your ten boxwood bobbins, which, in reality are not wanted at all. See the indices.)—H. V. S. AN ENQUIRER. (We do not know how to make a cell of those dimensions; but see No. 1,016, p. 28. Nor do we know how to make a "Lynden jar battery strong enough to drive a small machine." We do suggest a perusal of back numbers or a study of some elementary textbook.)—GWENT. (Perhaps there was a "crush of copy" then. At any rate, the answer was sufficient. The first number of the ENGLISH MECHANIC appeared on March 31, 1865. Vol. XLIII. is just completed.)—ICE (Do not know it under that name; but the ammonia ice-making machine was illustrated in No. 323.)—A. COLLINS. (The ingredients will vary with the district; but ground flint, potter's clay, and

borax are the principal components. Common work is often coated with a glaze made of white lead 53 parts, ground flint 36, flint glass 4, and Cornish stone 16 parts. These are ground up with water, and the glazing is accomplished by heat. To do the best work, it is necessary to make a frit—that is, fuse the ingredients together first, and then grind them up to make the glaze or enamel. See the indices.)—N. W. SMITH. (See No. 958, p. 510, and the indices, but there is no thoroughly effectual remedy.)—CONSTANT READER. (It must be made on a former, using the same materials and in the same manner as for the ordinary bellows work; but of course the materials must be cut taper.)—ELECTRICIAN. (You must line a glass jar with tinfoil outside and in to about two-thirds of the height. The directions have been recently given)—G. H. B. (Say what you mean by indiarubber; pure, vulcanised, or hard? 2. Speeding pulleys has been recently answered.)—LONDON. (No works of the kind yet—that is, none suitable for answering examination questions. Guthrie's "Electricity and Magnetism" (Collins) will suit for the ordinary exam.)—X. (See one of the elementary text-books. Cardew's voltmeter was described in No. 1,016, p. 31. 2. No room for such questions as that about borax, which are fully answered in the cyclopædias. 3, Goodeve's "Mechanics," Molesworth's "Pocketbook," Templeton's "Workshop Companion." See previous answer.)—CARBON PLATE. (How strange you have never seen an answer during all that time! See reply on p. 585 last week, and apply to Mr. G. G. Blackwell, Chapel-street, Liverpool, for his catalogue; it contains much useful information about the Leclanché or manganese cell.)—ANGLO-GRECIAN. (Certainly not easy. Hours longer; wages much less than in this country.) —G. H. T. (Kindly look up the back numbers.)—RELIEF SIGNALMAN. (Not of sufficient interest. Can you not see copies of the returns?)—C. C. T. (Nigrosine is obtainable from dealers in dye-stuffs, and all who sell the aniline dyes. The coloured bottle is to prevent the action of light.)—BLACKING. (It does not become mouldy when properly made.)—ASTRO. (Apply to the hon sec., Mr. W. H. Davies, Irvine-street, Liverpool.)—THOMAS TURNER. (Procure a handbook published by Mr. Eldridge, 54, Murray-street, Hoxton, at 1s. 6d. or 2s.) —ROMAN. (No risk at that temperature.)—IGNORANT GEORDY. (If it is a silver ink it can be done with cyanide. 2. Same manure as is used for onions, and plenty of it.)—SOLAR SYSTEM. (It seems to have been a sort of orrery, but no one can guess how it was arranged without further details. Look up the word "orrery" in a cyclopædia.)—TELEGRAPHIST. (We are not aware that any such posts are open to outsiders. They are usually filled up by the appointment of men who have served in the Royal Engineers. You can, however, apply to the War Office.)—A. THOMPSON. (A number of recipes have been given for japans and varnishes; but it is cheaper to buy than to make, unless they are wanted in large quantities.)—A. Z. (Electric alarms, or alarums, have been frequently described. You may find some useful hints in Vol. XXXVIII. pp. 478, 538; but see the indices generally.)—APPRENTICE. (Try carbolic acid; but it is difficult to suggest a remedy without knowing how the ants come through the floor.)—S. N. D. (How can anyone say what to add, without knowing what the ingredients already are? There are plenty of recipes for harness polish in back numbers. Perhaps you want something which has not yet been invented. 2. What do you mean by "tin polish"? You can but abrade the surface by any of the usual methods—whiting, say; then lacquer if you want to preserve the polish.)—G. L. WATKINSON. (Inadmissible; you are welcome, or anyone else, to criticise Mr. Stretton's facts or statements, but not to impute motives. Whether Mr. Stretton was or was not ever employed by any railway company seems to us altogether beside the question.)—F. W. REYNOLDS, M. R., RAILWAYMAN, AJAX, LANCASHIRE DRIVER, P., KAPPA, W. B. THOMPSON, D. H. SCOURFIELD. (In type.)

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The Meat Consumption of the World.—An economist of repute, Pedro S. Lamas, has summed up the total quantity of meat consumed in the world. There are, he finds, on the surface of the globe 47,500,000 head of cattle and 105,000,000 of sheep. Europe and Algeria provide 25 million of cattle and 50 million sheep; Australia, New Zealand, and the Cape, 2½ million of cattle and 20 of sheep; the United States and Canada, 9,375,000 cattle and 9,750,000 sheep; the Argentine Republic and Uruguay, 6,000,000 cattle and 24,000,000 sheep; and Central America, 4,250,000 cattle and 1,250,000 sheep. Having allowed a percentage for the reproduction of species, M. Lamas fixes the yearly consumption of beef at 7,930,000,000 kilogrammes (each kilogramme about 2 1-5lb.), and of mutton at 10,550,000,000 kilogrammes. Comparing these figures with the populations in the five great groups into which he has divided the cattle and sheep world, he finds that every inhabitant of Plata has 160 kilos of beef and 56 kilos of mutton at his disposal each year; in the United States and Canada it is 23 kilos of beef and 2 of mutton; in Europe it is 15 of beef and 2 of mutton; and in Central America it is 14 of beef and a quarter of kilo of mutton. In the Argentine Republic they eat 60 kilos a head, and export 156; in Australia a similar quantity is consumed and 56 kilos exported; while every citizen of the United States wants 7 kilos of foreign meat to augment the annual consumption of 52 kilos. The average consumption in Europe is 18 kilos per head, and 1 kilo imported. We get 180 million kilos from Australia, 250 from the United States and Canada, and 14 million from Plata. North America, it seems, oversells itself.

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OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Vertical **Engine and Boiler**, on one base, 1 H.P. nearly new, to work with gas burner or coal, Hindley, Maker.—H. CREWE, 16, Montpelier Vale, Blackheath, S.E.

Rhumkorff's Coil, new, ⅜ spark, 700 round carbons, 13 mm. by 12in. long. What offers?—PERCY HUDDLESTON, 74, Rotherhithe New-road, S.E.

Will exchange my 52in. **Bicycle**, cost fourteen guineas, for Tools, Lathe or Organ.—W. B., 20, Coleherne-road, S.W.

4½in. **Screw-cutting Lathe**, 4ft. gap bed, chucks, tools, &c., quite new, for good Tricycle or Safety Bicycle in part exchange.—E. B., 64, Park, Eccles.

Single-barrel **Breechloading Gun**, choke bore, rebound lock, central fire, 12 bore. Will exchange for 2 man-power Engine and Boiler if good, or £3 10s. cash.—F. FOWLER, Haslemere, Surrey.

Wanted, **Lathe** with slide-rest, about 5in. centre—Full particulars of lathe to H. MILLER, 51, Manchester-street, Manchester-square, W., London.

Set of **Carpenter's Planes**, &c. Offers in exchange.—H. B., care of Mrs. WEBBER, Fore-street, Bodmin.

Wanted, "**Spons' Workshop Recipes,**" cheap, good condition.—HODSON, 24, Upper Walhouse-street, Walsall.

Corn Grinder, cost 35s. Will exchange to value of Cloth in plain face cloth. Offers.—Address, H. CULPIN, Hemply House, Marsden, Yorkshire.

Chemical Apparatus, Reagents, and Works on Chemistry, "Knowledge," 204 Nos.; "Science Gossip," 62 parts; "Metal World," 52. What offers?—S. RICE, Harrow, Middlesex.

24 2s. 6d. monthly parts "**Working Drawings** AND DESIGNS OF MECHANICAL ENGINEERING AND MACHINE MAKING," all perfectly clean. What offers?—PORTEOUS, 22, Junction-street, Leith.

Microscopic.—Will exchange first-class Mounts of Whole Insects, select Diatomaceæ, &c., for good Lantern Slides.—W. WHITE, 17, York-street, Nottingham.

2 H.P. **Boiler**, externally fired. Exchange for 1 H.P. Vertical.—BATCH, Creek-road, Deptford.

I have Vols. I. to VII. of "**English Mechanic,**" bound, good condition, complete, clean, &c. Offers.—F. ROBINSON, Noble-buildings, Bridge End, Rastrick, Brighouse.

Small **Electrical Cylinder Machine**, 2 Leyden jars, and other accessories. in case. Exchange Microscope. Offers. Approval.—J. GORDON, 130, Clarendon-place, Dover.

To Brass Finishers.—Will exchange **Foot-Power**, consisting of Flywheel, Driving Wheel, Double Crank Bearings, &c., for Circular Saw, Spindle, and part cash. What offers? Must sell.—37, Bridport-place, New North-road, Hoxton.

Wimshurst Electrical Machine, 5in. spark. May be seen working any evening. Will exchange for Stock, Dies, and Taps, from ¼in., or offers.—H. HOWELL, 61, High-street, Peckham, London.

Harmonium, by Gilbert L. Bauer, one set reeds, excellent tone, good as new. Exchange for Foot Lathe, with slide-rest, or good Telescope, with cash, or what offers.—SAMUEL FERRELL, Gulval, Penzance.

Motor for driving pleasure boat. Motor, propeller, rudder combined, and powerful Battery, £5 10s., or exchange for Safety Bicycle.—H. JONES, 48, High-street, Lambeth, S.E.

Diamond Drills for china, glass, stone, &c. Diamond Turning Tools. Stamp for reply.—C. BLANCHARD, 29, Earl-street, Lisson-grove, London.

Tricycle, Coventry, 2-track, 50in. wheels, double-steerer, good condition. Offers in exchange.—FORD, 75, St. Paul's-road, Camden, N.W.

Combined **Lathe, Fretwork and Circular**, iron bed on iron standards, with chucks, turning tools, 2 circular saws on spindles, adjustable table for inlaid work. What offers?—TURNER, 1, Gainsboro Cottages, South Hackney.

36in. **Facile Bicycle**, ball bearings, Hancock's non-slipping tyres, dropped handle bars, Humber spring, mud guard, bell. What offers?—TURNER, 1, Gainsboro Cottages, South Hackney.

Good exchange offered for **Plate Glass**, 6ft. and 2ft., or larger (in one or two pieces).—BERNARD GREEN, 7, Mountain-view, Cockermouth.

Six good **Lantern Slides** of Lake District for disposal. What offers to value of 6s.?—BERNARD GREEN, 7, Mountain-view, Cockermouth.

"**Christison on Poisons**" (1829), in good condition. What offers to value of 5s.?—BERNARD GREEN, 7, Mountain-view, Cockermouth.

Wimshurst Influence Electrical Machine, 17in. plates, mahogany stand, 4 to 6in. sparks. Exchange Electro Motor, equal value, or offers.—Mr. DEWHURST, to be left G.P.O. Manchester.

8 complete and 10 incomplete vols. "**English Mechanic,**" and 1 Vol. of "Gardening." Exchange anything useful.—ELEKTRON, 5, Lansdowne-road, Sheffield.

Wanted, pair **Lathe Headstocks**, about 3in., cone bearings. Exchange 12ft. Fishing rod and Tackle.—SMITH, 6, Berne-terrace, Clive-vale, Hastings.

Horizontal Cylinder, brass, well finished, 1½in. diam., with guides, bearings. Will exchange for Magneto Machine.—DUNBAR, 143, Norfolk-street, Glasgow.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

New Illustrated Price List of **Screws, Bolts, and** NUTS for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

Perspective, do you understand? "Knight's Practical Guide," 1s.—SIMPKIN and MARSHALL, or of J. P. KNIGHT, Art Master, Cheltenham.

Mica or Talc.—RICHARD BAKER and CO., 9, Mincing-lane, London.

Hardy's Patent **Safety Benzoline Lamp**, self-lighting, self-extinguishing, and unspillable post free, 1s. 3d.—THISTLETON, Oakham.

Wheel-Cutting to 12 inches diameter in brass only.—CLEGG, 18, Belinda-street, Hunslet, Leeds.

Planing to 12in. by 12in. by 8in. Boring, Turning, Screw-cutting, Slide-rests, &c.—CLEGG, as above.

Tracings heliographically reproduced at from 3s. Mechanics' drawings prepared.—Patent Office, Ashcroft-buildings, Victoria-street, Liverpool.

Patents.—Provisional Protection from £2. Complete from £5.—MANAGER, Patent Office, Ashcroft-buildings, Victoria-street, Liverpool.

Injectors, certain in action, easily fixed, no trouble, suit any boiler, and give perfect satisfaction.—POWELL.

Injectors, 2, 4, and 6 H.P., from 21s. Certain in action, no trouble.—POWELL, Engineer, Tunbridge Wells.

Brass Castings of Model Engines of all classes, in sets or otherwise. These castings are the best in the trade, and have obtained the highest testimonials from amateurs and others in all parts of the United Kingdom for cleanness of moulding, ease in finishing, and correctness of detail and design; being models of engines of modern construction. Boilers supplied of every type to suit the above from stock or to order. Fittings of all kinds, feed pumps, governors, safety valves, steam gauges, water gauges, &c. Comprehensive price list, post free, two stamps.—LUCAS and DAVIES, 21, Charles-street, Hatton-garden, London.

Japanese Bamboo **Fishing Rods**, 6 and 10 joints, 1s. 3d.; 5 joints, 1s.—BRISTOW and CO., Hull.

Lathes, 3in. to 7in. centre, chucks, tools. Illustrated List, 3d.—MILLS, Tintern-street, Sunderland.

Castings, Lathe Heads, Beds, Standards, Wheels, Slide Rests, Chucks, rough or machined. Illustrated List, 3d.—MILLS, Sunderland.

Launch Boilers and Engines up to 6½in. bore. Locomotive Boilers, Engines, Castings supplied. State requirements.—MILLS.

Model Engines, Parts, Tubing, Screws, Castings, rough or bored, turned, fitted, finished. List, 3d.—MILLS, Sunderland.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 10, 1886.

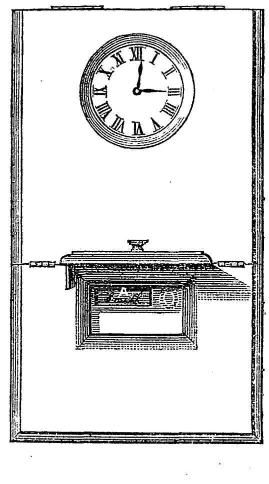
THE ART OF GLASS-BLOWING.*

ALTHOUGH some little knowledge of the art of glass-blowing is nowadays essential to the student of chemistry and physics who desires to succeed in laboratory work, there is, so far as we know, no handbook which gives clearly and with sufficient completeness the details necessary for performing some of the simple operations in producing laboratory apparatus in glass—except the little book which has just been issued by Mr. Shenstone, the lecturer on chemistry in Clifton College. The extraordinary productions of Mr. Gimingham and other skilled workers show what can be done by means of suitable material and the aid of the blowpipe, and it is not too much to say that many of the most interesting researches of the present day have been rendered possible by the glass-blower! In the majority of the textbooks such simple instructions as are required for making a capillary tube or for hermetically sealing a tube may be found; but in none of them will the student find such general instructions as will enable him so to manipulate glass as to produce any desired piece of apparatus he may require—perhaps in a hurry, at all events before he can get it from the workshop of the professional. Mr. Shenstone says that the opportunities of obtaining practical instruction in the art of glass working are so few in this country, and the advantages to be derived from an acquaintance with that art are so considerable to those who are engaged in physical and chemical experiment, that it appears to him a treatise on the subject is likely to be useful. He also says that although there are several amateurs more skilful than himself in glass-working no one has undertaken to write a book which will enable students and others to train themselves in the art, and so render them more independent in designing and constructing apparatus for research and for technical purposes. Even in a work so useful in the laboratory as Weinhold's "Experimental Physics" there is little information about glass-working, although the directions for making other apparatus are sometimes elaborate and invariably sufficient to enable an intelligent youth to prepare most of the articles he requires. Of other works dealing with experimental physics much the same may he said, for they give, if anything, less than Weinhold; while even most of the cyclopædias are silent, so far as the art of glass-blowing is concerned. The kinds of glass used in laboratory work are known commercially as soda glass, lead glass, and hard glass, but their composition varies from time to time, and is not of much importance, so long as the operator can distinguish readily between the three trade varieties. According to Mr. Shenstone, in a true glass there are at least two metallic oxides; but published analyses of different kinds of glass show that it is scarcely a definite mixture, and so far as the purposes of this work are concerned it is immaterial to the operator, for if the specimens he has are not suited to the treatment he will quickly discover the fact. It is well to purchase a considerable stock of tubes at once, and from the manufacturer, for it frequently happens that pieces from the same batch are more readily welded than pieces differing slightly in composition. The commercial apparatus is made in both soda and lead glass, mostly, perhaps, in the latter, and as repairs and additions are often necessary, it is advisable for the worker to provide himself with a supply of both kinds, for soda and lead glass are not readily joined in permanent union. Soda glass is, in some respects, easier to work than lead glass; but it is more apt to crack when cooling, and not unfrequently breaks with sudden changes of temperature. Carefully annealing will, however, remove these objections to a great extent, but not altogether, and therefore, although the cheap soda glass may be employed for most purposes without distrust, Mr. Shenstone advises those who propose to confine their operations to one kind of glass to take the small extra trouble required to learn to work lead glass. Hard glass is used only for apparatus required to withstand great heat, and is therefore difficult to work. According to Mr. Shenstone, tubes for glass-blowing should be as free as posssble from knots, air-bubbles, and stripes; should be in straight pieces of uniform thickness and cylindrical bore. When a sharp transverse scratch is made with a file, and the scratch is touched with a fine point of red hot glass of the same kind as the tube, the crack should pass round, so that the tube may be broken into two pieces with regular ends. If the crack proceeds very irregularly, and especially if it tends to extend along the tube, the glass has been imperfectly annealed, and should not be employed for glass-blowing purposes. Tube which is thin and of small diameter should not crack when suddenly brought into a flame; but large and thick tubes should be held in the warm air near the flame before being tested by actual immersion. In practice, all glass of whatever kind should be warmed up gradually, so that it has become quite hot over a considerable length or area before the flame of the blowpipe or lamp is actually applied. In his first chapter, Mr. Shenstone describes the apparatus and the working place, the latter being of much importance if the greatest measure of success is to obtained. First of all, the work-bench must be in a place perfectly free from draughts, and it must not face a window nor be in too strong a light, which renders the non-luminous flames almost invisible. Many glass-blowers, in fact, prefer to work by gaslight, sitting on a high stool so that they are well over the bench or table; but as that is rather fatiguing, when a long spell of work has to be done, Mr. Shenstone recommends sitting on a chair or low stool at a table of such a height that the elbows can be rested upon it while the hands hold the glass in the flame. As to blowpipes and bellows, the Herapath is the simplest; but we need scarcely say that the intending workers should consult Mr. Fletcher's list, which, as Mr. Shenstone observes, contains "ingenious combinations" besides the standard articles. It is, however, in connection with the practical details that Mr. Shenstone's little manual will be found so useful, for the reader there comes across information that is not generally found in the textbooks. Thus, in working with lead glass, the operator finds that when heated in the brush flame of the ordinary Herapath blowpipe, or within the point of the pointed flame, the surface becomes blackened in consequence of a portion of the lead becoming reduced to the metallic state, and the same thing will happen in bending a piece of lead glass tube if it is made too hot in a luminous flame. Consequently, when it is required to bend or draw out tubes it is advisable to remember that they may be softened sufficiently in a smoky flame; but where it is required to make joints, to form bulbs—in short, in all cases in which it is necessary to thoroughly soften the glass, that can be done without discolouring it by means of a powerful blower supplying a strong and steady blast and a blowpipe giving a clean brush flame. As in most other arts more is learned by a little practice than by any amount of reading; but Mr. Shenstone's little book will bear reading many times—until, in fact, its contents are committed to memory, for it contains just that kind of information which the beginner in glass-blowing requires. Thus he says, for instance, that beginners are apt to raise their glass to a higher temperature than is necessary, and to employ larger flames than are wanted; but the rules are:—Always employ, in the first instance, the smallest flame that is likely to do the work required; and in operations involving the blowing out of viscous glass, attempt to blow the glass at low temperatures before trying higher. Directions for making a variety of apparatus are given by Mr. Shenstone, accompanied by diagrams which render the instructions complete. He gives also a chapter on graduating and calibrating glass apparatus, which will be found very useful to the laboratory worker. In an appendix diagrams showing the chief sizes in which glass tubes are made are given with their trade numbers, so that they can be ordered from the warehouse in lead or soda glass by merely noting the number and the weight required. If Mr. Shenstone would append to these diagrams a table giving the weight per foot of the various sizes he would increase the value of this portion of his very useful work.

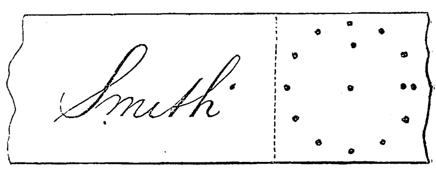
* The Methods of Glass-Blowing for the Use of Physical and Chemical Students. By W. A. SHENSTONE. London: Rivingtons.

MORRIS'S ERGOMETER (WORK-MEASURER).

MECHANICAL contrivances for checking time are no new invention; but Mr. T. Wilson Morris's ergometer, for which letters patent have just been granted, and which is now being shown by Messrs. J. Milne and Sons



at the Edinburgh Exhibition, deserves to supersede or supplement the machines that are at present in use. In every department of industry the importance of punctuality is recognised with increasing clearness, and the machine



which we are about to describe supplies a want that has been long and keenly felt.

The ergometer consists of a polished mahogany box, 17in. long, 9in. wide, and 4in. deep, showing the face of an eight-day lever clock. In front of the dial is a lid (Fig. 1).

The lid being raised a strip of paper is exposed to receive a signature or other entry, and when the lid is closed the time indicated by the dial is recorded opposite the entry (as in Fig. 2). When the lid is again raised the last entry disappears and fresh paper is automatically substituted. Should anyone, after signing, fail to

close the lid, the negligence does not go unpunished, as the time marked would be that at which the lid was next closed—an act which must be performed before paper can be obtained for another signature.

To explain the process in a few words, it will be enough to say that by a step-by-step mechanism the raising of the lid causes a strip of paper (from a roll long enough for over 1,000 entries) to be drawn past the opening A (Fig. 1).

The clock is geared by a train of wheels to a miniature counterpart fitted with steel cones indicating the hours and the extremities of the hour and minute hands. Accordingly, when the lid is closed the points on the miniature dial are impressed on the slip of paper, to the right of the entry. It will be obvious that by this arrangement no strain is put upon the clock, as the requisite power is supplied by the raising and the closing of the lid.

The invention which we have briefly described is not merely a clever piece of mechanism, but an apparatus of general utility. The following points of excellence should not pass unnoticed:—

In tne first place, every employé being required to affix his signature, opportunities for fraud are reduced to a minimum. A man whose ideas of right may be sufficiently lax to enable him to deal with medals other than his own would probably be unwilling to sign a name which did not belong to him, even supposing that he were endowed with the rare imitative faculty necessary to evade detection. Secondly, the ergometer has this important advantage over all previous contrivances—that it requires little preparation and no attention, being constantly ready for use by day or night, and only needing to be wound up once in eight days. It gives a convenient and permanent record of the time of every entry. Thirdly, the machine is compact and portable, hence in building and other trades it will be found most useful in outlying jobs where it could be readily affixed, and the expense of a timekeeper saved. The adaptability of the ergometer to railway signal boxes and to Stock Exchange purposes will be apparent to everyone. In hospitals it might be useful to indicate the due administering of medicine through the night; in the postal department to show the times at which letter boxes are cleared, and by its aid the time might be clearly and automatically printed on every telegraphic despatch.

A NEW PHOTOMETER FOR ESTIMATING PHOTOGRAPHIC EXPOSURES.

THIS instrument is the invention of Mr. H. D. Taylor, of York, and was patented last year, and introduced to the public but recently. The accompanying woodcut is one-half the real size of the instrument, and exhibits its construction. Fig 1 is a longitudinal and vertical section. The instrument consists essentially of a lamp L L L', and of an observing tube T T T'. The inventor makes use of the standard Parliamentary sperm candle as a convenient and portable source of light of sufficient constancy for the purpose in view. The candle is inclosed in the light metal lamp 4 4', and the latter is so arranged that the air feeding the candle flame finds its way into and out of the lamp by devious ways which, at the same time, prevent any exterior light penetrating into the lamp, which is thus rendered light-tight. The lamp is formed of two casings, the inner one (shown white) forming one piece with the tube holding the candle, and the outer one (shown black) forming one piece with the chimney and the short side tube or socket, K K. By grasping and twisting the candle tube the inner casing may be rotated within the outer one, and by so doing either an opening is uncovered in the side of the lamp through which to light the candle, or this opening is closed and a clear way left through which the candle light may fall upon and illuminate a disc of opal glass placed at O, within the tube K K. Provided that the candle is burning properly and the lamp held upright, it is evident that the opal disc O forms an indirect source of light of a practically constant intensity.

A metal slip, S S, perforated with a graduated series of apertures (see Fig. 4) slides through

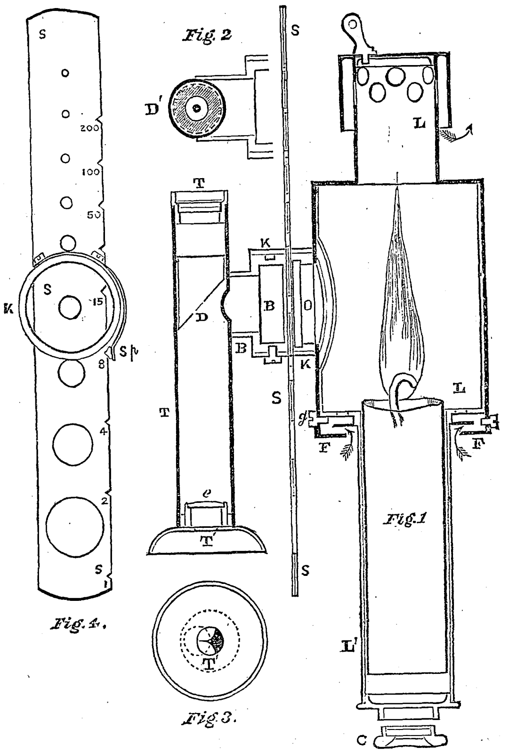


Fig. 4. Fig. 2 Fig. 3. Fig. 1

K K, just in front of the opal disc O. Its purpose is to vary or limit the area of the opal disc O which is allowed to shine into the observing tube T T'. A spring catch Sp. (Fig. 4) detains the slide S S, whenever any one of the apertures comes centrally over O, and the number corresponding to that particular aperture is read off near the point of Sp. Thus, 8 is the reading in Fig. 4.

The apertures in S S are figured or numbered in inverse ratio to their areas, the largest being No. 1, and the aperture which is $\frac{1}{30}$th of the area of No. 1 is numbered 30, and that one $\frac{1}{200}$th of the area of No. 1 is numbered 200, and so on. A hollow socket, B B, rotates stiffly within K K, in front of S S. This socket bears, fixed at right angles to it, the observing tube T T'. A thin metal diaphragm, D, is placed diagonally within T T', just where the light from O shines into T T'. This diaphragm is perforated at its centre by a small hole, and is painted white, in the form of a ring, immediately round this hole. In Fig. 2, D' shows the appearance of the diaphragm D when the white ring is illuminated by O, and viewed from the eye-end T' of the tube T T', in which end is placed a lens (*e*) to enable the eye to view the ring and hole in D with distinctness. The eye end is cupped out well to afford a shield to the eye, and keep out side light from the latter. A cap containing blue glass is screwed into the other end T of the tube T T'. Its purpose is to only allow the visible actinic rays of light to pass through the hole in D from any object to which T T' may be directed. Since T T' is connected by means of the rotating socket B with the lamp 4 4, it follows that if the lamp is held upright, then T T' can be pointed in *any* desired direction, up or down, right or left.

The object of the instrument is to enable the photographer to measure the brightness of the shadows or *darkest visible details* of his subject.

The correct exposure for any subject presenting shadows is that which is just sufficient to imprint on the photographic plate the *darkest visible details* of the subject, while any really blank shadows come out as clear glass in the resulting negative. Any exposure *less* than the above will yield an amount of blank shadow untrue to nature, while any exposure *in excess* of the above is, in most cases, superfluous, and apt to endanger the definition through the increased chance of objects moving, or to over-expose the high lights in subjects, presenting much contrast. Therefore, the proper exposure for a subject is properly determined by the brightness of the darkest visible details. Now, if the candle in the photometer is burning and the lamp held upright and the observing tube T T' is directed towards the darkest visible details of the subject, and the eye placed at the eye-end, then the hole in D will appear as a spot of blue light, more or less bright or faint. It is obvious that this spot of light is the actinic light reaching the eye of the observer from the particular darkest visible details to which T T is directed. This spot of light appears uniform in its brightness, since the lens (*e*) prevents any details being visible, as it throws them out of focus.

The spot of blue light is seen to be surrounded by the white ring illuminated by the opal disc O. Now, if S S is pushed up or down, the brightness of the white ring must vary according to the areas of O exposed by the apertures in S S. When aperture 30 is centrally over O, or, what is the same thing, when the reading of S S is 30, it is evident that the white ring on D is illuminated with just $\frac{1}{30}$th of the intensity with which it would be illuminated, were aperture No. 1 centrally over O (or were the reading of S S only 1). If, now, the white ring can always be made, by means of S S., to appear of the same brightness as the blue spot within it, then the readings of S S obviously furnish an *inverse* measure of the brightness of the blue spot of light, and therefore a *direct* measure of the exposure required to just imprint on the plate those details and that part of the shadows of the subject to which T T' is directed, and from which the spot of blue light emanates. Thus if, on a certain occasion, a photometer reading of 1 is taken from the shadows of a subject and the proper exposure is 3sec., and, on another occasion, a reading of 50 is taken of the shadows, then in this latter case the proper exposure is fifty times what was required in the former instance, or 3sec. by 50sec., or 150secs. In the latter case the details or part of the shadows observed by the photometer are only $\frac{1}{50}$th of the brightness they have in the former instance, and therefore require 50 times as much exposure. If the proper exposure is known for any particular reading of the photometer, then the proper exposures for all other readings are known, since they run in direct ratio to the readings, and the only remaining factor to be allowed for is the size of stop used in the lens used to photograph the view.

The inventor publishes a pamphlet fully describing the construction and use of the instrument, and giving full instructions, in which all calculations involved in its use in conjunction with lenses of varying apertures and stops, are reduced to a simple matter of mental multiplication. These pamphlets may be obtained from the licensee, Mr. Chas. Copeck, 100, New Bond-street, W.

It might be supposed that it would be impossible to balance and equalise the brightness of a

white ring with that of a spot of *blue* light within it; but by a very simple contrivance, not necessary to describe here, the difference of colour between them is made to almost disappear and form no obstacle to their comparison.

With the aid of this instrument, exposures may be made with the utmost confidence in the most deceptive of situations on the dullest days, or after sunset, since its readings embrace in themselves corrections for all those factors, bad light, confined situation, shaded position of shadows, time of day and nature of sky, &c., which combine together to utterly deceive even experienced judgments when unaided by any instrument. Nor can it be said that the photometer interferes in any degree with the artistic judgment of the photographer, for it is evident, that after taking an observation of his subject with it, he is quite at liberty to either under-expose or over-expose as he thinks best. If he is convinced that his picture will come out best artistically if he allows two or three times the *theoretical minimum* exposure (indicated by the photometer), he is perfectly at liberty to allow such increase, while he has the advantage of knowing what he is about; whereas, if he is unaided by the photometer, he is, as a rule, blissfully ignorant as to whether he has given too little or too much exposure, and only learns in what way he has erred—if at all—when the plate is developed and it is too late to expose another plate in case of failure. An observation with the photometer does not occupy more than two minutes after lighting the candle, after which it is immediately extinguished.

It is especially adapted for landscape work, in which the unaided judgment is so very liable to failure.

RECKENZAUN'S IMPROVEMENTS FOR REVERSING ELECTRO-MOTORS.

FIG. 1.

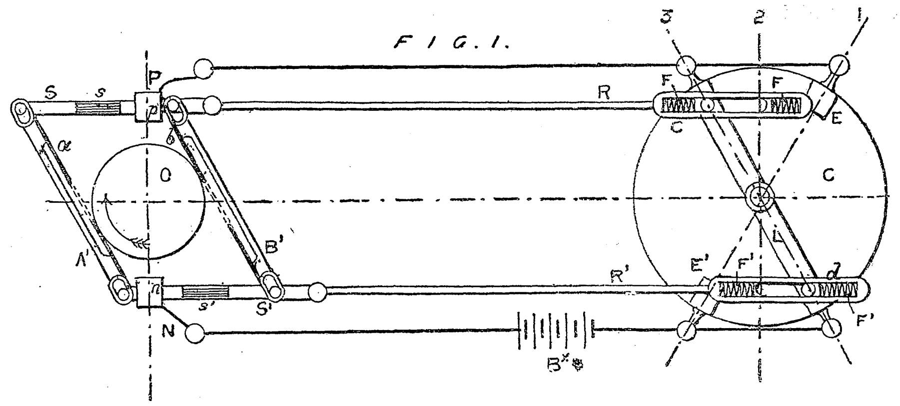
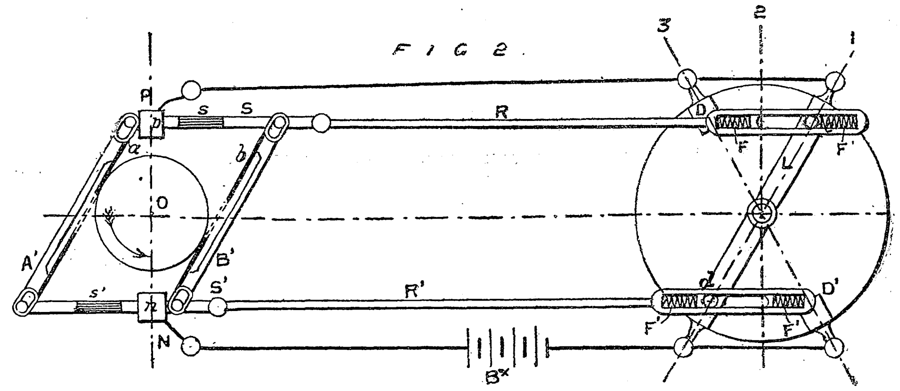


FIG. 2.



THE ingenious manner in which Mr. Reckenzaun has succeeded in effecting the reversal of an electro-motor, just at the moment when no current is passing, is shown in the annexed engraving, which represents the invention as patented. It has been well known, ever since the introduction of electric motors, that the armatures of such machines will rotate right-handed or left-handed according to the position in which the brushes are placed, relatively to the poles of the Field Magnets, and in the Specifications to Letters Patent granted to John Hopkinson, 1879, No. 2411 and No. 4653 there are described means of shifting the position of two pairs of brushes by pivoting the free ends of the same on a pin. If, however, the brushes of a motor are removed from the commutator whilst a current is flowing through the armature, two serious things will happen; firstly, an arc is formed between the receding brush and the nearest commutator segments, thereby damaging the metal surfaces; and secondly, the flow of the current from the generator being suddenly directed into the armature through different points, the currents induced by the sudden make and break have the tendency to destroy the insulation between the adjacent wires, and thus often permanently injure part or whole of the motor circuit. To avoid these objectionable features, Mr. Reckenzaun effects the reversal or the displacement of the brushes, relatively to the commutator, by means of parallel bars, capable of sliding to and fro, in or on fixed slides. Upon these bars he places the brushes, which will approach to or recede from the commutator according to the movement of the bars, which are in plan at right angles to the axis of the armature. In order to prevent the possibility of an untimely reversal, which often occurs in a hurry during excitement on board an electric boat, car, or other vehicle propelled by electricity, or on anything driven by electric motors, he connects the sliding bar or bars by suitable means with the lever of a switch which makes and breaks the main circuit between the motor and the generator. Either the switch lever is provided with an oblong hole, or the reversing bar, or some intermediate link, can be made to have sufficient backlash or freedom of movement or lost motion so that the contact on the switch is broken whilst the brushes of the motor are at rest. By moving the switch handle still further, the brushes are reversed, and finally, by putting the lever to the end of its course, contact is made in the switch to allow the current to flow when the rotation of the armature is the opposite of what it was with the switch lever in its original position. The return movement will of course bring the mechanism back to the first condition. The back lash of the mechanism and an intermediate spring or its equivalent determine the relative motion of the switch handle and the brushes. Fig. 1 shows the position of parts when the motor runs in one direction and Fig. 2 the position of parts when the motor runs in the opposite direction, as indicated by the arrow in each case on the commutator O of a motor of any suitable or usual construction. A^1 and B^1 are the brass or copper backings or holders for the brushes *a* and *b*, which latter thus virtually or electrically are only one brush each, although cut in the middle lest the commutator O should work against the brushes, which if the latter (as is usual) are made of copper wire or sheet copper would, or might, buckle or damage them. The brush holders A^1 and B^1 are, by pins working in oblong slots, jointed to parallel bars S and S^1, capable of sliding to and fro in fixed metal guides, *p* and *n*, and made in parts with insulating pieces *s* and s^1 inserted between. Continuation rods R and R^1, with intermediate springs F F^1 to give the needed elasticity, are jointed to one end of the parallel bars S and S^1 respectively, and form means of connection with the lever L of a switch of ordinary construction which makes and breaks the main circuit between the motor and the generator, there being sufficient lost motion or backlash by pins on the lever L working in oblong holes on the rods R and R^1 so that the contact on the switch is broken whilst the brushes *a* and *b* are at rest. The rods R and R^1 are insulated from the switch lever L. P and N are the terminals of the motor. The switch-disc C is fitted with contact pieces or blocks and binding screws D D^1, and E E^1 and the current from the source B^x passes through them, a circuit being made when the switch lever L is in either of the positions 1 or 3 for working the motor in one direction of revolution or the other, while in the intermediate position 2, and whilst the brushes are at rest, the contact on the switch C is broken. The current of electricity will, in series machines, pass round the field magnet coils, and enter at the binding screws P and N, thence passing to the guides *p* and *n* and through the rods S and S^1 and brushes *a* and *b* to the commutator O With shunt machines the current will pass directly from P and N into *p* and *n* and through the rods S and S^1 and brushes *a* and *b* to the commutator. The arrangement of switch lever for making and breaking the main circuit between the motor and the generator before reversing may also be employed in combination with other reversing arrangements depending on the displacement of the brushes. It will be seen that when the switch lever is moved to reverse the motor the main circuit between the motor and the generator is broken, and the defects which are liable to take place when the brushes are removed from the commutator whilst the current is flowing through are thereby obviated.

COMPOUND LOCOMOTIVES.

THOSE of our readers who are interested in the subject of compound locomotives will, when the Transactions of the Institution of Mechanical Engineers are published, have an opportunity of consulting two remarkable papers, one of which—that of Mr. Alexander Borodin, of Kieff—is almost a volume in itself. Mr. Borodin is connected with one of the Russian railways, and in 1880 altered a locomotive to the compound system adopted by that distinguished advocate of the type, M. Mallet. The cylinders were in the proportion of 1 to 2, and, practically, the locomotive would cost no more to build than one of the ordinary type. The cylinders were jacketed, and, for comparison, one of the locomotives of the usual type was also fitted with jackets. Both engines were tested with experimental trains, and were subsequently jacked up in a shed and used to drive a machine shop. All sorts of experiments seem to have been made with steam at various pressures and with different degrees of cut-off, with steam in the jackets and without. As a result of the trials, Mr. Borodin concludes that with the same expansion of steam the consumption of water and of fuel is less in a compound locomotive than in a simple engine, and as that is the gist of the whole question, it might be considered that it would be better settled by a comparison between locomotives in actual work. As to the question of jacketing, it must be remembered that a very great deal depends upon how the jacketing is done, and it seems clear that in the case of Mr. Borodin's engines the arrangements for draining the jackets were not all that could be desired. However, the following conclusions were arrived at:—When the jackets are not in use, the compound engine gives in comparison with the ordinary engine an economy of 13 per cent. in consumption of steam, and of 24 per cent. in consumption of wood. Admission of steam into the jackets does not sensibly affect the consumption of steam in the ordinary engine; whilst in the

compound engine it produces an injurious effect, and increases the consumption of fuel and water per indicated horse-power. In summing up the results of his inquiries, Mr. Borodin says that: The steam jackets on the ordinary engine, while working in the testing shed in the first and second notches, undoubtedly gave a mean economy of steam of 16 to 13 per cent. In the experimental trains the jackets did not generally give satisfactory results, except when the ordinary engine was working in the first notch; but this must be attributed partly to the losses of steam necessary for warming up the walls of the jackets each time the regulator was opened, and above all to the defective drainage of the jackets, which probably transformed them into condensers. All experience has taught makers—especially of portable engines—that unless jackets are properly drained they are worse than useless, and Mr. Borodin is probably of that opinion; indeed, he said that a better method must be sought for with regard to the compound system. He says that it undoubtedly gave an economy in water and fuel varying from 15 to 20 per cent.; an economy which, if it can be maintained in practical work, will be found of considerable importance in localities where fuel is dear and water scarce and bad. Mr. Sandiford in his paper gave an account of the working of compound locomotives in India, in the shape of data connected with two compounds of different patterns. One of these engines has two cylinders, respectively 18in. and 24in. in diameter, with a stroke of 22in., and an arrangement for admitting steam direct to the low-pressure chest; and that engine worked satisfactorily with a saving of 13½ per cent. of fuel as compared with an ordinary coupled engine having cylinders 16in. by 24in. The other locomotive has four cylinders: two of 11⅝in. outside, and two of 17in. inside, with a 24in. stroke. This pattern heads the list for economy of fuel, although the pressure of steam used (120lb.) is not sufficient in Mr. Sandiford's opinion to develop the full benefit of the compound system. M. Mallet, although he has made other designs, prefers a compound with two cylinders only when the low-pressure cylinder can be made large enough; but where that is impossible it is best in his opinion to have four cylinders. It is not unlikely that the whole question will be discussed fully on a future occasion, as from the nature of the late meeting the actual results shown by Mr. Borodin's tables could not be carefully criticised.

TRACTION AND ADHESION.*

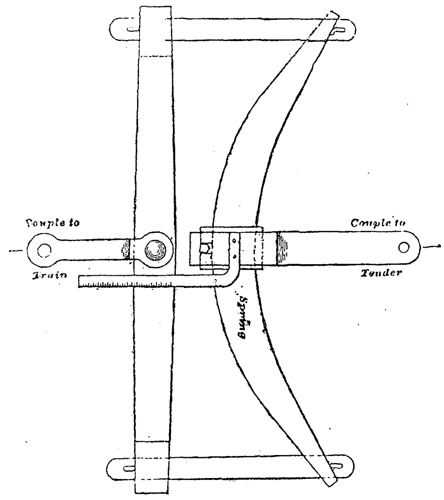
CONSIDERING the number and extent of the researches that have been made on the twin subjects which head this article, is seems strange that so much doubt should still exist as to the amount of friction between a driving wheel and a dry rail. Go into almost any roundhouse, and you may find by conversation with the runners that a large (*i.e.*, too large) proportion of the engines are "slippery," and although every day broken pins and side-rods, flat tires and worn rails swell the bills for "repairs," the same-sized cylinders are put to work on drivers bearing the same weight, and with the exception of the men who are obliged to climb hills with these engines, holding the throttle lever in one hand and sand lever in the other, no one notices this serious defect in design, or experiments with a view of remedying it.

We do, it is true, see once in a while an engine carrying around half or three-quarters of a ton of extra metal in the shape of a heavy deck-plate or cast-iron cab, and once in a while a "traction increaser" kindly relieves the tender of a portion of its load for the benefit of the engine, probably on the principle that "Whoso hath, to him shall be given." These means are all endeavours to atone for a faulty design, and could many realise how easily the proper weight for the drivers, under ordinary conditions for any given size of cylinders, could be fixed on, there would be less work for the wheel lathes.

In order to examine the subject fully, let us first see what traction is; then examine the methods of finding the power exerted on the wheels by the pressure of the steam in the cylinders. And finally I shall give some examples from actual practice that have come under my own observation, and explain a simple method by which master mechanics may, at a very slight expense, find for themselves the power exerted by their engines in hauling their trains, and proportion the loads on the drivers so that sliding and slipping will be reduced to a minimum.

First, What is the tractive power of an engine? The tractive power is its hauling power, or the power by which it is forced in a horizontal direction along the rails, and depends not only on the size of its cylinders, but also on the amount of adhesion of the driving wheels to the rails. As an engine is only as strong as its weakest part, if the wheels slip before the maximum power of the cylinders can be exerted, the excess of cylinder capacity does no more good than if it were not on the engine. Indeed, it is a great disadvantage, as the engine, when working at the longer points of cut-off, must do so on a partially closed throttle; and these points are the very ones where a full throttle opening is imperatively demanded. In the modern locomotive the pressure of the steam on the pistons is communicated by means of rods to the wheels directly. Therefore, friction aside, the work done by the steam in the cylinders must be "given out," we may say, at the circumferences of the driving wheels. As work, mechanically speaking, is the product of a resistance and the distance through which the resistance is overcome, we may ascertain the amount of work done in the cylinders of any engine during one revolution of the drivers by multiplying the pressure required to move the pistons by the distance through which the pistons move in one revolution of the wheels, or four times the length of the stroke.

This amount of work will be exerted at the circumferences of drivers on the rail, and will urge the engine in a horizontal direction along the track, if the wheels don't slip. Since, for any particular case, we wish to know not only the amount of work during one revolution, but also the tractive force which the drivers are exerting on the rail, we may ascertain the latter by remembering that the work done by the steam on the pistons is the same (friction aside) as that done by the drivers on the rail. To make this clear, we may state it in this form:



$$\left.\begin{array}{l}\text{Work done in}\\ \text{cylinders in}\\ \text{one revolution}\end{array}\right\} = \left\{\begin{array}{l}\text{Pressure on pistons by distance}\\ \text{travelled by pistons.}\end{array}\right.$$

which is always equal to

$$\left.\begin{array}{l}\text{Work done by}\\ \text{drivers in}\\ \text{one revolution}\end{array}\right\} = \left\{\begin{array}{l}\text{Resistance to motion of drivers}\\ \text{by distance travelled over by}\\ \text{driver in one revolution.}\end{array}\right.$$

This once understood, we may easily determine the resistance to motion of drivers (which, if the drivers overcome it, will be the tractive force), by dividing the work done in cylinders in one revolution by the distance moved over by drivers in one revolution. This distance is the circumference of the wheel.

Let us apply our rule: Take an engine with cylinders of 17in. bore, 24in. stroke, and drivers 62in. diameter. The area of a piston will be $17 \times 17 \times \cdot7854 = 226\cdot981$ square inches. To get the pressure on a piston, we multiply this product by the mean effective pressure in the cylinder during the stroke. If the steam admitted to the cylinder has a pressure of 135lb. per square inch, and the valve closes after the piston has moved 21in., the mean pressure in the cylinder will be about 127lb. per square inch of the piston; and since there are 226·981 square inches of surface in the face of a piston, the pressure on that face will be $226\cdot981 \times 127 = 28826\cdot587$ on an average throughout the stroke.

This force is exerted through $24 \times 4 = 96$in. during one revolution of the wheels, so the pressure by the distance through which it is exerted, or $28826\cdot587 \times 96 = 2767352\cdot352$ equals the number of inch-pounds of work done in the cylinders during one revolution of the drivers. This work is done, and also given out, during one revolution of the drivers. The circumference of a 62in. wheel equals $62 \times 3\cdot1416 = 194\cdot779$in., and the resistance to motion, or the tractive force, as we have seen, will be equal to the work done in one revolution divided by the circumference of the wheel, or $2767352\cdot352 \div 194\cdot779 = 14207\cdot652$lb.

Let us now compare this tractive power with the figures given by other experimenters for the adhesion of a driver to a dry rail.

On looking over the results of past experiments made by different authorities, we find it difficult to choose a result which we may be sure is nearly right for the use to which we would put it. We wish to load our drivers so that they will not slip when a force to overcome a resistance of 14207·652lb. at the circumference is applied, and yet we are sure that less weight is needed than would seem to be indicated as necessary by the results of some of the experiments. For instance, Poiree, a French experimenter, states that the wheels will just commence to slide at a speed of ten miles per hour if for every ton (of 2240lb.) of load on the wheels a force of 465·9lb. be applied to the circumference, while Westinghouse and Galton give as the results of their experiments under similar conditions 246·4lb. per ton as being sufficient to slip the wheels. Recent experiments conducted by the experimental department of the Pennsylvania Railroad indicate a much higher co-efficient of friction than has yet been supposed to exist, rising, in some cases, as high as 550lb. per ton of load, and, as we shall see, these figures are more nearly correct than the former ones.

I will now give a few figures from actual practice as observed while riding on engines hauling heavy trains over the Northern Pacific Railroad, and show that the figures of Poiree and Westinghouse are, for some cases at least, much too low, and then by means of experiment and comparison of results, we will try to establish a percentage of load for our drivers, which, while not excessive, will decrease the slipping.

These observations were made on the performance of an eight-wheeled engine of the "American" type. Cylinders 17in. diameter, 24in. stroke, drivers 62in. diameter. Weight of engine loaded, 77,800lb. Weight on drivers, 49,700lb. According to the figures of Poiree, which exceed those of Westinghouse, a resistance of 10,333lb. would cause the wheels to slip, whereas this engine actually took a train which, on a straight track, offered a resistance of 12,190lb. up a grade of 40ft. to the mile, and around a sharp reverse curve, with the rails wet with dew, and only slipped once—this being on the curve mentioned above, and the slipping was instantly stopped by the application of a little sand to the rails. On the curve the resistance must have increased to 15,000lb., which would give for the amount required to slip the drivers 670lb. and over per ton of load. Laying supposition aside and taking the resistance of the train on a level track, which we know to be 12,190lb., we see that the load on the drivers was 22·18 tons of 2,240lb. per ton, and that with these 22·18 tons of load the engine overcame the above resistance, therefore it must at least have required

$$\frac{12,190}{22\cdot18} = 545\text{lb.}$$

per ton of load to pull the train, and it did this easily without slipping.

At a future date, if desired, I will add the results of some experiments made with the indicator as a check on the other results; but at present I will be content with suggesting a simple form of traction dynamometer which any master mechanic can rig up for himself in odd moments (if master mechanics have any odd moments), and may find of great service and surprising accuracy, considering the simplicity of design as compared with the expensive and elaborate dynamometer cars, which are fitted up at a cost of thousands of dollars for the purpose of solving such problems as are presented here. The apparatus referred to consists of a driving or other convenient spring having attached to it a graduated metal scale. The amount of deflection of the spring can be measured on any grade and with any weight of train, and the greatest power which the cylinders can exert as well as the resistance at which the drivers begin to slip, can be noted, and the weights on the drivers regulated accordingly.

Do not, however, be content with reading this explanation of the apparatus. Make one, use it. It was from a fear that farther experiments would not be made that I have withheld figures obtained by myself. We are too likely in this age of experiment to accept results of some one's else experiments instead of troubling ourselves to add to the data. Finally, when we find the right load for our drivers, let us apply it. Not in the form of a traction increaser or a heavy sand-box cover or dome-casing, but in boiler space. It is here that so many American engines are deficient. It is here that so much fuel goes to waste by endeavouring to keep a pressure of 140lb. for cylinders that open their huge capacities to be filled with steam four times every revolution.

* By A. B. ROPES, in the *American Machinist.*

BRITISH ASSOCIATION.

THE ADDRESS IN MATHEMATICS AND PHYSICS.

THE address in Section A was delivered by Prof. G. H. Darwin, M.A., F.R.S., F.R.A.S., president of the section, who, after a few preliminary remarks, and a reference to the inadequacy of the denudation theory to give an accurate measure of geological time, proceeded as follows:—

But there is another theory which is precise in its estimate, and which, if acceptable from other points of view, will furnish exactly what is requisite. Mr. Croll claims to prove that great changes of climate must be brought about by astronomical events of which the dates are known or ascertainable ("Climate and Time"). The perturbation of the planets causes a secular variability in the eccentricity of the earth's orbit, and we are able confidently to compute the eccentricity of many thousands of years forward and backward from to-day, although it appears that, in the opinion of Newcomb and Adams, no great reliance can be placed on the values deduced from the formulæ at dates so remote as those of which Mr. Croll speaks. According to Mr. Croll, when the eccentricity of the earth's orbit is at its maximum, that hemisphere which has its winter in aphelion would undergo a glacial period. Now, as the date of great eccentricity is ascertainable, this would explain the great Ice Age and give us its date. The theory has met with a cordial acceptance on many sides, probably to a great extent from the charm of the complete answer it affords to one of the great riddles of geology. Adequate criticism of Mr. Croll's views is a matter of great difficulty on account of the diversity of causes which are said to co-operate in the glaciation. . . . . Now, there is one result of Mr. Croll's theory which should afford almost a crucial test of its acceptability. In consequence of the precession of the equinoxes the conditions producing glaciation in one hemisphere must be transferred to the other every 10,000 years. If there is good geological evidence that this has actually been the case, we should allow very great weight to the astronomical theory, notwithstanding the difficulties in its way.

[Prof. Darwin here alluded to the views of Wallace in "Island Life," and to suggestions made by other thinkers; but we have space only for an abstract of his interesting address.]

When looking at the astronomical theory of geological climate as a whole, one cannot but admire the symmetry and beauty of the scheme, and nourish a hope that it may be true; but the mental satisfaction derived from our survey must not blind us to the doubts and difficulties with which it is surrounded.

And now let us turn to some other theories bearing on this important point of geological time. Amongst the many transcendent services rendered to science by Sir William Thomson, it is not the least that he has turned the searching light of the theory of energy on to the science of geology. Geologists have thus been taught that the truth must lie between the cataclysms of the old geologists and the uniformitarianism of forty years ago. It is now generally believed that we must look for a greater intensity of geologic action in the remote past, and that the duration of the geologic ages, however little we may be able mentally to grasp their greatness, must bear about the same relation to the numbers which were written down in the older treatises on geology, as the life of an ordinary man does to the age of Methuselah.

The arguments which Sir William Thomson has adduced in limitation of geological time are of three kinds. I shall refer first to that which has been called the argument from tidal friction; but before stating the argument itself it will be convenient to speak of the data on which the numerical results are based. Since water is not frictionless, tidal oscillations must be subject to friction, and this is evidenced by the delay of twenty-four to thirty-six hours which is found to occur between full and change of moon and spring-tide. An inevitable result of this friction is that the diurnal rotation of the earth must be slowly retarded, and that we who accept the earth as our timekeeper must accuse the moon of a secular acceleration of her motion round the earth, which cannot be otherwise explained. It is generally admitted by astronomers that there actually is such an unexplained secular acceleration of the moon's mean motion. No passage in Thomson and Tait's "Natural Philosophy" has excited more general interest than that in which Adams is quoted as showing that, *with a certain value for the secular acceleration*, the earth must in a century fall behind a perfect chronometer, set and rated at the beginning of the century, by twenty-two seconds. Unfortunately, this passage in the first edition gave an erroneous complexion to Adams's opinion, and being quoted without a statement of the premises, has been used in popular astronomy as an authority for establishing the statement that the earth is actually a false timekeeper to the precise amount specified.

In the second edition (in the editing of which I took part) this passage has been re-written, and it is shown that Newcomb's estimate of the secular acceleration only gives about one-third of the retardation of the earth's rotation, which resulted from Adams's value. The last sentence of the paragraph here runs as follows:—"It is proper to add that Adams lays but little stress on the actual numerical values which have been used in this computation, and is of opinion that the amount of tidal retardation of the earth's rotation is quite uncertain." Thus, in the opinion of our great physical astronomer, a datum is still wanting for the determination of a limit to geological time, according to Thomson's argument.

However, subject to this uncertainty, with the values used by Adams in his computation, and with the assumption that the rate of tidal friction has remained constant, then a thousand million years ago the earth was rotating twice as fast as at present.

In an interesting discussion on subaërial denudation Croll has concluded that nearly one mile may have been worn off the equator during the past 12,000,000 years, if the rate of denudation all along the equator be equal to that of the basin of the Ganges ("Climate and Time," 1885, p. 336). Now, since the equatorial protuberance of the earth when the ellipticity is $\frac{1}{230}$ is fourteen miles greater than when it is $\frac{1}{300}$, it follows that 170,000,000 years would suffice to wear down the surface to the equilibrium figure. Now, let these numbers be halved or largely reduced, and the conclusion remains that denudation would suffice to obliterate external evidence of some early excess of ellipticity. If such external evidence be gone, we must rely on the incompatibility of the known value of the precessional constant with an ellipticity of internal strata of equal density greater than that appropriate to the actual ellipticity of the surface. Might there not be a considerable excess of internal ellipticity without our being cognisant of the fact astronomically? And, further, have we any right to feel so confident of the internal structure of the earth as to be able to allege that the earth would not through its whole mass adjust itself almost completely to the equilibrium figure? Tresca has shown in his admirable memoirs on the flow of solids that when the stresses rise above a certain value the solid becomes plastic, and is brought into what he calls the state of fluidity. I do not know, however, that he determined at what stage the flow ceases when the stresses are gradually diminished. It seems probable, at least, that flow will continue with smaller stresses than were initially necessary to start it. But if this is so, then, when the earth has come to depart both internally and externally from the equilibrium condition, a flow of solid will set in, and will continue until a near approach to the equilibrium condition is attained. When we consider the abundant geological evidence of the plasticity of rock, and of the repeated elevation and subsidence of large areas on the earth's surface, this view appears to me more probable than Sir William Thomson's. On the whole, then, I can neither feel the cogency of the argument from tidal friction itself, nor, accepting it, can I place any reliance on the limits which it assigns to geological history.

The second argument concerning geological time is derived from the secular cooling of the earth. We know in round numbers the rate of increase of temperature, or temperature gradient, in borings and mines, and the conductivity of rock. These data enable us to compute how long ago the surface must have had the temperature of melting rock, and when it must have been too hot for vegetable and animal life.

The present argument as to the date of the consolidation of the earth reposes on the hypothesis that the earth is simply a cooling globe, and there are reasons why this may not be the case. The solidification of the earth probably began from the middle and spread to the surface. Now, is it not possible, if not probable, that, after a firm crust had been formed, the upper portion still retained some degree of viscosity? If the interior be viscous, some tidal oscillations must take place in it, and, these being subject to friction, heat must be generated in the viscous portion; moreover, the diurnal rotation of the earth must be retarded. . . . . Now, if this amount of heat, or any sensible fraction of it, was actually generated within a few hundred miles of the earth's surface, the temperature gradient in the earth must be largely dne to it, instead of to the primitive heat of the mass. Such an hypothesis precludes the assumption that the earth is simply a cooling mass, and would greatly prolong the possible extension of geological time. It must be observed that this view is not acceptable unless we admit that the earth can adjust itself to the equilibrium figure adapted to its rotation.

It seems also worthy of suggestion that our data for the average gradient of temperature may be somewhat fallacious. Recent observations (*Challenger* Expedition) show that the lower stratum of the ocean is occupied by water at near freezing temperature, whilst the mean annual temperature of the earth's surface, where the borings have been made, must be at least 30° higher. It does not then seem impossible that the mean temperature gradient for the whole earth should differ sensibly from the mean gradient in the borings already made.

The foregoing remarks have not been made with a view of showing Sir William Thomson's argument from the cooling of the earth to be erroneous, but rather to maintain the scientific justice of assigning limits of uncertainty at the very least as wide as those given by him. Prof. Tait ("Recent Advances in Physical Science," 1885) cuts the limit down to 10,000,000 years; he may be right, but the uncertainties of the case are far too great to justify us in accepting such a narrowing of the conclusion.

The third line of argument by which a superior limit is sought for the age of the solar system appears by far the strongest. This argument depends on the amount of radiant energy which can have been given out by the sun. The amount of work done in the concentration of the sun from a condition of infinite dispersion may be computed with some accuracy, and we have at least a rough idea of the rate of the sun's radiation. From these data Sir William Thomson concludes (Thomson and Tait, "Natural Philosophy," Appendix E):—"It seems, therefore, on the whole most probable that the sun has not illuminated the earth for 100,000,000 years, and almost certain that he has not done so for 500,000,000 years. As for the future, we may say, with equal certainty, that inhabitants of the earth cannot continue to enjoy the light and heat essential to their life for many million years longer unless sources now unknown to us are prepared in the great storehouse of creation."

This result is based on the value assigned by Pouillet and Herschel to the sun's radiation. Langley has recently made a fresh determination, which exceeds Pouillet's in the proportion of eight to five. With Langley's value Thomson's estimate of time would have to be reduced by the factor five-eighths. It has been suggested by Croll that the primitive solar nebula may have been hot. This heat must have arisen from the collision of two or more masses; if their relative velocity before collision was that due simply to their mutual attraction, the heat so generated is already counted in the heat so generated by the concentration of the sun from a state of infinite dispersion. But if the relative velocity existed otherwise than from their mutual attraction, then the total heat in the sun might exceed that due simply to concentration. Sir William Thomson considers the hypothesis very improbable. The term improbability seems, however, almost to lose its meaning in these speculations, and at least we know by the spectroscope that actual nebulæ do consist of incandescent gases. In considering these three arguments I have adduced some reasons against the validity of the first argument, and have endeavoured to show that there are elements of uncertainty surrounding the other two; nevertheless they undoubtedly constitute a contribution of the first importance to physical geology. Whilst then we may protest against the precision with which Prof. Tait seeks to deduce results from them, we are fully justified in following Sir William Thomson, who says that "the existing state of things on the earth, life on the earth, all geological history showing continuity of life, must be limited within some such period of past time as 100,000,000 years." At present our knowledge of a definite limit to geological time has so little precision, that we should do wrong to summarily reject any theories which appear to demand longer periods of time than those which now appear allowable.

THE ADDRESS IN CHEMISTRY.

The address in Section B was delivered by Mr. W. Crookes, F.R.S., president of the section, who took for his subject the foundations of chemistry as a science, or the nature and probable origin of the elements. It was a valuable contribution to the study of an idea which has occurred to many distinguished workers, even so far back as Roger Bacon, and was supported by some account of the spectroscopic investigations which Mr. Crookes has been making. It is almost impossible to give even an abstract of this lengthy address; but the following is the summary:—

A genesis of the elements such as is here sketched out would not be confined to our little solar system, but would probably follow the same general sequence of events in every centre of energy now visible as a star. Before the birth of atoms to gravitate towards one another, no pressure could be exercised; but at the outskirts of the fire-mist sphere, within which all is *protyle* (προ, earlier than; ὕλη, the stuff of which things are made)—at the shell on which the tremendous forces involved

in the birth of a chemical element exert full sway—the fierce heat would be accompanied by gravitation sufficient to keep the newly-born elements from flying off into space. As temperature increases expansion and molecular motion increase, molecules tend to fly asunder, and their chemical affinities become deadened; but the enormous pressure of the gravitation of the mass of atomic matter outside what I may for brevity call the birth-shell would counteract this action of heat. Beyond this birth-shell would be a space in which no chemical action could take place, owing to the temperature there being above what is called the dissociation point for compounds. In this space the lion and the lamb would lie down together; phosphorus and oxygen would mix without union; hydrogen and chlorine would show no tendency to closer bonds; and even fluorine, that energetic gas which chemists have only isolated within the last month or two, would float about free and uncombined. Outside this space of free atomic matter would be another shell, in which the formed chemical elements would have cooled down to the combination-point, and the sequence of events so graphically described by Mr. Mattieu Williams in "The Fuel of the Sun" would now take place, culminating in the solid earth and the commencement of geological time. Summing up all the considerations we cannot, indeed, venture to assert positively that our so-called elements have been evolved from one primordial matter; but we may contend that the balance of evidence, I think, fairly weighs in favour of this speculation. This, then, is the intricate question which I have striven to unfold before you, a question that I especially commend to the young generation of chemists, not only as the most interesting, but the most profoundly important, in the entire compass of our science. I say deliberately and advisedly the *most interesting*. The doctrine of evolution, as you well know, has thrown a new light upon and given a new impetus to every department of biology, leading us, may we not hope, to anticipate a corresponding wakening light in the domain of chemistry? I would ask investigators not necessarily either to accept or to reject the hypothesis of chemical evolution, but to treat it as a provisional hypothesis; to keep it in view in their researches, to inquire how far it lends itself to the interpretation of the phenomena observed, and to test experimentally every line of thought which points in this direction. Of the difficulties of this investigation none can be more fully aware than myself. I sincerely hope that this my imperfect attempt may lead some minds to enter upon the study of this fundamental chemical question, and to examine closely and in detail what I, as if amidst the clouds and mists of a far distance, have striven to point out.

THE ADDRESS IN GEOLOGY.

The address in Section C was delivered by Prof. T. G. Bonney, D.Sc., F.R.S., the president of the section, who selected as his subject "The Application of Microscopic Analysis to Discovering the Physical Geography of Bygone Ages." The following is an abstract:—The ultimate aim of geological researches was to obtain answers, in the widest and fullest sense, to these two problems in the history of our globe—the evolution of life upon it, and the evolution of its physical features. In the former a host of labourers, before and since the epoch of Darwin's great book, had been employed in collecting and co-ordinating facts, and in framing hypotheses by scientific induction. In the latter the workers were fewer, but the results obtained were neither small nor unhopeful. In the past generation, men like Godwin-Austen pointed out the principles of work and gathered no small harvest, but in the present the application of the microscope to the investigation of rock structure had facilitated research by furnishing them with an instrument of precision; this, by disclosing the more minute mineral composition and structural peculiarities of rocks, enables them to recognise fragments, and sometimes even to determine the source of the smaller constituents in a composite clastic rock. The microscope, in short, enabled them to declare an identity where formerly only a likeness could be asserted, to augment largely in all cases the probabilities for or against a particular hypothesis, and to substitute in many a demonstration for a conjecture. Every rock in which the constituent particles admitted of recognition and identification might be made to bear its part in the work of deciphering the past history of the globe. Where the constituents had been derived from other rocks they obtained some clue to the nature of the earth's crust at that epoch; where the locality whence a fragment was broken could be discovered, the nature, strength, and direction of the agents of transport could be inferred—some idea as to the structure and surface contour of the earth in that district, and at that time, could be formed; and thus the petrologist, by patient and cautious induction, might in process of time build up from these scattered fragments the long-vanished features of the pre-historic earth, with a certainty hardly less than that of the palæontologist when he bid the dry bones l[illegible] and re-people land and sea with long-vanished races. The latter study was in vigorous maturity, the former still in its infancy; so much wider then was the field, so much more fascinating, to many minds, was the investigation. It was at present hardly safe to attempt to trace the exact land boundaries of the Cambrian Ocean, but the enormous masses of Archæan material entombed in the earlier Palæozoic strata of Wales and the North-West of Scotland could only be explained by the proximity of a great continental land—an extension of the present Scandinavian Peninsula, which had a general slope towards the south-east, the main watershed of which might have lain some distance to the west of the outer Hebrides. Possibly the comparatively rapid deepening of the Atlantic beyond the 100 fathom line may have had some relation to the western outline of this primæval Atlantis. But even over the more central parts of Great Britain there could not have been deep or open ocean. Great volcanic outbursts appeared to have studded the sea with volcanic islands, and to have added to the hetorogeneous materials from which the sediments were now formed. It was evident that in Silurian times the coast-line had extended southward and eastward. The old red sandstone of Scotland and Wales indicated a yet further continental extension towards the south-east. A great epoch of mountain-making in the Scotch Highlands, which had perhaps been going on at intervals from the beginning to the end of the Silurian period, had now come to an end; the southern uplands had risen up, like a Jura, to the Alps. The Palæozoic land mass continued to extend on its south-eastern flank. The Devonian period introduced them in the greater part of Great Britain to an epoch of limited and exceptional deposits, and of widely prevalent terrestrial conditions. It seemed almost certain that the old red sandstones of Scotland and Wales were of fresh-water origin. In one case, the old red sandstone of North-East Scotland, they might perhaps discern in the Great Glen some indication of the old river course. The Scottish old red sandstones were obviously the detritus of the Highland mountains—then probably a far grander and loftier chain. At this time marine conditions prevailed in the south of England. The sea appeared to have deepened towards the south. Probably the Brito-Scandinavian Peninsula curved round to the east so as to include some part of Brittany. Prof. Bonney then referred to the formation of the carboniferous limestone, and traced briefly the geological history of these islands, and he concluded by saying that the brief sketch he had given might suffice to indicate that in this search for "Atlantis through the microscope" they might find it very near at hand, and might discover analogies, as had been indicated in the president's address, between the two borders of the ocean which severed Europe from America. The facts which he had brought before them had justified, he trusted, his opening remarks as to the rich harvest which yet awaited investigations into the structure of the fragmental rocks. The land of promise stretched far away from beneath their feet, till it seemed to melt into the dim and as yet unknown distance. Not speedily would its riches be exhausted. Their hands would long have vanished, their voices would long have been still, before the work of discovery was ended, and men have reached the shore of that circumfluent ocean which, at least in this life, limits their finite powers.

THE ADDRESS IN BIOLOGY.

The address in Section D was delivered by Mr. W. Carruthers, F.R.S., F.L.S., the president of the section. The following is extracted from it:—The literature of science is of little, if any, value in tracing the history of species and in determining the modification or the persistency of characters which may be essential or accidental to them. If help could be obtained from this quarter botanical inquiry would be specially favoured, for the literature of botany is earlier, and its terms have all along been more exact than in any of her sister sciences. But even the latest descriptions, incorporating as they do the most advanced observations of science and expressed in the most exact terminology, fail to supply the data on which a minute comparison of plants can be instituted. But the means of comparison which we look for in vain in the published literature of science may be found in the collections of dried plants which botanists uave formed for several generations. The local herbaria of our own day represent not only the different species found in a country, but the various forms which occur, together with their distribution. They must supply the most certain materials for the minute comparison at any future epoch of the then existing vegetation with that of our own day. The preservation of dried plants as a help in the study of systematic botany was first employed in the middle of the 16th century. The earliest herbarium of which we have any record is that of John Falconer, an Englishman, who travelled in Italy between 1540 and 1547, and who brought with him to England a collection of dried plants fastened in a book. This was seen by William Turner, our first British botanist, who refers to it in his "Herbal," published in 1551. No collection of English plants is known to exist older than the middle of the 17th century. A volume containing some British and many exotic plants collected in the year 1647 was some years ago acquired by the British Museum. Towards the end of that century great activity was manifested in the collection of plants, not only in our own country, but in every district of the globe visited by travellers. The labours of Ray and Sloane, of Petiver and Plunkenet, are manifest, not only in the works which they published, but in the collections that they made, which were purchased by the country in 1759, when the museum of Sir Hans Sloane became the nucleus of the now extensive collections of the British Museum. The most important of these collections in regard to British plants is the herbarium of Adam Buddle, collected nearly 200 years ago, and containing an extensive series which formed the basis of a British flora that, unhappily for science, was never published, though it still exists in manuscript. Other collections of British plants of the same age, but less complete, supplement those of Buddle. These various materials are in such a state of preservation as to permit of the most careful comparison with living plants, and they show that the two centuries which have elapsed since their collection have not modified in any particular the species contained in them. The early collectors contemplated merely the preservation of a single specimen of each species; consequently the data for an exhaustive comparison of the indigenous flora of Britain at the beginning of last century with that of the present are very imperfect, as compared with those which we shall hand down to our successors for their use. The most important materials, however, for the comparison of former vegetation of a known age with that of our own day have been supplied by the specimens which have been obtained from the tombs of the ancient Egyptians. The recent exploration of unopened tombs belonging to an early period in the history of the Egyptian people has permitted the examination of the plants in a condition which could not have been anticipated. And, happily, the examination of these materials has been made by a botanist who is thoroughly acquainted with the existing flora of Egypt, for Dr. Schweinfurth has for a quarter of a century been exploring the plants of the Nile valley. The plant-remains were included within the mummy wrappings, and, being thus hermetically sealed, have been preserved with scarcely any change. By placing the plants in warm water, Dr. Schweinfurth has succeeded in preparing a series of specimens gathered 4,000 years ago, which are as satisfactory for the purposes of science as any collected at the present day. These specimens consequently supply means for the closest examination and comparison with their living representatives. The colours of the flowers are still present, even the most evanescent, such as the violet of the larkspur and knapweed, and the scarlet of the poppy; the chlorophyll remains in the leaves, and the sugar in the pulp of the raisins. Dr. Schweinfurth has determined no less than 59 species, some of which are represented by the fruits employed as offerings to the dead, others by the flowers and leaves made into garlands, and the remainder by branches on which the body was placed, and which were inclosed within the wrappings. After a further discussion of the character of these remains of the flora of Egypt, Mr. Carruthers referred to the deposits discovered at Cromer, and the remains which exist of pre-glacial flora, and came to the conclusion that the various physical conditions which necessarily affected these species in their diffusion over such large areas of the earth's surface in the course of, say, 250,000 years, should have led to the production of many varieties, but the uniform testimony of the remains of this considerable pre-glacial flora, so far as the materials admit of a comparison, is that no appreciable change has taken place.

THE ADDRESS IN GEOGRAPHY.

The address in Section E was delivered by Major-General Sir F. J. Goldsmid, president of the section, who said:—The place which geography holds among school studies is not that which it ought to hold if its uses were understood and appreciated. Primers and elementary books already published are good enough in their way, but the instruction they contain is not seriously imparted; and it may be that something fitter and more attractive to the beginner could be produced. At present all school books on geography may be said, as a rule, to be consigned to the shelf of secondary subjects; and this is not the treatment which should be reserved for a study of such real magnitude. As a matter of State or public school education the science of geography should, in truth, be elevated, not degraded. In my humble opinion, it should be placed

on a par with classics, mathematics, and history, with each and all of which it has affinity. Undoubtedly there are accomplishments which come, as it were, of themselves, or are the outcome of lightly-sown seeds in the home. These for the most part are rather mechanical than mental, though some may have advocates to claim for them intellectual honour. But a knowledge of geography is not to be so acquired; it will not come, like handwriting, with incidental practice, nor is it to be gained by mere travelling. After dwelling at some length on the deficiencies in geographical teaching in our schools and universities and reviewing the efforts for its improvement made by the Royal Geographical Society, and certain provincial societies, Sir F. Goldsmid advocated the partial fusion under one professor in our universities of the two departments of history and geography, a practice which, till recently, prevailed in France and Germany. The president then gave a long account of the work done by travellers, the particulars of which have been made known during the past year.

THE ADDRESS IN ECONOMIC SCIENCE AND STATISTICS.

The address in Section F, which was presided over by Mr. J. B. Martin, M.A., dealt mainly with political economy as a science, and with statistics in connection with town and country life. Thus Mr. Martin said: We need not despair of the future of political economy, and acquiesce in its relegation to a distant planet, because its teaching, based too often on *à priori* reasoning, and too little on the experience of history, does not always square with the actions of men, warped in their judgment of any particular problem of the day by prejudice or self-interest. May we not claim that political economy has rather taken up wider ground than, as has been said by a recent writer, that it has abandoned many of its outworks. It is no reproach to economic science to have done so, to have recognised as matters within its proper scope considerations that the older economists, concerning themselves with wealth in its narrow sense as the summum bonum, and with the desire for its acquisition as the one mainspring of human action, would have rejected as sentimental or philanthropic. Humanity is many-sided, its units do not lend themselves to grouping or combination with the precision of mathematical symbols, and the experiments of the social philosopher are subject to disturbances unknown in the laboratory of the chemist. It is at this point that the statistical method comes in as an inseparable ally of economic speculation. If the latter has had from time to time, and still has, to assert its position among the sciences, what place shall be assigned to the method, which is only too often assumed to be the mere massing and grouping of figures? It has been said—and the saying is not altogether devoid either of truth or humour—that "statisticians when they meet together devote half their time to discussing the status and dignity of their pursuit, and its precedence of, or subservience to, economics." The vulgar misuse of the word "statistics" has no doubt contributed, in many cases, to ambiguity in its use. The extreme instance need perhaps hardly be mentioned when "statistics" are used simply as equivalent to "figures"; one may read or hear even this expression, "You can prove anything by statistics." To say that you can prove anything by figures is intelligible; just so can you prove anything by a syllogism with a faulty premiss, or that might is right by the law of the stronger. But apart from cases in which false figures do not tell the truth—I do not say false statistics, for to speak of false statistics appears to me to be very nearly a contradiction in terms—there is the much more frequent class of cases in which they do not tell the whole truth.

THE ADDRESS IN MECHANICS.

The address in Section G was delivered by Sir James N. Douglass, M.Inst.C.E., the president of the section. It consisted of an historical account of the erection of lighthouses, and of the development of the use of light vessels, beacons, buoys, &c. The following is extracted from it:—Ancient lighthouses were erected on prominent parts of coasts beyond actual attack by the sea, and in many instances they were at considerable distances from navigable water, and thus, with their feeble and uncertain wood or coal fires, they were far from efficient as aids to mariners. So slow was the development in lighthouse illumination for many centuries, that, so recently as 1822, the last beacon coal fire in this country was replaced by catoptric oil light apparatus at Saint Bees Lighthouse, on the coast of Cumberland. With Winstanley's structure on the Eddystone in 1696 might be said to have commenced the modern engineering efforts "in directing the great sources of power in nature for the use and convenience of man": efforts which, followed up by Rudyerd, Smeaton, the Stevensons, and others, had since been so successful in converting hidden dangers into sources of safety, and insuring the beneficent guidance of the mariner in his trackless path. These works of modern mechanical science were now to be found around all the nautical centres of civilisation and commerce, and were very numerous. During the last century a very considerable increase had occurred in the number of lighthouses and light-vessels on the various coasts of the world, which had been required to meet the rapid growth of commerce. Only during the last twenty-five years could accurate statistical information be obtained, and it was found that in 1860 the total number of coast lights throughout the world did not exceed 1,800, whereas the present number was not much less than 4,000. Japan, which had not a single coast light in 1860, now has 57, eight of which are of the first class. The United Kingdom in 1885 had 655 lighthouses and 72 light-vessels, while the United States, which comes next in order, had 458 and 22 respectively, many light-vessels having been abolished when permanent lighthouses were erected. Concurrently with the enormous increase in the number of coast lights during the last fifty years very great improvements have been effected from time to time in their efficiency. In 1759 Smeaton's lighthouse on the Eddystone was illuminated by twenty-four tallow candles, weighing 2-5lb. each. The intensity of the light of each candle was about 2·8 candle units each; thus the aggregate intensity of radiant light from the twenty-four candles was only about 67 candle units. No optical apparatus, moreover, was used for condensing the radiant light of the candles, and directing it to the surface of the sea. The consumption of tallow was about 3·4lb. per hour; therefore the cost of the light per hour, at the current price of tallow candles, would be about 1s. 6¾d., sufficient to provide a mineral oil light, at the focus of a modern optical apparatus, to produce for the service of the mariner a beam of about 2,400 times the above-mentioned intensity. The introduction of catoptric apparatus for lighthouse illumination appeared to have been first made at Liverpool about 1763, and was the suggestion of William Hutchinson, a master mariner of that port. The invention of Argand, in 1782, of the cylindrical-wick lamp provided a more efficient focal luminary than the flat-wick lamp previously employed, and was soon generally adopted for both fixed and revolving lights. In 1825 the French lighthouse authorities effected another very important improvement in lighthouse illumination by the introduction of the dioptric system of Fresnel in conjunction with the improvements of Arago and Fresnel on the Argand lamp, by the addition of a second, third, and fourth concentric wick. Coal and wood fires, followed by tallow candles and oil, had been referred to as the early lighthouse illuminants. In 1827 coal-gas was introduced at the Troon Lighthouse, Ayrshire, and in 1847 at the Hartlepool Lighthouse, Durham, the latter for the first time in combination with a first-order Fresnel apparatus. The slow progress made with coal-gas in lighthouses, except for small harbour lights where the gas could be obtained in their vicinity, was chiefly due to the great cost incurred in the manufacture of so small a quantity as that required and at an isolated station. After some remarks on buoys, &c., Sir J. Douglass referred to the recent experiments on the use of gas, oil, and electricity for lighthouses, and concluded by asserting that now the relative merits of electricity, gas, and oil had been accurately determined, the investigations of the Trinity House Committee would, for many years to come, furnish to the lighthouse authorities of all maritime nations of the world, and their engineers, valuable data which could not fail to assist largely in the development of lighthouse illumination, and thus tend materially to the present aids to navigation, and to a consequent reduction in the loss of life and property at sea.

THE ADDRESS IN ANTHROPOLOGY.

The address in Section H was delivered by Sir George Campbell, M.P., the president of the section, who said he took for his subject practical rather than scientific anthropology—the study and cultivation of the creature man as he exists, rather than that branch of the subject which sought to inquire into his origin and development. Intensely interesting as were such inquiries, their knowledge on the subject was still very limited, and their progress slow; they had not got hold of the missing link, and scarcely knew whether the flint instruments were the work of man or of some earlier intelligent creature. They were hardly on firm ground until they came to man very much in his present form, and even already divided into the principal varieties which exist to this day. He invited them to approach the subject rather as practical agriculturists dealt with the subject of horses and cattle than as scientists who traced these animals to very ancient prehistoric types. It could hardly be doubted that, in distinguished well-marked types of humanity, the eye was perhaps, after all, the easiest and safest guide. On the other hand, when they came to nicer and more subtle distinctions, especially among the mixed races which occupy most of the world, they must confess that anthropometric science as applied to craniology, &c., gave them results only partially conclusive. So again as regarded other guides to race. It was admitted that language was not always a safe guide, but still it was a very important element in ethnological inquiries, especially among primitive races; and having paid some attention to that his impression was strong that language tests of race were to be found in the few simple elementary words and forms which any observer could easily master and examine, and not in the higher developments of the language, which were generally much intermixed with and influenced by foreign elements. There was another race-guide which required much care and some scientific accuracy, though not of what they should call a properly anthropometric character—he meant laws, customs, and habits. These were at least as persistent as, perhaps more persistent than, language. Among other habits and institutions well worthy of observation were marriage and the family descent, through the female or through the male, the forms of small self-governing communities, and the tenure of land. Animals of nearly allied species seemed to be divided by curiously sharp lines into polygamous and monogamous races, and they had yet to discover to which class man belonged before laws divided the race into two opposite camps in this matter. And what could be more important than to ascertain the effect on the race of modern urban life, of the increased use of meat, of the diminished use of milk, of the enormously increased consumption of tea, of the more constant use of the eyes and the brain, viewing these subjects in their broad general results, rather than from a merely medical point of view? It might be admitted that they were not in a position to begin confident man-culture at once. Much study was first required and much knowledge must be accumulated before they could be confident in practice. The first thing that struck them in man, as compared to all domesticated and even most widely-spread wild animals, was the extremely small variation in man all over the globe. There were differences which seemed large to them, but were extremely small from a more enlarged point of view. How enormous were the differences between different breeds of dogs, horses, and cattle! When they came to man the difference of which they made most was that of colour—a feature which they thought quite trivial in animals. Their skilled eyes recognised variations of human feature, but they were so slight that the inhabitant of another planet would see no more difference than in the countenances of a flock of sheep. In size, compared to other animals, the differences were but slight. Then, as regarded the mind, they had yet to learn that there were very wide differences of mental capacity between different races. Very likely—probably, he might say—there are considerable variations, but they are not so wide as to be apparent without careful and accurate study. With the superficial knowledge they had, no one could say that Europeans, Hindus, Chinese, were born with brains superior or inferior to the other; and even in regard to the negro he did not know that it was yet shown that with equal advantages negro babies might not grow up nearly or quite as intelligent as Europeans. Both the general knowledge they had of humans and the analogy of animals tended to show the great benefit of the crossing of breeds. Using the word English for the Teutonic inhabitants of these islands, one could hardly doubt that the English breed crossed with a dash of Celtic blood produces a better animal than either of the parent races. Witness the people of many parts of Scotland, of Ulster, and he believed he might almost say of Cornwall.

ABSTRACTS OF REPORTS PAPERS, &c.

Standards of Light.

Prof. George Forbes presented the report of the committee on standards of light. The committee had met repeatedly during last summer. It had been proposed in last year's report to carry on experiments on electrical standards in the hope of arriving at an absolute standard of light. One of the first steps was to discover a means of reproducing a definite temperature, and certain experiments were proposed for this purpose. At one of the first meetings of the committee Capt. Abney announced that he had already found a means of doing this in a different manner to that proposed in the committee's report, and depending only upon the change of resistance of the carbon filament. Under these circumstances the committee left this part of the experimental investigation to be reported upon by Capt. Abney. His further researches had, however, led him to believe that the law which he had announced to the committee did not hold with all qualities of carbon filament. He had, however, been engaged upon further experimental researches, which were almost ready for publication, and which had an important

bearing upon the labours of the committee. In last year's report attention was drawn to the value of the Pentane standard of Mr. Vernon Harcourt as a practical reproducible standard, and Mr. Rawson had been since then engaged in a further examination of that standard. Sir James Douglass had also made some experiments which were not quite complete, but had gone so far as to give great promise. Some account of the experiments in that report had been expected by the committee, but the absence of Sir James Douglass on official business had interfered with this. At one of the first meetings of the committee the secretary showed what he had done in the way of improving thermopiles such as it was hoped would be of use in the investigations recommended in last year's report, and he was instructed by the committee to proceed with the construction of the instrument, which had been completed, and was now to be placed before the section and described in a separate paper. The committee requested to be reappointed, with a grant of £25. The instrument is a combination of a thermopile and a galvanometer, and opinions were expressed by Lord Rayleigh, Lord Rosse, and Professor Fitzgerald on it in comparison with the bolometer.

The Action of Glass upon White Light.

Lord Rayleigh gave an address on "The Intensity of Reflection from Glass and Other Surfaces." He explained an apparatus which was intended to measure the amount of light reflected from glass surfaces. The amount of light reflected from a glass surface was compared with the amount transmitted by a black disc perforated with an aperture of known angular magnitude. It was found that the result depended very considerably upon the state of the glass as regards polish, the repolishing greatly aumenting the intensity of the reflected light.

Sir J. Conroy submitted "A Note on Some Observations of the Loss which White Light Suffered in Passing Through Glass." He said the experiments were made to determine the amount of light absorbed by glass, and also the amount reflected at perpendicular incidence. It was thought that by taking plates of the same kind of glass, not of different thickness, both these quantities could be calculated directly from the observations without assuming the truth of the formulæ for reflection. The amount reflected from the first surfaces would be the same, whilst that reflected from the second surfaces of the plates of glass would differ but slightly, since the amount absorbed or scattered by the glass being small, the quantity of light which reached the second surfaces would be nearly the same in all. Hence by determining the amount transmitted by two plates of the same kind of glass differing in thickness only, the amount absorbed or scattered by a thickness of glass equal to the difference between the two plates would be given to a first approximation at least. A photometer was used, and two white surfaces so placed that whilst both were visible to the observer, one only was illuminated by the light from each of the mirrors. The observations were made by determining the distance at which the movable screen had to be placed from the lamp in order that it and the fixed screen might appear equally bright when both were seen distinctly, and when one was seen directly and the other through one of the plates of glass. As the apparent brightness of a surface does not vary with its distance, no connection was needed in this case for the effect produced by the glass. Experiments were made with Messrs. Chance's "lighthouse" and with ordinary dense flint. The refractive indices of the two kinds of glass were: Messrs. Chance's glass, 1·5145; dense flint glass, 1·6330. The percentage amount of light from the first surface was for Messrs. Chance's glass 4·187, and for the flint glass 5·779. Assuming that the same percentage of light is reflected from the second surface, and neglecting the small difference produced in the amount so reflected by the absorption of the glass, of the light thrown upon the surfaces 91·80 per cent. should escape reflection with Messrs. Chance's glass and 88·77 per cent. with flint glass. The thinnest plates of the two kinds of glass transmitted respectively 91·50 and 88·83 per cent. of light, or assuming the truth of the formula and the correctness of the operations there was practically no absorption with these kinds of glass, a supposition which the decrease in the amount of transmitted light as the thickness of the plates increase manifestly contradicted. These experiments appeared to show that with Messrs. Chance's glass about 2·5 per cent. was absorbed or scattered per centimètre, and with the flint glass about 12 per cent. The determinations having been made with gaslight their value would probably be slightly different with daylight. The experiments are still in progress.

Freezing as an Aid to the Sinking of Foundations.

A paper on this subject was read by Mr. O. Reichenbach. After referring to the extended use that has been advantageously made of caissons as a means of founding the supports of bridges at great depths, especially in India over the Sutlej and Ganges, the author referred to the difficulties experienced when, adopting this method, obstructions or boulders are met with far below the surface, or where the piers are finally founded on rock of an uneven surface. Whereas piers have been founded at depths of 140ft. below water level by this method, the pneumatic method, to which preference was given in the case of the St. Louis Bridge, over the Mississippi, is limited in its application to depths of about 120ft. The method of freezing the ground in sinking foundations was patented some years ago by Mr. F. Poetsch, a well having been sunk in this manner as early as 1862. It consists in freezing the water contained in the surrounding ground; and thus providing a watertight lining, which enables the necessary excavations to be carried out without difficulty. Calculations showed that, to take an imaginary case, the freezing of the ground to sink a pier 60 mètres below water level, and 40 mètres below the river bed, and having a base 18 by 8 mètres, would occupy 2,250 hours, and require a cooling effect equivalent to 2,230 cubic mètres (or tons approximately) of ice. About 2,900 cubic mètres of ground would be frozen in the operation.

On the Laffitte Process of Welding Metals.

Mr. William Anderson, M.Inst.C.E., read a paper on this subject, in which he pointed out that in order to make a sound weld it is necessary that the surface of iron should be free from oxide, and that the usual mode of approximating to this condition is to heat to the "welding" heat—about 2,800° F. So high a temperature, however, impairs the quality of iron and, to a far greater extent, of steel. Many qualities of steel cannot be welded. In order to overcome these difficulties, powders, with borax as a basis, are generally employed. With a view to overcome the difficulties experienced in spreading these powders evenly over surfaces, often irregular and of considerable extent, M. Laffitte has invented plates, usually consisting of very pliable wire gauze, on both sides of which the flux, being vitrified, is evenly spread. Paper may also be used as a support, and in the case of small surfaces it is often sufficient to form a sheet of the flux and metal filings agglomerated together. After describing the method of preparing the plates and various modes of applying them, the author mentions that they have a very extensive use in France for all branches of metal work, including fancy ironwork, and in the arsenals, gun factories, and on the railways, &c.

Measurement of an Electric Current.

Prof. James Blyth explained a new form of current-weigher for the absolute measurement of an electric current, which he had devised. The method was by measuring in grammes the electromagnetic force between two parallel circular circuits, each carrying the same current. For convenience of calculation circles had the same radius, and were placed with their planes horizontal. The construction of the instrument was as follows:—A delicate chemical balance is provided, and the scale-pans replaced by two suspended coils of wire. Each of these is made of a single turn of insulated copper wire (No. 16 about) fixed in a groove round the edge of an annular disc of glass or brass of suitable diameter. The disc is made as thin and light as possible consistently with perfect rigidity. By means of two vertical pillars of brass this annulus is attached to a rigid cross-bar of dry wood or vulcanite, in the middle of which is placed a hook for suspending the whole from one end of the balance beam. On each side of the hook, and equally distant from it, two slender rods of brass are secured into the wooden bar, which support two small platinum cups for holding mercury or dilute acid. The position of these cups is so adjusted that when the whole hangs freely the cups are in line with the terminal knife-edge of the balance beam, and have their edges just slightly above its level. The free ends of the insulated wire surrounding the disc, after being firmly tied together for a considerable length and suitably bent, are soldered to the brass supports of the platinum cups, which thus serve as electrodes by means of which a current can be sent through the suspended coil. A precisely similar coil is suspended from the other end of the balance-beam. The speaker then went on to explain the arrangement by means of which a current was led through the suspended coils so as to interfere as little as possible with the sensibility of the balance.

A New Calorimeter.

Mr. T. J. Baker gave a description of a new calorimeter for lecture purposes. The instrument consists of two exactly similar metallic air thermometers, mounted side by side, with their U-shaped thermometer tubes adjacent, so that their indications can be easily compared with each other. The air vessel of each thermometer contains a cylindrical well, in which the substance to be experimented with is immersed. Each well is provided with a discharging tube furnished with a stopcock. The scale common to both thermometers is of milk-glass, divided into 100 equal parts, both above and below zero, and let in to the stand so as to constitute a translucent window which can be illuminated from behind. By means of this instrument many thermal problems can be demonstrated before a large audience.

Girder Bridges.

Mr. W. Shelford, C.E., and Mr. A. H. Shield, C.E., contributed a paper upon "Some Points for Consideration of English Engineers with Reference to the Design of Girder Bridges." The writers affirmed that a general comparison of English, German, and American bridges, with especial reference to the class of work adapted to newly-developed countries, afforded sufficient grounds for the examination of the English practice. This examination was limited in the paper to bridges of moderate span, which, on account of their number, were of greater economic importance. The results of a comparison of typical designs for bridges of 140ft. span were given, and it was stated that the difference between the weight of good designs of the same depth was comparatively small, while the principle that economy was obtained by increasing the depth obtained to an extent which, if recognised in theory by English engineers, had not hitherto found general expression in their practice. This was, however, partly due to external conditions, and it did not appear that there were essential national errors or prejudices in design which were likely to place English engineers at a disadvantage in colonial work. The difference between the position of the designer in America and England was investigated, with the result that, while the advantages of the English system in the interest of security were admitted, it was found to be attended with disadvantages with respect to economy, for which the publication of details of comparative cost of different methods of construction and the adoption of standard sections for rolled iron were suggested as partial remedies. The scientific and commercial interests of engineering called for the abolition of the Board of Trade rules which determined fixed limits of working stress, unless they could be brought into conformity with modern knowledge of the properties of materials and the laws of construction. The objections to their abolition, although it would open the investigation of the subject to private enterprise, were pointed out, and the construction of new rules was suggested; such rules, while preserving the freedom of the engineer in the choice of design and material, and leaving to him the estimation of all those effects of loading a structure which were capable of determination by known methods, should determine for his guidance by coefficients of safety the provision to be made separately for each of the effects which were usually understood to be covered by an arbitrary factor of safety. It was suggested that the construction of such rules would be more worthy of the professional attainments of English engineers, and would be designed to raise the standard of professional knowledge by avoiding the use of fixed coefficients of which the origin and scope were not known to the user, and to encourage good workmanship and the use of materials of a high class by varying the working stress according to the quality of the materials employed. The revival of the Royal Commission of 1847, to effect for wrought iron and steel what was then done for cast iron, was indicated as the best means of obtaining the necessary data for the construction of rules with these objects.

The Nature of Solutions.

Several papers were read having more or less reference to the nature of solutions, amongst which may be noticed the report of a committee consisting of Profs. W. L. Goodwin, and D. H. Marshall, of Queen's University, Kingston, Ontario, read by Prof. Ramsay, in which it was stated that the object of the research was to determine the condition of equilibrium assumed by molecular weights of two salts placed in separate small vessels with a weighed quantity of water. The water is attracted to the salts by the process of invaporation. The salts so far used are sodic, potassic, and lithic chlorides. The salts were carefully dried and washed out in small test tubes. The water was weighed out in a similar tube, and divided between the salts, in the case of sodic and potassic chlorides about half to each, and in the case of sodic and lithic chlorides the greater part to the latter. A little water was always left in its tube, and the three tubes were sealed up in a larger tube. After the water became quite dry the inclosing tube was opened and the three smaller tubes weighed. They were then sealed up again, and examined once more after a certain time. The examination was repeated until it was found that no change took place in the weights of the two tubes containing the salts. Three experiments were made with sodic and potassic chlorides, varying the relative

quantity of water. It was found that sodic chloride invaporates water more powerfully than potassic chloride, and that, at least with small relative quantities of water, the sodic chloride invaporates nearly all, leaving the potassic chloride almost dry. Comparing this with the state of equilibrium assumed by equivalents of caustic soda, caustic potash, and sulphuric acid in solution together, it seems that the force in the first case is of a different nature from that acting in the second. In a fourth experiment the relative quantity of sodic chloride was doubled, with the effect of hastening the completion of invaporation. The sodic chloride took all the water. Three experiments were made with sodic and lithic chlorides, varying the relative quantities of water. With small relative quantity of water the lithic quickly attracted the whole; but, with a largely relative quantity (16 molecules of water to one of each of the salts), the sodic chloride attracts part, showing that here is a limit to the quantity of water which the lithic chloride can hold against the attraction of sodic chloride. The general conclusion is that when the relative quantity of water is small it is not divided between the two salts in the ratio of their attractions for water, but this may be the case with large relative quantities of water.

Prof. Tilden read a paper on "The Nature of Solution." There were two theories held—one that solution arose from chemical combination between the solid and the liquid in which it was dissolved, and the other that it was merely a process of mechanical adhesion. He had studied the thermal phenomena with the object of seeing how far it was true that evolution of heat indicated chemical combination. The majority of solids and nearly all the salts expanded on being melted, but at what point chemical action ceased and mechanial action began he thought it was impossible to say, as the thermal changes and the volume changes were all continuous. He could not formulate a definite statement to explain why salt or sugar dissolves in water. The chief lesson he had learnt was that, practically speaking, they could not distinguish chemical combination from other forms of combination. He was inclined to believe that chemical combination differed in no respect from adhesion or cohesion, except that the atoms come together very much more closely and in a more intimate manner.

Prof. Ramsay read a paper prepared by himself and Dr. Young on "The Nature of Liquids." All liquids, dissociable or stable, showed an increase in the density of their saturated vapours above a certain pressure and temperature, differing of course for each liquid. Some liquids, known to be dissociable into simple molecules, showed an increase both on rise and fall of temperature and pressure, above and below a certain temperature and pressure peculiar to the liquid. It was known that a high temperature favoured dissociation; hence it might be expected that the increase of the density of the saturated vapour universally observed at high temperature should be explicable, not on the hypothesis that such high pressures promote combination, because the corresponding high temperature would be extremely unfavourable to combination, but on the theory that, in spite of the tendency of the high temperature to separate the molecules from each other, they were nevertheless forced into close proximity by the corresponding high pressure. On the other hand, a low temperature was known to favour stability; hence bodies consisting of molecules capable of chemical combination with each other, such as nitrogen, peroxide, and acetic acid, might be expected to give, as they did, evidence of such combination at low temperatures, in spite of the corresponding low pressures. It was impossible to conclude that the same effect should be produced under such totally opposite conditions by the same cause. The molecules of stable liquids exhibited physical attraction, not chemical attraction; the molecules of dissociable liquids exhibited, *qua* liquids, physical attraction, but they also exhibited chemical attraction, inasmuch as they tended to unite in pairs, or perhaps in simple groups.

The Glacial Formations of the Midlands.

Dr. Crosskey read a paper on "The Glacial Formations of the Birmingham District," with which he incorporated a "report on the erratic blocks of England and Wales." The object of the paper was to point out typical sections and indicate the vast problems involved in the glacial geography of the Midland district. With regard to the question as to what are the lowest beds in the Midlands of the glacial age and where is to be found at the base of the masses of clay, sand, and gravel freely scattered over the Midlands, the author mentioned that the best section of the Midland series that had been exposed was at California. At the base was a thick ice-formed clay, with striated blocks, followed by sands and gravels, and a thick upper clay with erratics dropped into it. The California lower boulder clay differed from the Wolverhampton boulder clay. At Wolverhampton Lake, blocks, Scotch granites, with a few flints had been found. It was a distinct type as containing a collection of erratics from several districts. Some of the contorted sands and clays of the district probably were deported at an early period in the glacial epoch, having been subsequently contorted. Passing on to the question of "Are there any glacial beds distinctly referable to the period of glacial subsidence?" he said that marine shells with Arctic species had been found in two localities, at Wellington and Lilleshall, supporting the theory that there must have been a Midland glacial sea. In Icknield-street, Birmingham, the rock was struck and smashed by ice laden with Welsh boulders. Owing to the subsidence of the land, blocks were floated off by the ice starting from the various points of a Birmingham land area. In consequence of the re-elevation of the land, blocks were floated off from various points in the ever-widening land area which was covered with ice during the later period. Rowley Hill, Charnwood Forest, Malvern Hills were centres of dispersion of their rocks.

The Rev. W. Tuckwell read a paper "On the Glacial Erratics of Leicestershire and Warwickshire." He referred at the outset to the evidence of a south-western dispersion of rock from Charnwood. In Stockton, a village midway between Leamington and Rugby, there was a mass of boulder clay containing abundance of Mount Sorrel granite, of so-called gneiss from Charnwood Forest, large decomposed "pockets" of red sandstone, blocks of grey sandstone highly glaciated, Bunter pebbles, flints, carboniferous limestone, and lias rock of a different texture from that native to the district. Lying loose in the village street of Stockton was a fine boulder from Mount Sorrel, glaciated, of nearly two tons weight. This had recently been inclosed and inscribed. After having described Mount Sorrel with the unmistakable character of its hornblendic granite, the author noted the extraordinary profusion of Mount Sorrel erratics as far as Leicester; at Rothley, Thurcaston, and Anstey. "Stone," or "Ston," was a suffix of nearly all the villages along the line. He further mentioned a special stone, the largest found in Leicestershire, near Humberston, estimated at twenty tons, partly imbedded in boulder clay which is filled with Bunter pebbles and rolled slate from Charnwood. Finally, he called attention to the reappearance of Charnwood stones north and south of Coventry, at Eathorpe, six miles south-west of Coventry, at Stockton, completing the evidence of a south-west stream from the Charnwood elevation throughout the two counties.

Striated Pebbles and Boulders in the Punjab Range.

Mr. A. B. Wynne, F.G.S., submitted a paper on "A Faceted and Striated Pebble from the Boulder Beds of the Olive Groups of the Punjab Salt Range." The author described this interesting specimen from the so-called glacial boulder beds of the Olive series immediately underlying and comformable with the Salt Range Eocene limestone, which was found by Dr. H. K. Warth last June, and transmitted to the writer quite recently. It consists of a reddish felsitic rock from the peninsular region of India, and it was inclosed in a group of boulder beds which contain one layer, with transported fossiliferous pebbles, inclosing *Conularia* and other fossils. The specimen, possessing twelve faceted sides, striated in different directions, must have undergone numerous changes of position, and been completely turned over in the process of grinding and polishing; and being only 2in. thick it cannot have been held with greater resistance than that afforded by the superficial 2in. of the ice mass in which it is supposed to have been imbedded or fixed from time to time.

Mr. W. T. Blandford, F.R.S., read "Notes on a Smoothed and Striated Boulder from a Pretertiary Deposit in the Punjab Salt Range," remarking that this block of stone, like that exhibited by Mr. Wynne, was obtained by Dr. Warth at Chel Hill in the Punjab Salt Range. It consists of a purplish-brown porphyry, apparently an altered felspar porphyry. The boulder is subangular, the two principal surfaces being plane, smooth, finely striated, opposite to each other, and nearly, but not quite, parallel. Each of these surfaces is bevelled off on one edge by a number of smaller facets, meeting the principal surface and each other at very obtuse angles. Besides the larger plane surface, there are on one side five smaller smoothed facets, and on the other two, but one in each case is ill-marked, the angle at which it meets the next surface being so obtuse as to be with difficulty recognised. All the smoothed surfaces on one side are striated in the same direction; those on the other side are striated similarly to each other, but diversely to those on the opposite surface of the block. Those surfaces of the block that are not smoothed are somewhat rounded.

The Cambrian Rocks of the Midlands.

Prof. C. Lapworth read a paper on this subject, remarking that about eight miles to the south of Birmingham there rises the remarkable ridge of the Lower Lickey Hills. The core of this ridge is made up of remarkable rock known to geologists as quartzite. By the earlier geologists this rock was believed to be the oldest in the district, but by Sir R. Murchison and his followers it was believed to be a metamorphic rock of Silurian age. It has been discovered, within the last few years, by Prof. Lapworth and Mr. T. Houghton, M.A., F.G.S., that this quartzite is actually of Cambrian age, rising out of the Silurian and resting upon older volcanic rocks of unknown date. The age of the quartzite is demonstrated by further discoveries, originally made by Mr. Lapworth and Mr. Harrison, among the rocks in the neighbourhood of Nuneaton. In the early survey maps of the district the quartzite of Hart's Hill, well known as the chief road metal of the Midlands, together with underlying series of shales, the Stockingford shales, were laid down as the lower part of the local carboniferous system. These observers have demonstrated that the two formations are actually of Upper Cambrian age, the shales containing in abundance the characteristic fossils of that epoch, and being underlaid, like the Lickey quartzite, by a volcanic series of much greater antiquity seen in Caldecote Hill. These fossils give us a means of fixing the exact geological age of the beds. They correspond very closely with those of the Tremadoc slates of Malvern, Wales, and Scandinavia. The carboniferous has also been proved to overlie these old rocks, and these new discoveries enable us to parallel the coal measures of East Warwickshire with those of South Staffordshire, division for division, and render it exceedingly probable that the Staffordshire thick coal is continuous under the red rocks of Sandwell and Hawkesbury. The igneous rocks of Caldecote seem to be parallel with those of the Wrekin and Charnwood. All the remarkable intrusive igneous rocks of this region are now known to be of a date long anterior to the carboniferous age. These new discoveries make it highly probable that the upper carbonian beds of Shropshire, the Wrekin, the Malverns, and Nuneaton were once continuous, and open an entirely new chapter in the history of British geology.

SOAP BUBBLES.

THE Friday evening discourse during the meeting of the British Association was delivered by Prof. Rücker, M.A., F.R.S., who took for his subject "Soap Bubbles." The lecturer commenced by stating that the curious and beautiful phenomena displayed by soap bubbles had, at all events for many centuries, attracted considerable attention. In the Museum of the Louvre in Paris there was an Etruscan vase on which was depicted a group of children blowing bubbles. We thus learned not only that the sport was of considerable antiquity, but that the graceful attitudes of the children engaged in it suggested a fitting theme for artistic treatment alike to the Etruscan potter and to the Royal Academician of to-day. It would be strange if natural phenomena which had attracted such attention should have been passed over by those whose special duty it was to attempt to interpret nature, and as a matter of fact it had not been so. Scientific men had studied bubbles carefully, but in spite of this there were many points connected with them which were too imperfectly understood. The lecturer, therefore, made no apology for the apparent triviality of his subject, and made no attempt to cover the wide ground which the title indicated. He asked the attention of his audience while he dwelt for the most part upon one, and one only, of the most interesting but least studied peculiarities of soap films. He need hardly remind them that the explanations of the colours of soap films was one of the triumphs of the theory of light. That explanation had now become one of the commonplaces of science, and applied not only to soap films, but to other phenomena, such as those to be exhibited by Professor Roberts-Austen next evening. He wished, however, to impress upon his audience at the beginning that the colours of films not only enabled us to measure their thickness, but within certain limits afforded us a very accurate measure of their thickness. The thickest soap films were so thin that it was convenient to employ a very small unit of length in measuring them. He therefore chose the millionth of a millimètre, or the twenty-five millionth part of an inch, and said he would express the magnitudes with which he would have to deal in terms of that unit. The thick soap film displayed no colours, and it might be said that the first tints were seen when its thickness was, in round numbers, two thousand millionths of a millimètre. The colours succeeded one another in regular order, but at last the film became black. According to Newton, the point at which this took place was when the thickness of the film was thirty-six millionths of a millimètre; and thereafter, however thin the film might become, no further change in colour was exhibited. A knowledge of the colours

enabled the skilled observer to study the thickness of the film to within about 1 per cent., but this power failed when the film was either too think to display any colour or so thin that it displayed nothing but the black. In this case, however, as in many others, information became specially difficult to obtain just at the point when it was specially interesting. It was by the study of extremely thin films that we might expect to learn most with regard to the molecular composition of liquids. A liquid was held together by means of attractive forces in play between the particles of which it was composed. A particle within a liquid was surrounded by others upon all sides, and was therefore attracted upwards as well as downwards, to the right as well as to the left. But the particle in the surface had neighbours on one side only, and thus the attraction exerted upon it was on the whole downwards. It followed from this that, since particles in the surface and in the interior were acted upon differently by molecular forces, they would probably be differently arranged among themselves; and since the properties of a body depended not only on its chemical composition, but also on the arrangement of its particles, we should expect that the surface of the liquid would display phenomena of which the interior showed no trace. As a matter of fact it was so, and the liquid must therefore be regarded as consisting of two parts—the interior, throughout which the properties are uniform, and a very thin surface layer, in which the properties are somewhat modified. The soap bubble, therefore, if tolerably thick, must be regarded as composed of an interior and two surface layers. If it became so thin that the interior position drained away and the two surface layers met, we might then expect that it would display some novel phenomena from which instructive information as to the nature of molecular forces might be obtained. Now there was in connection with a film which displayed the black one phenomenon which seemed to show that a limit something like this had been reached. In general the colours of a film faded gradually the one into the other, proving that the thickness changed gradually from point to point. The edge of the black, however, was nearly always a sharp line, and the colour which came next before it was often such as to prove that there was a sudden and very great change of thickness between the black portion of the film and that with which it appeared to be in contact. In some cases the black was at least 55 times thinner than the film which touched it. Bearing these facts in mind, the lecturer and Prof. Ethos Reinold some time ago undertook the study of the black portions of soap films, and the first question which they set themselves to solve was to determine, if possible, what this thickness might be. In order to measure the thickness of the black film, they began by studying the resistance which liquid films offered to the electric current. If the ordinary laws held good in the case of such films, it was to be expected that the resistance would increase in the same proportion as the thickness diminished, so that if the thickness were halved the resistance would be doubled, and so on. There were many difficulties in proving that this law held good; but the experimenters succeeded in showing that it certainly did so as long as the thickness of the film was greater than about 400 millionths of a millimètre. Below that their experiments did not enable them to speak with certainty. It was very evident that if the law held good for greater degrees of tenuity, it would enable them to measure the thickness of a black film by measuring its electrical resistance, for if that resistance were a hundred times greater than that of a film so thick that its colour enabled them to measure its thickness, they would thus know that the thickness of the black film was a hundred times less. Pursuing this method two sets of experiments were made, which gave accordant results. The mean of the first proved that the black had a thickness of 11·9 millionths of a millimètre; the mean of the second that its thickness was 11·7 millionths of a millimètre. As it was very important to make certain that the assumption was really true that the law on which this calculation was based held good for films, the experimenters devised another and an independent way of measuring the thickness of a film by means of optical observation. The mean result was in complete accord with that previously obtained, being 11·5 millionths of a millimètre. It followed, then, that any theory which was to satisfactorily account for the properties of a surface of a liquid must explain, first, the sudden change in thickness at the edge of the black; secondly, the constant thickness of the black itself; and, thirdly, the fact that the thickness of the film in contact with the black might on different occasions be very different. To explain this the lecturer discussed he properties of the surfaces of liquids. He showed in the first place that the viscosity of the surface was often very different from that of the interior, a fact which was illustrated by experiment. He then showed by other experiments the well-known fact that the surface of a liquid is in a state of tension—that is, like a blown-out bladder, which tends to contract. It had generally been supposed that if a film became so thin that all the interior liquid drained away, and the two surface layers began to intermingle, the surface tension would diminish; and many experiments had been made to attempt to obtain indications of this expected decrease in the surface tension. The result of these observations had been to prove that no such change could be detected; but as all such experiments had been made on comparatively thick films the lecturer and Prof. Reinold had recently extended them to the case of films thin enough to show the black. In doing this they had the authority of Maxwell to support the view that much might be learned by such methods as he said in his article on "Capillarity" in the "Encyclopædia Britannica," that measurements of the tension of the film, when drawn out to different degrees of thickness, might possibly lead to an estimate of the range of the molecular forces. The lecturer described the difficulties with which the investigation was beset, but stated that the final result arrived at was that if the black part of the film formed steadily, spreading quietly over the remainder of the surface, no change of surface-tension could be detected, and calculation showed that their experiments would have enabled them with certainty to detect a change of a half per cent. Sometimes, however, the black part of the film formed with great rapidity; and though it was impossible to secure that this state of things should take place at a given time, yet on the few occasions when the experimenters were able to make observations they found that the formation of the black in this way was accompanied by a change of surface-tension. They had further proved a very curious fact—that if an electric current were passed through a soap film it would apparently carry the liquid with it, so that if it was sent up the film it thickened it, and if sent down the film thinned it. By sending the current up a film which was partly black and partly coloured they found that they could obliterate the sharp edge of the black; but that when the current was removed the sharp edge in the course of a few seconds was formed again. The general result of these experiments was to show that when the film was a little thicker than the black there was an unstable thickness which could not permanently last, and that if the film were by means of the current forced to assume that thickness, it immediately on the removal of the current became thicker and thinner, and the thick and thin parts apparently were in direct contact. The forces which produced this change were certainly less than 2 per cent. of the surface-tension, probably less than a half per cent.; and the viscosity of the film permitted the effect of the complete separation of the thick and thin parts to take place in a few seconds. It remained then to explain these facts. Prof. Reinold and the lecturer came to the conclusion that they could best be explained by supposing that when the two surface layers of the film began to intermingle the first effect was—as had generally been supposed—a decrease in the surface-tension; but that this decrease was in turn replaced by an increase, so that there was a minimum of surface-tension for some particular thickness rather greater than that which displayed the black. In this view they were confirmed by Sir William Thomson, who they found had, unknown to them, expressed a similar opinion in a lecture given early in the present year. It remained, then, to explain further why this *minimum* of surface-tension existed, and here the lecturer thought that the true key was to be found in a calculation of Maxwell's given in the article of which he had spoken. Maxwell showed that the surface-tension would increase or decrease according to the relation of the thickness of the film to the distance at which the molecules repelled or attracted one another. If they attracted one another, the surface-tension would fall off as the film became thinner; if they repelled one another the surface-tension would increase. Hence in the sharp edge of the black the lecturer believed that we had experimental evidence, first of a *minimum* of surface-tension, and second of an alteration in the nature of the force in play between the molecules, which had been often assumed in physical investigations, but of which any direct proof was, he believed, wanting. The lecturer concluded by pointing out to the audience that the result to which his investigations had led seemed to afford hope that the state of tenuity might throw further light upon obscure and difficult questions connected with the nature of the forces in play between the particles of which liquids are composed.

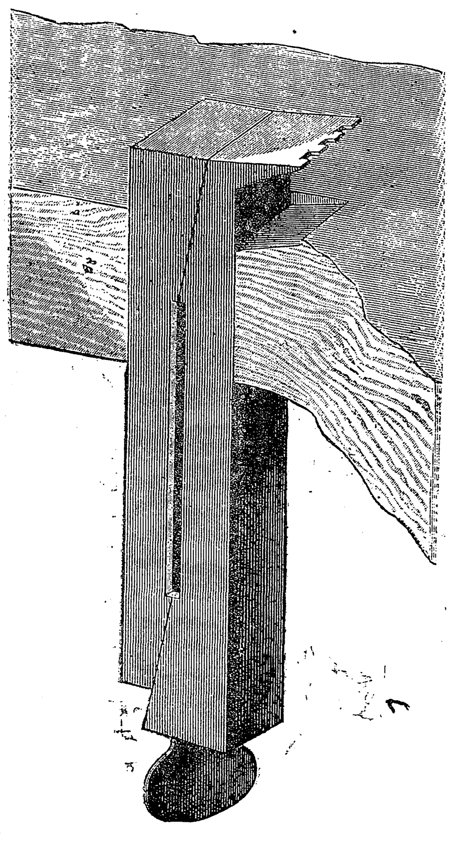
COLOURS OF METALS AND ALLOYS.

THE Saturday evening or popular lecture during the meeting of the British Association was delivered by Prof. W. C. Roberts-Austen in the Town Hall, a large number of the working classes attending. Prof. Roberts-Austen stated that under the title of the lecture he intended to include the consideration of the principal facts connected with the colours of metals and alloys, whether natural to them or produced by metallurgical art, as well as a brief examination of the kind of influence which the colours of metals appear to have exerted on the history of chemical science. With reference to the recognition of colours of metals by the ancients, he referred to the view expressed some years ago by Mr. Gladstone, "that the starting-point is absolute blindness to colour in the primitive man," and he urged that, if this be true, it is strange that in the metalwork or fabrics of savage nations the arrangement of such colours as they can obtain should be so thoroughly "understood," and the colours themselves so discriminatingly employed. Allusion was then made to the ancient belief that the seven metals known to the early chemists were specially connected, as regards colour, with the seven principal planets; to the persistence with which this belief survived, and to the fact that Sir Isaac Newton did not escape the charge of leaning toward mysticism when he stated that seven colours resulted from the decomposition of light by the prism. In relation to the influence of the colour of metals on the history of science, it was pointed out that from the 3rd to the 17th century the colour of gold appeared to haunt men, and induced the alchemists to make the strangest sacrifices, even of life itself, in the attempt to produce it. The alchemists were sustained by the knowledge that the colour of metals could be destroyed by small traces of impurity, and an appeal was made to the argument of even the "sceptical chemist," Robert Boyle, in the 17th century, that transmutation of base to precious metals is possible, because he destroyed the colour of gold, and believed that he had degraded gold to a base metal by the addition of a small quantity of a substance "given him by a stranger"; "it being," as Boyle said, "no small thing to have removed the bounds which nature has industriously set to the alteration of things." In illustration of the apparent degradation of gold by the presence of a small quantity of certain other metals, Prof. Roberts-Austen melted 200 sovereigns, added a tiny shot of lead, and proved that the bar into which the metal was cast was very brittle, and entirely different in colour from the original gold. The dependence of the colours of metals on their physical state of aggregation was then illustrated by some beautiful experiments with leaf-gold and with Faraday's finely-divided gold of bright ruby colour. The lecturer then passed to the effect of colour produced by alloying metals by melting them together. He incidentally said that he had many inducements to speak about brass—in particular he would have liked to dwell upon the beauty of such work as that of the great craftsman (William Austen) who, in 1460, made the magnificent monument in brass to Richard Beauchamp, Earl of Warwick; and he was glad to remember that the first patent for the manufacture of brass in England had been granted to W. Humphrie, an assay master of the Mint, and a predecessor in the office he was privileged to hold—but he did not intend to say much in Birmingham of the coloured alloy of zinc and copper which was its staple industry. His object was to claim the attention of the metal-workers of Birmingham to the coloured alloys of copper with which they were less familiar, and he referred at length to the alloys which had been used for centuries by Japanese Art metal-workers, the images of beautiful specimens of whose handicraft were projected on a screen. Special reference was made to a large plaque of copper inlaid with foliage, which in colour suggested the glories of a Canadian autumn, and it was stated that the addition of small quantities of gold, antimony, and cobalt to metallic copper enabled the Japanese to secure each beautiful shade of colour of purple, golden browns, and reds, for which their art metalwork is so remarkable. In illustration of the effect of various "pickling" solutions on copper, Prof. Roberts-Austen had himself prepared a trophy 7ft. high of richly-coloured leaves. Attention was then directed to the singular banded alloy known as moku-me, the manufacture of which, now almost abandoned by the Japanese, Prof. Roberts Austen is anxious to see introduced into this country; and he projected on the screen the image of a dagger-hilt of old Japanese native workmanship, in which, as a *tour de force*, the artist had reproduced the purple and brown markings of a "scarlet-runner" bean. A brief reference was made to the fact that the electro-metallurgist has at command, in the power of being able to deposit coloured alloys, an equivalent of the varied palette of the decorator; and beautiful specimens of coloured alloys, deposited by Messrs. Elkington's well-known firm, were exhibited. It was incidentally stated that one firm deposited annually six tons of silver in thin films, which, if continuous, would, it had been calculated, cover an area of 140 acres. Prof. Roberts-Austen then showed experimentally, by projection on the screen, the formation of coloured films by heating lead in air, and he claimed that the formation of a coloured calx of lead by heating the metal in air had been more frequently appealed to in support of various sets of views than any other fact in the

history of science, from the time of Geber in the 8th century to that of Priestley in the 18th. This beautiful experiment was of special interest to Birmingham, because, performed in a rougher way, it had directly led Priestley to the discovery of oxygen, and had removed his doubts as to the aërial source of the oxygen he obtained from other substances. Prof. Roberts-Austen concluded with a sentence from Mr. Ruskin's "Modern Painters," as to the right enjoyment of colour, and with a plea for the more careful study and extended adoption of coloured metals and alloys in objects intended for daily use, and for the restricted employment of gold and silver to the legitimate purpose of enriching metallic ornament.

ADJUSTABLE BENCH HOOK.

THIS device is the invention of J. B. Boyce, a practical pattern-maker, of Lockport, N.Y. It is of cheap construction, strong and durable, and



has the appearance of being a very convenient tool. It is easily attached to any wood-worker's bench, it being only necessary to cut through the top a mortise 1½in. square. No part being permanently attached to the bench, the tool is interchangeable in the mortise, and can be reversed, presenting a smooth face to the work, thus preventing marring. No second tool is needed to operate it, a half turn of the thumb-screw serving to either loosen or fasten. It may be removed from the bench and placed with other tools, securing the owner from loss by theft, as is the liability with tools for this purpose when screwed to the bench.—*American Machinist.*

Bakusine.—The patent of Herr Albert Muller (described in the *Chemiker Zeitung*) consists in mixing 100 parts of petroleum or crude naphtha and 25 parts of castor oil, or any other vegetable oil, with 60 to 70 parts of sulphuric acid at 66° B. The whole is well stirred, and is mixed with two or three times its own bulk of water. After standing for some time, the watery layer underneath is removed. The whole is let stand for some days, and is carefully neutralised with soda or potash lye. The lubricant thus produced (known as bakusine) is then packed in casks or cases.

THE late Mr. Samuel J. Tilden left between four and five million dollars for carrying on the work of free libraries in America. The sum is left in the hands of three trustees—Messrs. John Bigelow, Andrew H. Green, and G. W. Smith. After deducting the expense of establishing free public libraries in New Lebanon and Yonkers, the remaining portion of the money will, it is said, be devoted to founding a new public library in New York.

SCIENTIFIC NEWS.

SO far as attendance is concerned, this year's meeting of the British Association may be considered a success, as it may also in the number and importance of the papers read. Next year the Association will meet at Manchester on August 21, under the presidency of Sir Henry E. Roscoe, and it has been decided that Bath shall be the favoured city in 1888. With reference to the invitation from Sydney, New South Wales, that the Association should hold its meeting there in 1888, in January (on account of the difference in the seasons), it was felt that there were great difficulties in the way, but it has been so far decided to overcome them by sending a representative delegation of 40 or 50 members, who will probably meet at Sydney in January, 1888, and perhaps visit Melbourne. The council will, however, report on the matter at the Manchester meeting. The Government of New South Wales has offered to pay all expenses of 40 or 50 representatives of the British Association, and there will obviously be some difficulty in making a list which will meet with the approval of the council.

According to Dr. S. Oppenheim, of Vienna, Brooks's comet III., 1886, has a period of about nine years, but Dr. Hind calculates it at not much, if anything more, than six years and a quarter, so that the comet will return in 1892.

According to a telegram from Grenada, the observations of the corona during the last two eclipses, including that observed in Egypt, have been confirmed by the present. Captain Darwin's observations with the coronograph seem disappointing, the glare of irradiation from the body of the sun, and not the true corona, being visible on his plates. The bright lines seen in the spectra of the prominences are displaced in such a direction as to prove that there is in them a downrush of gas towards the sun. The curious prolongation of the corona observed on several previous occasions to occupy the sun's equatorial plane does not appear in any of the photographs taken, though it was visible at all the stations except Mr. Lockyer's.

The death is announced of M. Laguerre, Professor of Mathematical Physics in the College of France, at the early age of fifty-two.

Mr. Eli Whitney Blake, the inventor of the Blake stone-crusher, died at New Haven, Connecticut, on August 18th. He was born in Massachusetts, Jan. 26th, 1795. So far as we know the stone-crusher was the only successful invention of Mr. Blake; but he was one of the founders of the Connecticut Academy of Arts and Sciences, and was a frequent contributor to the *American Journal of Science*, and other scientific papers. So recently as 1882 he collected a number of his papers and published them under the title "Original Solutions of Several Problems in Aërodynamics." Mr. Blake is another instance of the effect of an active mind in promoting longevity.

From the Programme of the Finsbury Technical College of the City and Guilds Institute we learn that the entrance examination will take place on the 29th inst., and the evening classes will commence on October 4. Applications for entrance or matriculation examination of the Central Institution must be sent in not later than the 18th inst. The evening classes are under the care of competent teachers,—some of them distinguished men of science,—the fees are low, and they afford an admirable opportunity for obtaining sound and valuable information. Leonard-street, where the college is situate, is, too, within a short distance of three railway termini from which all parts of London and the suburbs are easily reached. Those who are interested in technical education, either for themselves or their sons, should send to Sir Philip Magnus, at Gresham College, for handbills and the Programme.

With reference to the article on tobacco-growing (p. 3), it may be of interest to state that Mr. Stanford, of Charing-cross, is about to issue a small work on the growth of the tobacco plant in France, containing suggestions as to its adoption here. The author, Mr. Philip Meadows Taylor, has been engaged in the cultivation of tobacco in the department of Lot et Garonne for the last forty years. He gives an account of the operations of the Régie Nationale, or tobacco monopoly in France, and full details as to the process of growth, harvesting, and drying of the plant, from the purchase of the seed from the Régie to the return to that authority of the leaves dried and ready for manufacture.

In addition to the exhibitions at Manchester and Newcastle, next year, there is to be one at Saltaire, in Yorkshire, the model industrial town founded by Sir Titus Salt.

The statement that Mr. F. Siemens, of Dresden, was experimenting with his hard glass for rails, turns out to be a mistake, the German journals having translated "sleeper" into "Schienen," which means rails, and was so translated for the English press. "Schwellen" is the term for sleepers, and it seems that Mr. Siemens has been very successful in producing these in hard cast glass.

The new Channel steamer, *Victoria*, which has already made the passage between Dover and Calais in the quickest time on record, is expected to accomplish the distance in less than an hour when a favourable opportunity occurs, and to make the trip as a regular performance in about an hour.

A tell-tale paint for hot bearings has been brought out by Mr. H. Crookes, of Westminster-chambers. When cool, or at normal temperature, it is a brilliant red; but as the temperature rises it grows darker, until at 180° Fahr. it is quite brown. As it cools it regains its original redness. This paint should be useful for high-speed machinery, especially if it will retain the remarkable property for any length of time.

Another instance of the effects of oil on waves is supplied on apparently excellent evidence. The North German Lloyd's *Werra* was recently disabled in mid-Atlantic, and was taken in tow by the *Venetian*. One morning a strong gale sprang up, and heavy seas broke over the bows of the former vessel, when the commander of the *Venetian* ordered an oil-bag to be hung over each side of his ship and dragged some distance astern. The effect was marked, as the sea became comparatively smooth, and not a drop of water broke on board the *Werra*.

At a recent session of the Academy of Sciences in Amsterdam, Prof. Forster stated that he and Dr. van Geuns had found that the comma bacillus was destroyed by heating the substance containing it to 55° C. (131° Fahr.). In their work "Les Bactéries," MM. Cornil and Babes state that the comma bacillus is destroyed by exposure to a temperature of 50° C. for a few days; also that a culture of comma bacilli can be sterilised by slowly heating it to 65° or rapidly to 75° C.

According to a telegram from Cooktown, Vice-Admiral Freiherr von Schleinitz, Governor of German New Guinea (Kaiser Wilhelm's Land), has sailed up the Kaiserin Augusta river from its mouth near Cape de La Torre, and found it navigable to the 140th degree of east longitude. A water road thus leads into the interior for more than 300 kilomètres (186 miles) in a south-westerly direction.

Births and Deaths in the United States.—The death-rate for the whole United States for the last census year was 18 per 1,000. Comparing it with the rates of some other countries for the year 1880, we find that in England and Wales the rate was 20·5; in the rural districts of England, 18·5; in Sweden, 18·1; in Belgium, 22·4; in the German Empire, 26·1; in Austria, 29·6; and in Italy, 30·5. The mean annual birth-rate of the United States is 36 per 1,000 of population, and the annual increase of population from the excess of births over deaths is nearly 2 per cent. a year, and this is exclusive of the increase from immigration. The mean annual birth-rates of some foreign countries are as follows—viz., England and Wales, 35·4; Sweden, 30·2; Denmark, 31·9; Belgium, 32: Austria, 39·1; German Empire, 39·3. The birth-rate is greater among the coloured than among the whites, but this difference is less in the rural districts than it is in the cities.

THE increase in population in New South Wales in 1885 was 59,305, being almost equal to that of Victoria, Queensland, South Australia, West Australia, Tasmania, and New Zealand combined.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE CITY AND GUILDS OF LONDON INSTITUTE—FINDING THE TIME WITH A SEXTANT—DETERMINING CLOCK-RATE—LUNAR LIBRATION—METEORS?—TERRESTRIAL TELESCOPE.

[26218.]—I SEE it announced that Mr. Owen Roberts, one of the Honorary Secretaries of the City and Guilds of London Institute, and a very keen and active original promoter of that somewhat dubious establishment, has resigned his secretaryship "in consequence of the pressure of other work." I wonder what this means. A little while ago Mr. Magnus, who is the director, or something of the sort, was made a knight—and Mr. Roberts wasn't; but it can hardly be the "spretæ injuria formæ" which has deprived the Institute of Mr. Roberts' services. If my memory serves me, Mr. Roberts was not too active in his opposition, when certain snobs who had been "got at" by the Brompton Ring, were instant to have the "Central Institute" located in Exhibition-road, S.W. They succeeded, and the City Guilds have had to pay through the nose accordingly. I, however, see a ray of hope in the dissolution of Mr. Roberts's connection with this charming transaction. According to the "Directory," he is clerk to the Cloth Workers' Company, who have (presumably under his guidance) been among the most munificent of the contributors to the Institute. Would it be too much to hope that if that Guild is to continue to contribute to the furtherance of technical education, it will, for the future, be advised rigidly to confine its donations to the Finsbury Technical College, which is really giving legitimate instruction to legitimate recipients in an entirely suitable locality. If, getting over their "genteel" fit, the Guilds come to realise the way in which their money has been squandered at Brompton, and have the sense and firmness to say, once for all, that they must decline to spend it in a way which brings such a wholly disproportionate return, then we may trust that the whole of the South Kensington affair will collapse, the omnivorous Commissioners of the 1851 Exhibition appropriate their palatial buildings, and a genuine system of technical education for the British workman rise out of the ruins of a detected and exploded piece of humbug.

In reply to query 60242, Vol. XLIII. p. 587, I think that I shall possibly render the method of finding the Greenwich Mean Time by the aid of a sextant more intelligible to "H. A.," if I describe it verbally, and in detail, instead of employing the trigonometrical equations which he would find in any book on Spherical and Practical Astronomy to which I could refer him, and if, further, I work out an example at full length. I shall suppose him to be in posssession of a good box sextant, an artificial horizon formed of a pail of water—or better still, a bucket of tar, a book of logarithms and the *Nautical Almanac* for the current year. I presume, in limine, that he knows how to measure the sun's altitude by bringing either of its limbs into contact with its reflection in his artificial horizon. Of course, half the resulting angle with the sun's semi-diameter applied and corrected for refraction and parallax, will be the height of the sun's centre at the instant of observation. Then, under the latitude we write the sun's declination, each with its proper sign, N. or S., marked against it. If these signs are alike, we must take their difference: if one is N. and the other S., their sum. Under this result we write the true zenith distance of the sun's centre; we take the sum and difference of these two quantities and their half sum and half difference. We add together the log. secants of the latitude and declination and the log. sines of the half sum and half difference, divide the result by 2, and the quotient will be the log. sine of half the hour angle. Turning this into time and doubling it, we shall get the *apparent* local time when the sun is west of the meridian, 24 hours—the same hour angle gives the apparent local time when the sun is east of the meridian. Apply the equation, and the true local mean time will be known; then apply the correction for longitude, and we shall get Greenwich Mean Time. Now for an example to make all this intelligible. Suppose that I was in Chester on August 1st, and that when a watch supposed to indicate Greenwich Mean time showed that it was 7h. 43m. 18s. a.m., I took a double altitude of the sun by bringing the sextant image of his lower limb *just* to touch the reflection of the same limb in perfectly still water. Suppose, further, that I found this double altitude to be 54° 33′. Then 27° 16′ 30″ is the apparent height of the sun's lower limb. But from this 1′ 51″ must be subtracted for refraction and 8″ added for parallax; this leaves 27° 14′ 47″ as the true height of the sun's lower limb, and on adding 15′ 48″ the sun's semi-diameter to this again, we finally obtain 27° 30′ 35″ as the true altitude of the sun's centre at the instant of observation. 90°—27° 30′ 35″ = 62° 29′ 25″, the sun's zenith distance, which we shall emply in the calculation which is to follow. The latitude of Chester is 53° 11′.

Latitude	53°	11′	0″	N.	
Sun's Dec.	18	2	8	N.	
	35	8	52		
Sun's Z.D.	62	29	25		
	2)97	38	17	sum	
	2)27	20	33	diff.	
Half sum	48	49	8		
Half diff.	13	40	16		
53°	11′	0″	sec.	0·222387	
18	2	8	sec.	0·021881	
48	49	8	sin.	9·876583	
13	40	16	sin.	9·373552	
				2)19·494403	
33	58	4·5	sin.	9·747201	
		2			
67	56	9	hour angle = 4h. 31m. 45s.		

That is to say the sun is apparently 4h. 31m. 45s. east of the Chester meridian, or it is 7h. 28m. 15s. a.m. apparent time. To this we must apply the equation 6m. 5s., and we shall get 7h. 34m. 20s. as our true local time at the instant of our observation. Finally Greenwich is 11m. 36s. east, or fast, of Chester, so that adding 11m. 36s. to 7h. 34m. 20s. we obtain 7h. 45m. 56s. as the Greenwich Mean Time at which the sun's altitude was measured. But our watch showed 7h. 43m. 18s., so that it was 2m. 38s. slow. I must ask my querist to note that, knowing our time very approximately, the sun's declination has been computed for it. Such refinement is scarcely needed in the case of the equation of time.

One of the most simple pieces of apparatus, by the aid of which "Tempus Fugit" (query 60266, Vol. XLIII. p. 588) can ascertain his clock rate, is described by Lord Grimthorpe in the introduction to his book on "Clocks, Watches, and Bells." His diagram and description were copied by some correspondent into a back volume of the ENGLISH MECHANIC without any acknowledgment of the source whence they were derived. If "Tempus Fugit" has the sharp edge of a building or chimney-stack visible from one of his windows, and will paste a piece of black paper punctured with a small hole on one of the panes (so that his eye shall always occupy identically the same position with reference to such an edge, then, as stars rise south and set 3m. 56·41s.), sooner every night, if at the instant a bright star disappears behind the building, his clock shows, say, 7h. 22m. 4s., the next evening when the star vanishes, the clock should mark 7h. 18m. 8s., and so on. The shadow of a plumb line on a meridian line will give local apparent noon too; but your querist will find plenty on this subject in your former volumes.

The rule for which "H. C. L." inquires (query 60292) on page 588 of Vol. XLIII., appears on page X. (preface) of the *Nautical Almanac* for 1867, thus:

Putting $\lambda, \beta, \alpha', \delta'$ for the Moon's Longitude, Latitude, Right Ascension, and Declination affected with parallax and

$$\triangle\lambda = \tan^2 \tfrac{1}{2} I \sin 2 (\lambda - \text{☊})$$

$$\frac{1}{\overline{a'}} = \frac{1}{\cos. (\lambda - \text{☊}) \sin. I}$$

$$\tan. B' = \sin. (\lambda - \text{☊}) \tan. I,$$

Libration in Latitude, $b' = B' - \beta$

Libration in Longitude, $\overline{l'} = l - l_o$

$$= \lambda + \triangle\lambda - \frac{b'}{\frac{1}{\overline{a'}}} - l_o$$

Angle which the meridian of the middle of the Moon's disc makes with the circle of Declination, taken positive when the northern part of the circle of Declination is to the west of the Moon's meridian.

$$\text{Sin. } C = - \sin. i \frac{(\cos. l - \text{☊} + \triangle)}{\cos. \delta}$$

$$= - \sin. i \frac{(\cos. \alpha' - \text{☊}')}{\cos. b'.}$$

See also for further details on pp. 531, et seq., of Neison's admirable work "The Moon."

Had Mr. G. W. Middleton (letter 26180, p. 10) only focussed his telescope carefully upon his "Meteors," he would have found that they were simply feathered seeds of the thistle, and the like, drifting across his field of view and becoming brilliantly illuminated as they passed near to the sun. Did your correspondent notice the direction of the wind upon the day of observation? Should he be able to obtain a sight of Vols. XI. and XII. of the R.A.S. *Monthly Notices*, in any library, public or private, he might with advantage consult p. 48 of the former, and pp. 38 and 183 of the latter of these volumes.

As "D. G." addresses his query (60324) on p. 23 to "Garrison Gunner" "or others," perhaps I, having had very considerable experience with telescopes, may venture to answer him, and say that no 3in. telescope can in any legitimate sense whatever be considered "portable." The one he has probably magnifies something between 30 and 40 diameters if it is one of the best kind. I myself always carry a telescope of $1\frac{5}{8}$ aperture, giving a linear magnifying power of 24, and find this a most useful instrument, and quite as large as can be held steadily in the hand. Of course, if you have a tripod stand, or can fix your telescope on a wall or window sill, you can employ a larger and more powerful instrument; but I am speaking of one to carry about with you. By the bye, some of these $\frac{5}{8}$in. objectives have pancratic eyepieces fitted to them.

A Fellow of the Royal Astronomical Society.

PLANETARY NEBULA ON ONE OF MM. HENRY'S PHOTOGRAPHS—MAGNITUDES OF STARS NEAR VEGA—PLANETARY NEBULA G.C. 4373 AND SUPPOSED NEW NEBULA.

[26219.]—IN giving an account of one of MM. Henry's photographs of Cygnus in letter 25881, page 370 of Vol. XLIII., I omitted to state that a small planetary nebula was visible on the photograph in question. The nebula is No. 4 of Prof. Pickering's list in the *Observatory* for October, 1882, and was discovered by him while sweeping with a direct-vision prism attached to the 15in. equatorial on November 25th, 1881. Prof. Pickering says that "except by its spectrum, it is undistinguishable from a star of the fourteenth magnitude," in, I presume, the photometric scale. Its place for 1886·0 is XXh. 6m. 39·6s. + 37° 4′ 28″. On the photograph it seems nearly two magnitudes brighter than Prof. Pickering's estimate, and it appears precisely like a star.

Since writing letter 26177 on p. 10 of the present volume, I have received estimates of the magnitudes of some of the stars near Vega from Mr. Holmes. He rates γ and ϵ of the twelfth, and δ of the thirteenth in Smyth's scale; while he says ζ is the limit of visibility with his 9in. mirror. On the photograph ϵ and ζ seem very nearly equal in magnitude, ϵ being just a shade the larger of the two. Perhaps "F.R.A.S." or some other of your correspondents would examine the field. I am much obliged to Prof. Swift (letter 26181, p. 11) for referring me to Mitchel's Burritt, which I had overlooked. The R.A.S. possesses a copy of this very rare work, and Prof. Cleveland Abbe published the double-star observations contained in it in the *Monthly Notices* for January, 1877. I think I referred to this paper in a letter to the ENGLISH MECHANIC some time in 1877. Prof. Abbe included the names of nebulæ observed by Mitchel in the paper in question; but the Editor of the *Monthly Notices* omitted to print them. Had they been printed I should probably not have forgotten to refer to Burritt, as I consulted Mitchel's *Sidereal Messenger* while preparing letter 26050. In a letter received a few weeks ago, Prof. Swift tells me that the first volume of his Observations of Nebulæ, containing 350 discovered by himself, is in the press, and will shortly be issued. From the care with which their places have been determined, as is shown by his communication to the *Sidereal Messenger*, the *Astronomische Nachrichten*, &c., his catalogue will form a very valuable contribution to this branch of the science. Is not Prof. Swift's new nebula in field with 37 . H. iv. identical with one found by d'Arrest, and entered in the supplement to the G.C. as No. 5,893? D'Arrest found it on Oct. 6, 1866, and describes it as "Debilis, longula, irregulariter terminata; classis fere tertiæ. In campo pariter cum H. iv. 37. Solutionis levis suspicio tantum." Its place for 1885·0 is XVIIIh. 0m. 13·5s. + 66° 36′ 18″. It will be observed that this place

is within three minutes of arc of that in which Prof. Swift locates his *nova*, and I cannot help thinking that his new nebula must be identical with d'Arrest's. If so, Prof. Swift's estimate of its exceeding faintness must be at fault. Of H iv. 37 d'Arrest writes: "Per amplificationem 231 nimbus confertissimi ac coarctissimi stellularum agminis faciem induit."

Erratum.—On page 10, Aug. 23 is the date appended to letter 26177, and not to letter 25882.

Sept. 6. **H. Sadler.**

LIVERPOOL ASTRONOMICAL SOCIETY. CIRCULAR NO. 8.

[26220.]—The star D.M. + 35° No. 4002 was observed with the $17\frac{1}{4}$in. equatorial on the night of June 26th last, as a very red 8·5 star. On August 29th it was again observed with the same comparison stars, and was found to barely equal 9·5. There seems, therefore, reason for suspecting it of variation. Dunér calls this star "rouge-jaune foncé, Sp. III. *b*!!" and identifies it with Pickering No. 36 (A.N. 2376), which seems improbable, as Pickering's place is 1m. 20s. P., and 0° 7′ S. The place of D.M. + 35° No. 4002 for 1885 is xxh. 6m. 3s. + 35° 36·1′.

T. E. Espin,
Wolsingham, Sept. 1. Observer to the Society.

METEORS (?)

[26221.]—Referring to Mr. Middleton's letter (26180), describing his daylight observation of showers of "meteors" near the sun, on the 28th ult., which apparently continued until sunset, and were again visible next day, the majority appearing "as bright as Venus does in the telescope in the day time," and moving comparatively slowly, so that they could easily be followed by the telescope, it would be interesting to learn whether the same were seen by any other observer. For my own part, I am inclined to question their being meteors, and to think that to some other cause these appearances must be attributed. For instance, Dr. Dick, in his "Practical Astronomer," states that in his frequent observations of Venus, to determine the nearest positions to the sun in which that planet could be seen, he frequently perceived a luminous body pass across the field of the telescope, apparently of the same size as Venus—in several instances four or five appeared to cross the field of view. He was for a considerable time at a loss to form an opinion of the nature of these bodies; but continuing his observations every clear day for a twelvemonth, he discovered that some, at least, of them were birds, the convex surfaces of which in certain positions strongly reflected the solar rays. He, however, also quotes a curious observation made by Benjamin Martin, and likewise the apparent projection of star-like objects from the sun during the progress of an eclipse, as seen in France in the year 1820—all which were doubtless attributable to atmospheric undulations.

Dr. Phipson, in his "Meteors, Aërolites, and Falling Stars," states that Arago remarks that whilst observing the sun even through the coloured glass affixed to the ocular lens, he had frequently seen luminous points passing across the field of the telescope; he believed, however, that he had seen these appearances most frequently about the autumn, when flocks of spiders' web were wafted through the air. Phipson adds that he had himself witnessed similar appearances caused by the displacement of a little dust within the telescope, and further states that an interesting article in the journal *Cosmos* (Vol. I. p. 292, 1852) shows that the "meteoroid masses" seen in the rays of the sun by Mr. Reade, were proved by the later observations of Mr. Davis to be seeds of various kinds suspended in the air, and carried along by the wind. I have myself, when observing Venus by daylight, seen birds passing as described by Dr. Dick, and have been assured by persons looking for Venus at such time, that they have seen meteors flash across the sky, which appearances I have always attributed to the transit of birds.

I would suggest to Mr. Middleton that he should carefully repeat his observations, and favour the "E. M." with the results of the same, stating size and description of telescope employed, powers of eyepieces, direction of "meteors" (if seen), and direction of the wind.

Southampton, Sept. 4. **A. H. S.**

PHOTOGRAPH OF LIGHTNING FLASH.

[26222.]—It may interest some of your readers to know that I got two beautiful photographs of two different flashes taken by Mr. Auty, 10, Froutstreet, Tynemouth, where copies, I believe, may be had. These photographs show the fainter ramifications of the spark very well, and are interesting specimens of the kind. Seeing last week's letter brought these photos. to my mind, and I thought many readers of "E. M." might be glad to know where a photo. of lightning flash can be had in England. **T. R. Clapham.**

LIMITED EXPRESSION OF CHAMBER ORGANS.

[26223.]—I have read the letter by Mr. Charles Melross (26215, p. 16) with some little amusement; for the idea of an organist literally sitting on the swell pedal and enjoying his sedentary crescendo and diminuendo is deliciously funny. Mr. Melross says, "The weight of the player on the stool is so utilised that whilst he has *both feet* engaged in pedalling and *both hands* occupied in the manuals, he can with ease and certainty open the swell to any extent and keep it open as long as he wishes at any particular point." But why does he practically stop here? It would have been most interesting to the readers of the English Mechanic if he had given details of this *seat of expression*, and drawn us a picture of the graceful swaying of the organist's body in accord with the musical impulses of his soul, for I presume some movement of the trunk is required to open and close the swell shutters. I hope he will give us full particulars of this curiosity of organ building. Mr. Melross appears to overlook the fact that the mode of operating the Swell he alludes to does not invest it with additional powers of expression, it only leaves the right foot so far disengaged. I am acquainted with the other expedients which have been resorted to to render the action of the swell independent of the feet; but no success has attended them.

I note the air of commiseration in which Mr. Melross remarks that I get "no further than the 'balanced' swell pedal." I thank him for his sympathy, while I really do not feel as if I deserved it. He quotes my remark that "every expedient that can be devised to increase the flexibility of the instrument in this direction will be of the highest value from a musical point of view." Just so; but he has not laid sufficient value on the word *instrument* in the above passage. It will be observed I allude to *every department*, and, indeed, to *every pipe* in the organ, and do not specially allude to the *one department* known as the *Swell*.

Suppose I insist on having three departments made *expressive*, how is our sedentary friend, the organist, to gracefully sit on three expression levers? He would require three stools, and we know that between two stools one is apt to come to grief. But, joking apart, I must ask Mr. Melross to wait for my subsequent articles, in which he will find my views, with reference to the means to be adopted for imparting increased powers of expression to the Chamber Organ, given at some length. **G. A. Audsley.**

CHAMBER ORGANS.

[26224.]—Whatever good may in the long run result from the articles now appearing on the Chamber Organ, it is evident they will provoke honest discussion, and bring forward many interesting and very valuable communications. In reply to "Musicus," I must assure him I never felt further from joking in my life than when I wrote, "I shall dismiss the Chamber Organ with one clavier only as unworthy of serious consideration. It is an instrument so hopelessly imperfect that it is a matter for wonder that it should ever have been introduced, or that anyone with the slightest knowledge of the organ and organ music should have tolerated it." But I must ask "Musicus" to tell me where I condemn "the good old organs as 'unworthy of notice'"? I have no objection for my words to be honestly criticised, but I have a right to expect them to be *correctly quoted*. No man admires the tones of the organs by "dear old Snetzler" and the other fathers of the art of pipe-making and voicing more than I do, and I think every word I have written on the subject of voicing is an earnest cry to have those refined tones back again in our modern organs. I should much like to hear the sweet tones of the instrument so lovingly commented on by "Musicus." To listen to one of Snetzler's "singing organs" is a rare treat to the musical ear; and its lovely voice, indeed, makes one sigh over the degeneration in the art of organ pipe voicing which has so long obtained. It would be extremely interesting to have full particulars of the seven-stop Snetzler in the possession of "Musicus"; may I venture to hope he will give them in these pages?

To return to the more important question in his letter. It is certainly not my fault that a properly schemed and appointed Chamber Organ is beyond the reach of "artisans"; but that melancholy consideration does not alter the fact that a one manual organ (without pedals) is a "hopelessly imperfect" affair. The following passage, which I quote from a letter I have to-day received from a Doctor of Music and an organist of high repute, very strongly supports my own opinion. The writer says: "Your vigorous hits at that *one manual* abomination, whether Church or Chamber, are well calculated to consign it to the land of dusty curiosities, and in the interests of the true soul of music—living expression—I fervently hope oblivion will soon be its fate."

If "Musicus" is an "artisan," as he implies, surely he can see an easier way of procuring a decent Chamber Organ than by paying a large sum of money for it. If I was in his place I should convert the Snetzler into *one department* of an organ of more useful form, adding, by the work of my own hands, the other departments required, striving to arrive at, or as near as possible to, the standard of excellence presented by Snetzler's handiwork. He would then be able to show what that master did in the past era of organ building, and how closely he could walk in the master's footprints. See to it, good "Musicus," and in due time give us all the pleasure of knowing the successful result of your labours. Take the word of one who devoted many years to the maturing of his dream of what a Chamber Organ should be, that your skill and patience will be rewarded. In the mean time, do not forget to let us hear all about your charming little one manual.

G. A. Audsley.

EGYPTOLOGY.

[26225.]—I am glad to see this subject brought forward, as being one in which I am much interested, thanks to our good Editor, for it is scarcely scientific, and certainly not mechanical.

There is but little doubt, as Mr. Gerard Smith says, that the time of Joseph's power was during the rule of the Hyksos, or shepherd kings, in Lower Egypt. This seems to be a well-established point. On the other hand, it is the generally-accepted opinion, by Egyptologists of the present day, that the Exodus took place in the reign of Menephtah, the son and successor of Rameses II. (or the great), and that this same Rameses was the chief oppressor of the Hebrews, the oppression having probably however begun earlier. I need only give the very high authority of Dr. Birch for the above statement, though I could mention many others. Rameses II. was a great conqueror and builder, and it is certain that he employed captives and bondsmen in his great works, and that he used forced labour. Thothmes III. did the same; but it is not so certain that the "Aperu" mentioned in the time of this king were the Hebrews, although some think so. It seems to me probable that the period of oppression lasted much longer than is generally supposed, and that possibly Thothmes III. had to do with it as well as Rameses.

How about the chronology? Obscure and difficult as it is, and, in fact, impossible to attain to exactitude from any Egyptian data, yet we can get a good general idea of it. In the first place, take the period of the shepherd kings, I believe the length of which has been much exaggerated—Manetho is quite unreliable as to the duration of this, for the sources from which his history has descended to us are inconsistent with themselves—*e.g.*, Africanus gives the names of six kings, who reigned 284 years for the 15th dynasty. Eusebius gives virtually the same names, but calling them the 17th dynasty, and reigning 103 years. Josephus gives the same names, but allows them 259 years. For the 16th dynasty Africanus gives 32 Greek shepherd kings with no names, reigning 518 years, and Eusebius five Theban kings, unnamed, for 190 years. For the 17th dynasty Africanus gives 43 shepherd kings and 43 Diospolite, all unnamed, and reigning 151 years. Thus, according to Africanus the rule of the shepherds lasted nearly 1,000 years, while Josephus puts it as 511 years.

So much for the uncertainty of the historians. Now from monumental evidence, and also by comparison of the Egypt of the 12th dynasty and the Egypt of the 18th, it seems highly probable that these two dynasties were consecutive; that the 18th directly followed the 12th, or, at most, only a short interval elapsed. The 12th was Theban, confined to Upper Egypt, and during this the shepherds held sway in the Delta for an uncertain period of time. At last Aahmes, or Amosis, expelled them, and founded the 18th dynasty reigning over all Egypt. Doubtless this dynasty was unfavourable to Joseph and his nation, and probably the oppression had continued for some time before it became so extreme as at the end.

How are the dynasties between the 12th and 18th to be disposed of? There is no better established point than that many of the dynasties were collateral, and not consecutive, as Manetho meant to imply. Writing, as he did, for the edification of the Greeks, he doubtless did his best to extend the Egyptian antiquity, and he thus enumerates them. The 13th consisted of 60 Diospolite kings, unnamed, reigning 453 years; collateral, if real. The 14th of 76 Xoite kings for 184 years. This, possibly, was a small native line ruling in the Delta. The 15th is probably the genuine dynasty of shepherds; the names agree in the three sources of Manetho, and also with some found on the monuments of Lower Egypt. The 16th and 17th are exceedingly questionable, as we have seen above.

Now, as to the length of the 18th dynasty. From the various numbers given by the epitomists, and from certain numbers found in inscriptions, something like a dozen totals can be made. Poole adopts

185 years, and Bunsen 216 years for this dynasty. In round numbers, let us call it 200, and allowing over 100, perhaps 150, years for those kings of the 19th dynasty down to Menephtah, we have from 80 to 130 years as the time of the residence in Egypt of the Hebrews during the shepherd kings' rule. This is, of course, following the statement in the Hebrew, and consequently the English version in Exodus xii. 40, that the residence in Egypt was 430 years, and this is borne out by Genesis xv. 13, and also by Acts vii. 6. Fully in corroboration of this also is the statement on one of the monuments in which Rameses II. records that it was 400 years from the time of Set or Saites, the first of the shepherds, to one particular year of his reign, which one, however, is not mentioned. This also is totally against Manetho, and it considerably curtails the length of the Hyksos rule. It is interesting that about this period of the 15th dynasty, there was a famine lasting many years; it is mentioned in an inscription in the tomb of a nobleman named Baba at El Kab. Possibly this was the same famine as is mentioned in the book of Genesis.

In conclusion, I should be obliged if Mr. Gerard Smith would tell me where the best account of this recently discovered mummy of Rameses II. can be had, and also, as he states he has been to Egypt, and doubtless has seen the Great Pyramid, will he give us his opinion of how much sober truth there is in the statements that have been made about it. It may interest others beside his professional brother. **H. F. L.**

EGYPTOLOGY.

[26226.]—IN reply to Mr. Smith (26168), I remark that the historical references to Israel in Egypt are doubtful, and look as if written by very different people long after the fact. But the reason why Rameses II. is supposed to be the Pharaoh of the persecution, is because the Bible says the name of one of the cities built in Egypt by the Israelites was Raamses.

Raamses is generally identified with Zoan (Tanis) a large city near Goshen, and at the Palestine end of Egypt. It was one likely to be well known to the Israelites at all periods of their history. It was an old city, but, as R. S. Poole says, at page 75, in his "Cities of Egypt," "Zoan was rebuilt and called Pe Ramses, 'the house of Ramses,' carefully distinguished in the inscriptions as Ramses II., first apparently the name of a quarter, then that of the whole city." As Rameses II. was the greatest of the Egyptian Pharaohs, and as he lived within measurable distance from the time of the Shepherds, it is probable he was referred to.

Manetho says the Shepherd domination lasted for 511 years, and both Mr. Poole and Mr. Sayce, both excellent authorities, think it probably was so.

James Fergusson, in his "History of Architecture," gives the length of the 18th and 19th dynasties, which elapsed between the departure of the Shepherds and the Exodus of the Israelites, as about 500 years; but these numbers are not certain, and it is difficult to know how long the Jews were in Egypt.

In Ex. xii. 40, it is said: "Now the sojourning of the children of Israel who dwelt in Egypt was 430 years"—not the descendants of Abraham, but those of Israel—yet it is generally held, partly in deference to Galatians iv. 17, that the 430 years include the time from Abraham's visit. Again, but four generations are mentioned as living there, and as a generation usually is reckoned at 30 years, it is necessary to make a new calculation.

Indeed, from the various discrepancies, to say nothing about the large facts of the case, it seems unlikely that the numbers can be relied upon; the other numbers given—such as the ages of the patriarchs—seem doubtful—thus, Abraham, 175; Isaac, 180; Jacob, 148; Joseph, 110; Aaron, 122; Moses, 110.

The Israelites are not mentioned in any Egyptian inscription or papyrus, though the Shepherds are; and it is very strange that the period assigned to them is nearly the same as that assigned in the Bible to the time of the Israelites there; also, that their army and the Jewish army were the same in number (600,000).

As yet all inquirers must go to the Bible for information respecting Israel in Egypt; but it is not improbable that a section of Shepherds who were enslaved escaped into Palestine during the reign of Menepthah, the weak son of Rameses II. **Memnon.**

SOLENOIDS AND COILS.

[26227.]—THE explanations usually given of the behaviour of solenoids through which an electric current travels do not appear to me to sufficiently account for the fact that under such circumstances they assume a direction parallel with a magnetic needle.

We are taught that a wire conveying an electric current exerts a magnetic influence all round it with an equal intensity all round. Since a solenoid is but a wire coiled into a spiral, it follows that the magnetism outside each convolution should be precisely equal to, but in the contrary direction to, that inside. As a matter of fact, if the solenoid is encircled by a soft iron tube on its outside, this tube exhibits strong magnetic polarity precisely the opposite of that of an iron core when placed inside it.

I should like to know why, when no iron whatever is introduced into the arrangement, the magnetism on the inside of the solenoid preponderates over that on its outside. In all magnetic appliances I have seen, the magnetism exerted on the outside of the coils seems to be altogether ignored, and that only radiating from the interior of the coils is made use of.

This, in practice, may be most convenient; but it is not impossible to conceive that the magnetic influence radiating from the exterior of the coils might be impressed into active service. At present it is not only wasted, but being energy exerted in a contrary direction, it would seem to be likely to detract from the force now turned to account in all magnetic apparatus. **R.**

CURATIVE POWER OF MAGNETS.

[26228.]—I MUST beg the Editor's indulgence for a brief rejoinder to Mr. Caplatzi (p. 16, Vol. XLIV.), although I am conscious of somewhat deviating from the subject, because a clear statement seems to me very necessary. I will put the matter in a small compass, and endeavour to be concise and final.

I am glad that his statements are now reduced to "suggestions," which he has "by no means made up his mind are the right ones." Give me leave to say that, in connecting as cause and effect "extra charges of magnetism" (whatever that may mean) with "genius and special mental powers," he is working in a wrong direction. I will admit to the full the influence of magnets or electricity, or the physical man, or whatever else Mr. Caplatzi likes, on the intellect; moreover, I will go beyond that, and affirm that the intellect is often completely mastered by them. This shows a *connection*. To say that it is one of cause and effect in the sense that the magnetism, &c., causes the intellect, is a "leap." Doubtless a few particles of strychnine might have hindered the writing of the play called *Hamlet*. Shall we, therefore, erect altars to strychnine?

I rather think it the mark of a true scientific observer to have no pocket explanation at all in such a case, and especially to shun a *simple* (in the sense of easily understood) one. All stupendous facts may be attempted to be described in a few words, and every schoolboy is ready with what he calls the "causes" of the French Revolution and other simple matters. May we not rather say that not only words, few or many, are sometimes inadequate, but that there are things in heaven and earth which the intellect cannot in the least grasp, and which call forth a higher faculty of the soul?

Mind subsists by matter and by light, heat, electricity, magnetism, and chemical attraction, but not as the effect of which these are causes. The records of heroism exhibit the triumph of mind over these forces. Even Mr. Pitt, roused from his sleep by news of a mutiny, "orders the batteries to fire upon the ships," and turns over to sleep again—surely a "man in danger" who takes it coolly enough. The capture of Quebec wanted a surprising combination originating in the brain of its author, and no small "physical achievement." Yet Wolfe was the victim of an incurable and painful disease. I fancy the attempt to treat intellect of any sort like horse-power or electromotive force will end disastrously. Clairvoyance and mesmerism may be as calculable as hysteria; but as to what is the "cause" of strong intellect, the simplest and most natural statement is, "*I don't know.*" **E. Willmore.**

KREOCHYLE—BARFF AND WIRE LIQUID MEAT.

[26229.]—I WAS interested in the paragraph in "Scientific News" last week referring to my respected friend the late Professor Barff; but will you allow me to correct an error you have inadvertently made? Kreochyle was *not* invented by Professor Barff, neither has the secret died with him. I am the sole inventor of kreochyle, and Professor Barff found the money to perfect it; he became joint patentee with me, and then assisted to form the Kreochyle Company, which still makes both kreochyle and boroglyceride.

Leytonstone, Sept. 4. **Alfred P. Wire.**

A PSYCHOLOGICAL PROBLEM—THE TERRESTRIAL TELESCOPE.

[26230.]—IN answer to "H. W." (letter 26193, p. 13), I will give a case in point. I find myself in a great battle, in the exercise of my duty, with a heavy cannon fire directed on my battery. My imaginative faculty at once gives me a picture of shattered bones and bleeding flesh, and if I obeyed it I would at once run away. But I consult my reasoning faculty, which tells me that after all very little real damage is being done by the shells, and that the odds are that I shall not be hit. Now a change comes. The enemy's battery has gained an eminence whence it commands my guns, and the position becomes clearly untenable. Both my imagination and reason now tell me to retreat. I have no orders to do so; but no one could blame me for saving myself and my battery from destruction. Now comes in my will, and tells my imagination and my reason to hold their peace, and my reluctant body to stay where it is till it gets orders. Is not the will the superior here? Was any act of *true* heroism ever done to please the reason or the imagination? I should like to go further, were the ENGLISH MECHANIC a suitable vehicle for the utterance of religious truth, and enlarge upon the fact that when a man was a true Christian and had subordinated his will to God's, the ruling will was then an attribute of God, or rather God Himself in one of His aspects. But on this I will not enlarge here.

I do not care to reply to "E. W." (letter 26196, p. 13). His is the old argument ascribing physical facts to imagination. I suppose it is of no use to tell him that some animals can be mermerised, or that a person can be mesmerised without his or her knowledge at the time. I have no intention personally of discussing the matter any further unless I can really assist any true inquirers after truth; and even they I should recommend to leave the subject alone.

In answer to query 60324, "Terrestrial Telescopes," I cannot well answer "D. G.'s" question without knowing what degree of portability he requires. If he can carry about a light stand, say from one window to another, or to a convenient wall, then I should certainly recommend a 3in. telescope of say 50in. length, with a long draw tube worked by rack and pinion. I fear, however, he would have to get one made specially. If the telescope be for the purpose of carrying about from place to place without a stand, he might get a 2½in. made, to be 40in. long when in focus and fold up to 1ft., with a leather case and slings and a pancratic eyepiece giving powers of say 20 to 35. He might then have an astronomical eyepiece giving a power of 50. The whole ought to be made under £5, and would be a most useful instrument. For long terrestrial distances I always use an astronomical eyepiece, for one can read print, or flags, just as well upside down, and the clearness obtained by the dispensing with two lenses is of great avail.

I would advise "D. G.," if near London, to go to Negretti and Zambra and ask to see one of their telescopes made for the War Department for army signalling purposes. Their wholesale price to the War Department is only 19s. 6d., and they are marvels of workmanship for the money, and as good, small, portable instruments as could be desired. **Garrison Gunner.**

[26231.]—I HAVE not been able to see anything "curious" in "A Fellow of the R.A.S.'s" experience. I have often dreamed I was *dreaming*—and that I *suspected myself to be dreaming*—and once, even, that I *woke up*; also that I have been (which seems the most remarkable to me) doing outrageous things under the consolation that "I am only dreaming, so it won't matter." This last *does* seem to me strange, because it never did happen in my waking life—I don't see how it could, in fact. But I see nothing to wonder at in the fact that a person dreams that he does things which he would probably do in real waking life *if the same unexpected scenes occurred*. I only learn two things from it: 1st. That pinching, or writing, if done in waking moments, would prove no more than it did in the dream (as long as it lasts it proves nothing—only when it is found to have been fancy). 2nd. That what the eye (of imagination?) sees in dreams is wholly independent of the reason, and that the reason produces results (acts) which are attributed to a supposititious "will," acting under its guidance. **Crumby.**

BACTERIAL FERMENTS.

[26232.]—OUR next ferment is soon disposed of, as it is of not much importance in everyday life. B. subtile is somewhat like the butyric ferment, and is frequently mistaken for it at first sight; on further examination, however, the illusion is soon dispelled, for the properties of the two germs differ widely. In the first place B. subtile does not produce any products of fermentation like B. lactis and the butyric form; it grows very quickly, and, of course forms its structure from the medium in which it is living. Its great distinctive property from B. amylobacter is that it requires a comparatively large amount of oxygen to sustain its life. It secretes an enzyma or soluble ferment, which is capable of peptonising and dissolving albumen; a piece of white of egg boiled placed in contact with B. subtile soon becomes transparent and dissolves.

I am glad to find in "Ignoramus" another who is anxious to study this interesting branch of

pathology. The theory of germs demands much investigation and thought; any new fellow-worker is hailed with acclamation by the rank and file of bacteriologists. There is room for much research and discovery in microbian pathology, and none can say to what extent we shall be able, by patient observation and toil, to enlighten ourselves and the world. To prove beyond doubt that these minute forms of life are really the prime cause of many, if not all, of our maladies, will be one of the greatest struggles that scientific men of this day, and many days to come, will have. And, after all, I often think it will make us feel rather small to know that we, the "lords of creation" (save the mark!), owe all our ills to such an apparently unimportant factor as the presence or absence of a few minute germs. If we can prove that these germs do exist as the cause of evil, and are not the result of spontaneous generation, then to quote M. Pasteur, in his "Studies on the Silkworm Disease," "Man will have it in his power to cause germ diseases to disappear from the surface of this earth." And certainly it is quite within the reach of possibility that we realise the truth of this statement, provided we can find out an antidote germ or poison of a harmless nature to all but the germ that we desire to destroy.

We have, as an instance of antidote germ, the harmless common product of decay, Bacterium termo, which is able to supplant and destroy the dreaded consumptive microbe, Bacillus tuberculosus. Consumptive patients have been successfully treated by an Italian doctor, Cantani, by allowing the patient to inhale air containing B. termo, which settled on the lungs and supplanted the dangerous germ. We want to find the antidote germs for the various fevers, and such harmful bacilli as B. anthrax, the cause of "wool-sorters' disease." Disinfectants are at present used to kill off the fever microbes, and on the theory that most diseases are non-recurrent, inoculation with a modified form of the disease microbe is becoming a favourite mode of treatment for many diseases.

The introduction of an antidote germ gives an apt illustration of Herbert Spencer's theory of "struggle for existence." After all the parasite theory is an ancient one in medical science, and its revival by such men as Koch, Davaine, and Pasteur, has proved many of its former theories and added a vast amount of new truths and valuable information.

I would recommend "Ignoramus" to purchase, for general bacteriological information and the use of the microscope, &c., either an "Introduction to Practical Bacteriology," by E. M. Crookshank, M.B., F.R.C.S., (London: H. K. Lewis); or 'Microbes, Ferments, and Moulds," by E. Trouessart (London: Kegan Paul, Trench and Co.) Both books were brought out this year. And further, "Ignoramus" should possess Pasteur's "Etudes sur la Bière." The microscope that I use is by Crouch, cost £10 10s., and does all I want with a $\frac{1}{10}$th objective.

Wrexham, Sept. 4. **W. S. S.**

LAUNCH ENGINES.

[26233.]—I WAS much interested in the letter of "Engineering, Manchester." I have seen the engine mentioned by "R. N." The chief feature is that one slide valve controls the admission of steam to both cylinders. A large port is cast in the back of the slide valve, and this conveys the exhaust of the high-pressure cylinder to the low-pressure cylinder. The cylinders are, of course, tandem. Steam is carried in each cylinder for $\frac{9}{10}$ths of the stroke, which, of course, means that the expansion of the steam must be accomplished by the proportions of the cylinders. This accounts for the high ratio mentioned by "E. M." Also it is claimed for the engine that the very full admission of steam in each cylinder causes a very uniform effort on the crank, and I agree with "E. M." that is a great advantage, especially in a single crank engine. Altogether the arrangement is very compact; but I doubt if it is as economical as it would appear at first sight to be, for it is obvious that we lose the great advantage of a compound engine—viz., the reduction of losses by cooling—by dividing the extreme range of temperature between two cylinders. **G. D. Seaton.**

ENGLISH v. FOREIGN MICROSCOPES.

[26234.]—THOUGH calculated to benefit the English maker, I much doubt whether a "Briton's" letter will not bring about the contrary effect, with those who have to consult their pockets at least. For a price, the best English makers can hold their own, especially the stand makers; but how many such makers have we? Could they at present supply a fourth the demand? How many firms are there with a first-class reputation? When you descend to second and third-rate makers, the Englishman's price is double that of the foreigner. Need that be so? Must it always remain so? I say no. The circumstances are certainly in our favour if we choose to avail ourselves of them. The raw materials are here as cheap and as plentiful as on the Continent. Living can be made as reasonable, though three-fourths of our food is imported; our centres of industry are seaports, or near to them; our carriers and merchants can compete with the world. Why, then, can the foreigner under-bid us? Because he is better trained, more industrious, soberer, and more provident; because he takes more pride in his work, his calling, and his independence; because he does not encumber himself with domestic cares as soon as he is out of his apprenticeship; but wanders about from capital to capital, from shop to shop, and picks up new models, new ways, and new tools, learns languages, good manners, and gathers in a store of knowledge and experience, whilst his English competitor spends his good wages in acquiring expensive habits, improvidence, and carelessness.

The microscope, like many other instruments, is a *want* and a *luxury*. The humble student, the head of a numerous family, who feels the heavy item of education, only attends to the former. He wants an instrument for *work* and not for *show*; he listens to the recommendation of the professor, who, if worthy of his profession, has only the interest of his pupil at heart; but if mercenary, becomes the indirect agent of the seller, and receives a "tip" or commission. Let our makers attend closely to the strict wants and avoid superfluities. Taste and elegance are not incompatible with cheapness, and need cost no more than the clumsy, unsightly article. The exhibition of taste brings its own gratification in the process of manufacture; it elevates the worker to his dignity. I think that if our makers were to study a little more the ways of their formidable rivals they will benefit themselves and their country.

A. Caplatzi.

[26235.]—OUR friend Mr. Bottone (26212) has, to his own mind, settled the question, and finally put it out of the power of the British artisan to have a chance of living. Hold! friend Bottone—not so easily settled this matter. The "enormous disparity" no one denies, and those who have a practical knowledge of the trade, those who really can test and examine a microscope, also can and do aver, as I do myself, that the "enormous disparity" in the quality and value of the work is greater than the disparity in the wages. Indeed, Mr. B., the matter to my mind, if I went in for a summary settlement of it would be thus:—Although the foreign artisan works cheaper (perhaps not proven in this connection) he has not yet equalled the British one in making achromatic objectives for the microscope. Shade of Andrew Ross! What would it say to some of the ill-polished ("semi-worked" he would call it) achromatic lenses by the biggest Continental cracks now in the market. Workmanship is "out of the hunt." If our legitimate makers were to drop their standard to the same level they would simply spoil an English industry, for your English buyer, if of a *certain order*, would test all parts of the English instrument under the magnifying glass; while the foreign instrument would be passed through finger and thumb with closed eyes. Before leaving this part of the subject I do assert that not one of the German or French objectives I have seen (quite a number of the very best) is equally worked to contact where required; a lot of filling with the Canada balsam is requisite, and this in our best English shops is an important thing, and should be so, as stability of performance depends greatly upon this.

Can or does Mr. B. take an objective to pieces, clean out the lenses, and try for contact with strained balsam or "Newton's" rings. Then balsam the o.g., reset its parts, producing the best position, finally squaring the lenses in their cells? If Mr. B. does this, he will soon find how far behind that branch of work is compared with Ross, Powell and Lealand, and Beck and Becks. The public buyer can no more judge of the quality of a micro. o.g. than he can of a watch as far as its perfection of internal construction is concerned. An inferior watch may keep fairly good time, and look well outside. So with the objective; it may define perfectly at first, but a subtle power is at work in most foreign ones between the surfaces, and want of stability of performance is the result.

These two glaring defects of construction pass unnoticed, frequently unknown, by a lot of people who judge at the eyepiece end alone. I know there are at this present time being sold by some agents a quantity of French lenses of terrible make. These, of course, sell to the ignorant and bad-principled, and take their places in English instruments, thus thrusting out the well-made English lenses of the past. Produced by some wretchedly-taught designers of the slums of Paris, they are bought up by persons who know not the difference between a cast and a worked lens, and eventually rob our good workers of their bread; placing upon our shoulders, too, the discredit in the future of having worked them ourselves, a sort of fraud that "the industrious foreigner" will, I have no doubt, make all possible capital of.

Now, as to fine brass-work, nearly all foreign work is dependent on a daub of lacquer, most cleverly put on, for its outside finish. This is soon done, and has the appearance, *while it lasts*, of good bottom-work. The beautifully-prepared grain of the metal is, however, not there, as it is in the work of *our* best makers; and the result is that an instrument worked out in this way becomes a black, patchy, shabby affair in a short time. The working parts of mechanical staves in foreign microscopes are mostly dependent upon poorly-made fittings, as they cannot, at their prices, afford to discard bad fits. The foreigner (and here I give him credit for clever vamping) can, with a few dexterous taps with a polished-faced miniature hammer, so doctor a "bad fit" that it will work like a good one, until it is sold, at all events—perhaps for a year afterwards. Such vamping would never occur in our shops, as a price is generally charged that will allow of good work being done, and slippy, accidental pieces are consigned to the foundry again to melt up.

In conclusion—for I fear I am trespassing on your valuable space, sir—allow me to assert that the only reason why there is a difference in the prices of English and foreign microscopes is that most of the foreign work is "make-believe," while our own is genuine; and also allow me to assert that fair, honest inspection of the stocks of our own best makers will prove that foreigners cannot at *any price* equal us yet. Of course, a continual run upon foreign microscopes or other instruments will drive experts to trades in which the competition is fairer. Our microscope makers are capable men in any branch of metal work.

Hoping that the ventilation of this subject will result creditably for all "Britons," of which I have no doubt—however much Mr. Bottone and others interested in pushing in foreign stuff may arrange things to suit their own pockets. The English artisan, assisted as he is with appliances and machinery, to say nothing of a better physique, and an optical training dating a long way further back than his foreign competitor, earns more, does more work and better work. To deal with him means to deal direct—thus the agent's occupation would be gone. **Prismatique.**

THE THIMBLE BATTERY.

[26236.]—PERHAPS it may interest some of your readers to hear the result of a run with a little battery I constructed, which I have named the "Thimble Battery." No connections are visible except small thimbles protruding slightly from a frame, and filled with mercury, which carry the electrodes. The battery consists of eight small ebonite cells with small porous pots, two zincs, one carbon. The inner fluid, 3oz. of a chromic mixture; the outer, 9oz. of sulphuric acid and water (1 in 20). With this little battery I ran a 15 volt 5-c.p. lamp for 12 hours, and for a couple of hours more a lamp of less power. The cost of the charge was 5d. The zincs at the end of the run were quite clean and not much deteriorated.

I have had a battery of *large* cells running (with one charge) at intervals for some 54 hours, and lighting, alternately, dining or drawing room, hall, or orangery, as required, and is still in use for single reading lamps.

Sept. 6. **Charles Penruddocke.**

MIXED TRAINS.

[26237.]—I NOTE, p. 15, that Mr. Stretton quite agrees with the Board of Trade Circular that passenger carriages should be at the *front* of a mixed train. Now, Sir, I must disagree with both that gentleman and the Board of Trade. Suppose the train runs into another train, the nearer the passengers are to the rear the better. If they are put in front I don't see the advantage, and I note the *Engineer* writes in the same strain.

Anti.-Vac.

THE HEBERLEIN BRAKE.

[26238.]—MY attention has been called to a short notice signed "Brake," and published in this week's *Railway Review*, as taken from your columns, and which I now find is the answer to a previous query, No. 60096, and reads as follows:—

"The Heberlein brake on the Colne Valley does not fulfil the 'conditions.' In the first place, it is not fitted to the engine and tender."

I suppose I may take it for granted that the "conditions" here referred to are those laid down by the Board of Trade, and as they are, probably, better judges than "Brake" of the meaning of their own circular, I write to inform him and your other readers that, by a letter dated May 15th, 1885, we are informed by the Board of Trade that the Heberlein automatic brake on the Colne Valley Railway will always be retained as complying with the conditions!

The engines in use on that railway have no tenders, and it is exactly on that special point

(which has been overlooked by "Brake") that the whole question turns, as we invariably fit Heberlein Brakes to the tenders of any engines, and work them with the continuous brakes; but the engine driving-wheel brake (which, if not already present in the shape of a steam or hand-screw brake, we also fit on the Heberlein principle), is always treated as only available for the engine-driver as a brake for cases of danger.

Charles Fairholme.

Heberlein Self-acting Railway Brake Company, Limited, 18, St. Dunstan's Hill, E.C., August 31st.

RAILWAY SIGNALS.

[26239.]—I SHOULD like to know what our railway men have to say about how far a signal arm should go down. Should "all right" be the arm at 45° or right down in the post? What does "Libra" think of the Midland distant signals—a board turned on edge so that you cannot see it? Should a junction have one *distant* signal or two? Also, is it or is it not advisable to have a blue danger light for sidings? **Anti.-Vac.**

[26240.]—I SHOULD like to know what "Libra" thinks about distant signals. On the Midland we have got a lot of the "square discs"; when they are off, they are on edge—you see nothing. Should a signal-arm go right down into the post, or only down to "caution"?

We have got a lot of fixed signals: they are always "on"—there are no wires, &c., to get them off. When signals are on the wrong side, the green back-light of one is just in line with the green "all right" signal of the other. Now this is just the difficulty we have got to contend with. That signal at Binegar was on the wrong side: the driver, in the fog, looked on proper side by mistake; he missed it, and ran too far, and the signalman has got into prison over it—but it was all the bad signalling.

"Libra" (p. 576) says, "How if there are four lines?" Why, that is nothing; put all your signals on the "left-hand" of road, of course. Then there is another thing we have to contend with: some signals are very high: but the lamp is low down the post, so the positions of the day and night signals are different.

Some of your writers seem in a great hurry to attack Mr. C. E. Stretton personally on the proper position for signals: they don't seem to know that the railway men discussed the matter over years ago, and the "proper position" is insisted on by the Amalgamated Society unanimously, and even forms one of their 23 requirements. **Ajax.**

CONTINUOUS BRAKES.

[26241.]—I SHOULD much like to ask your practical readers to be good enough to discuss and answer the following ten practical questions so far as they refer to the Westinghouse and vacuum automatic brakes:—

1. Can the engine and tender (or two engines and tenders when two are employed), and every vehicle in the train be fitted with the complete apparatus for each system?
2. In case of accident, or if the engine and tender, and every vehicle were uncoupled, would the brake act automatically?
3. If the brake on one carriage is out of order, can it be shut off without affecting the apparatus on the rest of the train?
4. Can vehicles be uncoupled for shunting purposes, without trouble or delay?
5. In case of shunting vehicles when uncoupled from the engine, is the brake available either from the vans or automatically?
6. Is the brake instantaneous in action?
7. Can the brake be put on and taken off without trouble, especially upon long trains?
8. Does the brake cause trouble by using steam from the boiler, and does it cause extra consumption of coal?
9. Can trains be controlled when running down long inclines?
10. Are there any parts in the brake which give trouble or require improvement?

If some of your practical readers will come forward and answer, perhaps we may be better able to see how the Battle of the Brakes really stands.

A Railwayman.

LOCOMOTIVES, &c.

[26242.]—I AM reading all the letters on locomotives; but I must say I don't just yet know where the subject is going to come to a final ending, and I don't see that we are working in that direction. If I was a member of Parliament I should want to call order and ask correspondents to keep to the motion. I quite think, Sir, with Mr. Grey, that we have not the figures we want. What is the tractive power of the Mid., G.N., and L. and N.W. locos? How much coal and water a mile do they each use? What is the load in tons? the gradients and average speed? When we know this, then we can set to work to form a comparative idea of merit.

I am a very strong advocate of single-wheel engines with a sandblast.

"Q." speaks of Midland Nottingham express. Well, an engine with 19in. cylinders, 1668 class, ought to be able to run six or eight coaches to time. Surely one of the old 30 class of singles would run the trains without trouble.

What we want is some "single" engines, 19in. by 26in., 7ft. wheels, without bogies, 160lb. of steam, and 1,500ft. of heating surface, 18 tons on driving wheels, and a sand blast. **M. R.**

[26243.]—I CAN tell Mr. G. D. Seaton that the B.G. 8ft. run a stopping train each way between Bristol and Newton Abbot in their turn. The 7.10 a.m. from Bristol and the 5.28 p.m. from Newton Abbot are taken by Bristol men, whose opposite trips each way are on the up "Zulu" and down "Dutchman." I know that there are five or six of the Great Britain class kept at Bristol, besides a few old Bristol and Exeter singles, which are of two kinds, some very similar to the Great Britains, but with 7ft. 6in. driving wheels, the others being single framed 8ft. bogies. The Bristol and Exeter singles are so old that probably they will be withdrawn before long.

The run of the 11.38 a.m. Midland express between Birmingham and Cheltenham was a wonderful performance, considering the weight of the train and the rough road as far as Bromsgrove; but Mr. Seaton has given the mileage, via Camphill and Worcester, not by way of the new line out of Birmingham and over the loop from Stoke Works to Wadborough. It cannot be much over 46 miles, as run by the 11.38 a.m. and 3.12 p.m. trains, which, with the corresponding up ones, are the only passenger trains that use the loop line. I have travelled by the 11.38 a.m., and have remarked the very high speed between Bromsgrove and Cheltenham.

I cannot agree with Mr. W. B. Thompson in thinking "Kappa's" comparison (p. 527) hardly fair. Although the Brighton line is hilly, and there are many junctions, its very best express ought certainly to run faster than any company's fish train. The 5 p.m. from London Bridge only runs between two places, 50 miles apart. The fish train has come, perhaps, 200 miles before the L. and N.W. takes it over. The Brighton train is generally run by one of the Gladstone class of engines, the fish train by a Precursor, with wheels a foot smaller, less tractive force, and far less heating surface. I grant that the Brighton line is rough, and that there are many junctions; but are any of its inclines between London Bridge and Brighton anything like as long or as stiff as that between Low Gill and Oxenholme, and are not trains just as likely to be delayed at Oxenholme, Carnforth, and Lancaster, where there is probably more shunting of goods and mineral trains in a day than on the Brighton line in a week? The Brighton express is one of the very best appointed trains in the world, with selected carriages, and fitted throughout with the Westinghouse brake. The fish train may be made up anyhow, and has only the hand brakes to rely upon; and last, but by no means least, not only is there much greater probability of the weather being bad in the Tebay district, but if it is really rough it is generally rather different among the Westmoreland Fells to what it is in Surrey and Sussex.

I quite agree with Mr. Thompson's statement that a run from Rugby to Willesden in 91 minutes, with a 4-minutes stop in the middle, is a very fine performance indeed. As Mr. Webb's Precedents, which really are not very large engines, do such wonderful running, why cannot an enlarged edition of that excellent type be issued with 18 by 26in. cylinders, 7ft. wheels, and Dreadnought boilers? If as good in proportion to its size as the Charles Dickens, I believe it would beat any coupled engine going; but what I should really like to see on the L. and N.W. express trains is a 7ft. 6in. single, with cylinder and boiler capacity as above. For such an engine, London to Manchester in four hours ought to be a very easy performance.

D. H. P. Scourfield.

Williamston, Haverfordwest.

[26244.]—YOUR correspondent, Ghilleasbuig McTomae, says this week that the Caledonian company use the vacuum. Is he *quite* sure? If they do, it must be a new departure; for up till a very little time ago, they would have "nothing to say to it," as "Brake Block" has already stated. Will "G. M." be good enough to name a train on the Caledonian on which one may see it at work? Or will he tell us of one or two engines fitted with it? I have never seen or heard of any except one in the Edinburgh Exhibition, which has both the Westinghouse and vacuum brakes.

He then goes on to say, "They do not fit the vacuum on for the accommodation of the L.N.W.R., as there is only one through carriage in a regular way." Exactly. But the trains running over both Caledonian and L.N.W.R. are nearly all made up of W.C.J.S. coaches, which belong as much to one company as the other, and are fitted by each company with its own system. Notwithstanding this, however, nearly all the better Caledonian stock—coaches, horse-boxes, fish-trucks, and, indeed, everything that may be expected to run on N.W. passenger-trains, has been fitted with either the brake complete, or, at all events, the connecting-pipe, *simply to accommodate the North-Western.* If your correspondent concludes that the Caledonian use the vacuum from seeing some of their stock fitted with the connecting-pipes, he is no more justified than he would be if he told us the N.E.R. used the Clayton, because they have for years had a few carriages able to work in Midland trains to Bristol, &c.

Of course, fitting stock with brake apparatus to oblige another company is not the same thing as using that brake yourself.

I notice in this week's *Railway Review* that it has now been officially decided to make the L.N.W. brake into the automatic vacuum. The letter characteristically says that the N.W. trains are now to be fitted with *the best brake out.*

One recognises at once the familiar "cocksure" phraseology of Mr. Moon, who for so many years applied the words to the chain brake. Three years ago, however, he told his shareholders he was going to replace the best brake out by a better—viz., the Smith Vacuum, to which was, of course, attached the magic "F. W. Webb's patent." This system soon was brought into prominence at Penistone, and directors began to think that even "the best brake out" was hardly perfect yet. Still, £110,000 was thrown away before an accident nearer home—at New-street last May—showed them that if they meant to stick to their present idea they must be prepared to set aside good round sums for compensation and replacing damaged stock, &c., resulting from the brake failing and playing expensive pranks with the trains. This they appear to be rather afraid of in these days of bad dividends, so are now about to take up the automatic vacuum as used on the South Western and other lines. This, notice, is now the best brake out. How long will it remain so?

As each of these systems has been in existence contemporaneously with the others, one would rather like to know what the N.W. people mean by "the best brake out"? I suppose it is a euphemism for "the brake we have decided to adopt for the present," as the words seem to be applied without the slightest regard for fact. Why not admit at once that the Westinghouse is the best system that has ever been put into the field, and adopt it at all events, till something better be invented?

The last brake used on the line has been in favour just about as long as the small compounds, and I suppose the unfortunate shareholders must submit to see their £110,000 thrown away from time to time in adopting similar fads, which must in the course of nature be almost immediately discarded when applied to practical working.

I see there has been another series of brake trials in America, in which the Westinghouse, as elsewhere, has been proved distinctly superior to any of its rivals. One feature of the trials I thought rather novel: the brakes were tried on a train of *fifty* vehicles, and were found satisfactory only in the case of the Westinghouse.

In face of such arguments, it seems beyond comprehension why our greatest companies should be the slaves of an absurd prejudice as to spend untold sums on systems that don't profess even to be its equal. **W. B. Thompson.**

[26245.]—CAN anyone give me particulars of the new 7ft. 8in., inside cylinder, on the Great Western Railway, No. 10?

In my letter 26091 I had written "four and a quarter hours." Through a printer's error, therefore, my letter seemed to misrepresent Mr. W. B. Thompson in 26070. I see, however, no reason to withdraw my statement about the L. and N.W. being able to run to Manchester in $4\frac{1}{4}$ hours over the Midland gradients.

My reasons for stating that I did not consider 91 minutes from Rugby to Willesden (with one stop and 12 coaches) the limit of a L and N.W. engine's performance are—(1) That I have myself come from Rugby to Willesden in slightly over Mr. Thompson's time with 19 coaches and one engine (Precedent). (2) That Avon (Precedent) ran one day with eight coaches this $77\frac{1}{4}$ miles in slightly over 80 minutes. (3) That I have made runs with Compounds on this line which, by comparison, are fully equal to Mr. Thompson's runs in 26070. Some of these I may publish *in toto.*

It is but idle discussing points with Mr. Seaton if he will not be serious. Surely he does not expect anyone to receive his statement (26136) that "loads of 17 to 19 are nothing for such expensive and heavy engines" in sober earnest. Mr. Seaton seems to be ignorant of the fact that Tring is almost exactly as much above Euston as Lea-

grave (the highest point between London and Bedford) is above St. Pancras. *As much ground must be climbed in one case as in the other.* The Midland certainly rises more steeply; but it must be remembered that the long steady pull of about 1 in 400 from Willesden to Tring tells nearly as much on an engine as two short five-mile pieces of 1 in 176 and the rest gently rising, falling, or level.

It is as well to be accurate in making statements, and I may remark that Compounds are not *always* banked up from Euston to Chalk Farm. A few nights ago Harpy took out 21 (12-ton) coaches without pilot or bank engine. A start on a bank of 1 in 70 with this load looks like business.

Mr. Seaton is again wrong in saying that I think highly of the N.W. Compounds. I candidly confess that I do not. I am animated with a desire to give justice, and nothing more, to these engines. In my recent letters I have simply endeavoured to notice a few good traits in these engines; but I am sorry to say that your correspondents (or many of them) seem to have made up their minds to hear nothing of the Compounds nor of their few good works.

I am sure that Mr. Speed will, before this, have seen how hastily he made certain remarks in the eighth paragraph of 26127. I do not think Mr. Speed has any right to use the words "unjust and false" in reference to my remarks on Midland punctuality unless he is prepared to prove his case by observations as comprehensive as my own. This I am afraid he will be unable to do—Rugby is a bad place to see Midland unpunctuality. When I tell Mr. Speed that the arrivals of every train at Euston, St. Pancras, Carlisle, and Liverpool are at my disposal, he will at once see that my opinion on the subject must carry greater weight than his—simply because my means of judgment are far greater than his own. I have given long and great attention to punctual arrivals of trains, and my judgment on the Midland must remain. In my statement, "the Midland trains are timed so fast that they cannot even now and then keep time," I do not mean to cast any doubts on the engine. In several of my letters, indeed, I have given great praise to the Midland locomotive (see 25777, 25959, 26020, and 26046).

In compiling a time-table much more than the capability of the locomotive should be allowed for. If signal and other stops, for instance, are known to be frequent, then a minute or so must be allowed for them. For instance, there are several Midland trains, London to Liverpool, which are timed at a good pace between Marple and Liverpool. As there are several conditional stops to be made (and they generally are made), the result is that the express never keeps time between Marple and Liverpool. Again, look at the conditional stops from Bradford to Leeds by the Leeds expresses. Is it possible for any engine to do 13½ miles in 20 minutes with about five conditional stops included? I say it is not possible. These and other instances might be expanded to prove that traffic arrangements, &c., frequently (I might may, generally) are sufficient to ruin the performance of any engine on the Midland Railway. It therefore comes to this, that if the Midland people wish to be as punctual as their competitors, then either most drastic measures must be taken to obtain for the expresses a clear road, or a few minutes extra should be allowed to those expresses which are known to be troubled by incidental stoppages. A general rearrangement of the time-table is also eminently desirable. I could point out off-hand quite a dozen instances where one train is timed seemingly for no other purpose than that of impeding another.

I would point out to "Gorton" (26152, first paragraph) that the work of N.W. and Midland engines is not the subject of discussion. Punctuality is the subject in hand.

I should very much like to see "Q.'s" run from Nottingham when he made up 25 minutes. Unless complete details are given, I must express myself that I think there must be some mistake somewhere.

Mr. Thompson (26155) is quite right in pointing out that although advertised as Scotch trains, the 5.15 a.m. and 12 (night) from Euston are not through trains to Scotland. It is very misleading, and so also is it misleading that the 5.15 a.m. St. Pancras, with through Manchester coaches only, should be advertised as for Leeds, Glasgow, and Edinburgh, that the 3.40 p.m. (Mancr. and Liverpool) should be advertised as a Leeds express, and that the 12 (night) should be advertised as a through Scotch train, when changes have to be made at Leeds, Hellifield, and Carlisle before Scotland is even entered upon. P.

MIDLAND EXPRESSES — LOCOMOTIVES.

[26246.]—As regards the question of Midland punctuality, I quite agree with "P." and others that the Manchester is the only punctual service into London. The morning Scotchmen are the most unpunctual trains I know of. The Leeds expresses are fairly good, however, except those due St. Pancras 3.0 and 5.50 p.m., which are rather erratic in their movements. I saw the former arrive on Saturday, 21st, at 3.23, and also recently travelled by this train, arriving 18 late. On the other hand, the 7.50 p.m. is almost invariably punctual or before time.

I believe it is the fact that Midland down trains are punctual as a rule, but as regards the up trains there can be no question about the matter, whatever "Q." (26160) may say. Whatever the cause of this unpunctuality may be, I feel perfectly certain it is not the fault of the engines. Everyone knows the Midland engines are among the very best in existence, and when travelling by the Midland I always find the engines keep time—indeed, they generally make up time. I fancy that when Midland trains are late it must be due to signal stops, of which travellers generally experience such an abundance. For instance, the 3.0 p.m. down Leeds gets stopped about Sharnbrook something like five days out of seven, and the 12.20 down is also stopped there, but not so frequently—say three or four days out of seven.

Taken as a whole, the Midland Railway is as nearly perfect as anything human can be, and it is a great pity it is disfigured by unpunctuality of the trains I have alluded to.

I agree with "P." that the Midland mile posts are most confusing. They should all be numbered from London (where possible), whereas between London and Leicester alone they are numbered from three different places. It will be of service to those who desire to time M.R. trains to learn that Bedford Station is 65 chains north of post 49, and 72 south of post 17.

I recently made the following run, and consider it an excellent specimen of the locomotive performances of the Midland.

m. ch.		h. m. s.	Speed.	Remarks.
	St Pancras	10 10 38	—	due 10 10
1 52	Kentish Town	10 15 11	—	„ 10 14
	„ (dep.)	10 17 6	—	„ 10 16
7 0	mile post	10 26 33	33·9	
13 0	„	10 34 30	45·2	Engine 1499
17 0	„	10 38 40	57·6	(6ft. 9in.
35 0	„	10 59 40	51·4	coupled) &
37 0	„	11 1 35	62·6	equal to
48 0	„	11 11 4	69·5	13 coaches,
				one being
				slipped at
				Luton.
49 65	Bedford	11 13 15	50·2	due 11 16
16 8	(dep.)	11 19 5	—	due 11 19
20 0	mile post	11 25 52	34·4	
23 3	Sharnbrook	11 29 22	52·0	
26 0	mile post	11 34 2	38·0	
30 0	„	11 38 17	56·4	Slack at
38 30	Kettering	11 48 3	51·4	Wellingbro'
45 0	mile post	11 57 30	42·0	
56 0	„	12 10 6	52·3	
61 62	Wigston	12 16 2	58·3	
65 33	Leicester	12 20 16	51·5	due 12 22

The 13 coaches were made up as follows:—Van, two 12-wheel bogies, Pullman, van, two 8-wheel bogies, van and slip coach for Luton. The Pullman and 12-wheel bogies are counted as two, and the 8-wheel bogies as one and a half coaches. There was a moderate breeze with occasional showers.

I should inform Mr. Thompson that, in addition to the run I quoted of the North-Western fish train, the same train runs at 42 miles an hour Carlisle to Tebay (37 miles in 54 minutes), the line rising 845ft. in the first 30 miles. It runs at 45 miles an hour Rugby to Bletchley, and 46 thence to Camden goods station, which it reaches in 7 hours 9 minutes from Carlisle. We all know the compounds are worthless, but Mr. Thompson should not let his indignation against them blind him to the general excellence of the N.W. It is rumoured that the Chinese are thinking of building railways. The N.W. compounds could well be spared, and they would be capital engines for that ancient people to make a beginning with.

The following is extracted from a Pennsylvania paper, the *Bucks County Intelligencer* of August 14th:—"Another of the new style passenger locomotives being built by the Philadelphia and Reading Railroad Company, was taken out of the Reading shops on August 6th on a trial trip, which proved very satisfactory. This engine is intended for the Bound Brook division, and is mate to the one turned out some weeks ago, and which made the remarkable time of a mile in *forty* seconds"—90 miles an hour. Those who are of little faith may possibly doubt the concluding statement.

Kappa.

THE density of liquid atmospheric air has been found to be 0·59 at 146·6° Cent., and 45 atmospheres of pressure. Calculations from the densities of liquid oxygen and nitrogen give the figure 0·6.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[59762.]—**G.W. No. 9 Compound.**—Yes, I mean the 7ft. 8in. single, with eccentrics outside. I thought she was a compound. I shall be much obliged for full dimensions as well as sketch. I cannot quite understand the valve gear. NORTH-WESTERN.

[59842.]—**Effect of Time on Chances.**—My best thanks are due to "R. E. F." for his beautifully neat and simple method. I had searched through all available books on the subject for an explanation without success. In reply 59842, No. 1,119, p. 17, eighth line, ·069 is obviously a misprint for ·69. I was not aware that I had suggested any such table as "E. L. G." gives in No. 1,119, p. 13, nor do I see its utility. What I wanted was a table with which questions like the following could be solved by one multiplication only: "If the odds against success in one trial be 100 to 1, in how many trials will the odds be only 5 to 1 against?" It is evident that "R. E. F.'s" table is capable of far more extensive application than "E. L. G.'s," which merely gives two or three particular cases. I must beg "E. L. G." to excuse me answering his query (60318, p. 23), because I cannot understand it in the least.—ALIOTH, Earl's Court.

[59842.]—**Mathematical Probabilities.**—The notions of querists like "J. M." are gradually clearing themselves, and his last query, p. 582, is a very clear and usual one; almost daily blundered over, though quite simple, and always easy with logarithms, but hardly soluble without them. If we say the chance against a thing happening at one trial, or in a given time, is a to b, this is calling its improbability $\frac{a}{a+b}$, or its probability $\frac{b}{a+b}$. The two chances for and against anything are proper fractions, and their sums must be 1. Now, looking at the larger of these, the effect of doubling the trials, or the time, must be to square this fraction; and the effect of multiplying the trials or time by n, to lower it to its nth power; any power of a proper fraction being less than its root. If it be 20 to 1 against a thing happening to-day, and we ask in how many days this will be reduced to a proposed smaller odds, say 2 to 1, this is asking what power of the fraction $20 \div 21$ will be as little as $2 \div 3$, or what is the value of x in the exponential equation $\left(\frac{20}{21}\right)^x = \frac{2}{3}$. But, to avoid negative logarithms, we may reverse it thus: $\left(\frac{21}{20}\right)^x = \frac{3}{2}$. If we asked in how many days the chances will become even, we have similarly to find the x in $\left(\frac{20}{21}\right)^x = \frac{1}{2}$, or (what is the same), in $(1{\cdot}05)^x = 2$. Or, if we ask in what time the odds will be reversed, or be 20 to 1 that the thing does happen once at least, we have to find what x applied thus $\left(\frac{20}{21}\right)^x$, will bring it down to $\frac{1}{21}$, or, in other words, would raise $(1{\cdot}05)^x$ up to the value 21. This we do by simply dividing the logarithm of 21 by that of 1·05. Thus, 1·3222193 $\div$ ·0211893 = 62·4. In 62·4 days, then, the odds about the first day are reversed; or in 63 trials it becomes more than 20 to 1 the thing will happen. But as for "J. M.'s" question, in what number the adverse odds of 20 to 1 are reduced to 10 to 1, we may, to all practical intents, say simply 2. For though squaring the $\frac{20}{21}$ gives strictly $\frac{400}{441}$, this is so near ten-elevenths that the defect is not worth regarding. The effect of prolonged time, however, in converting improbability into probability, and this to an extreme degree, is most unexpected, and often more difficult of belief to those who guess without calculation than any of the geometrical progression paradoxes, the corn for the inventor of chess, &c. A case, perhaps never to be equalled, occurred in an early number of Mr. Proctor's *Knowledge*, while he was giving its readers a series of lessons on "Probability Reckoning." A report had got abroad, he said, that he thought the earth likely to run into a certain comet's head in about 15 years. He wished the world to take notice that he thought such an event more likely to be deferred 15 million years than to happen within 15. Now, the chance of its occurring in any decently businesslike term, say 15 years, is decidedly small—perhaps smaller than any of us would guess. Prof. S. Newcomb compares it to the probability of a blindfold man, by firing a gun upwards, killing

a bird. But, given the frequency and sizes of birds, and of his shots, of course that would be calculable; and so is the earth's chance of comet-shooting, with given statistics of her and their sizes, orbits, and frequency. Taking that of all those observed, and those known to have come but not observed, in the quarter century that the Danish prize for discovering any existed, I made out a centurial average of safe and unsafe ones, or those crossing and not crossing our orbit; and that (by the statistics of the sizes and paths, not of those in that period, but in all history) the odds against our running into one within a year are about 230,000 to 1. That would make the odds against our doing so in 15 years, 15,332 to 1; because the bringing fractions so small, or so near unity to their 15th-power, or even their 100-th, does not practically differ from adding or subtracting 15 or 100 times. But we have to compare this big fraction, 15,333 ÷ 15,334 with its millionth power. Its logarithm (or say that of its reciprocal) the difference between log. of

	15334 =	4·1856555	
and of	15333 =	4·1856271	
comes out		·0000284	
which, × 1,000,000, gives		28·4	but the
log. of a quadrillion is		24·0	
or is here exceeded by		4·4 = log. 25,118.	

That is, the odds against Mr. Proctor's supposition, the earth's avoiding all such encounters during 15,000,000 years, are above once and a-half as many quadrillions as the odds against one occurring within 15 years are units! Was there ever another guess, I wonder, or will there ever be, by calculator or rustic, so unlucky as to err beyond a quadrillion-fold?—E. L. G.

[59842 and 60052.]—**Box Filled with Spheres, &c.**—What I called paradoxical was that we may have two numbers of shot, of which the less number, if they are to fit into a rectangular case, need a larger one than the bigger number needs. Of course they will go into the box prepared for the bigger number; but they are to fit, or leave no room for another. Let "G.," or "Linkum Doddie," make, for instance, 364 fit into a case no bigger than the cube that holds 365. Now, as to my way of answering "J. K. P.," he having introduced, and referring only to these rectangular spaces, wanted to know whether, for those to hold "a large number," the base layer should be like that of a triangular pile or square pile. It must resemble neither (at least where more than 35 are to be held), and this is what I undertook to show, but which "G." has never hinted, and wrote p. 558 without knowing (though rightly correcting me about the smallest number). The remark that he says "incidentally answered 'J. K. P.,'" could not, for it was one that "J. K. P." had already made. As for my inventing a formula "wrong for any kind of pile," no kind of pile was ever in question, and it is right for all such spaces as were in question—namely, rectangular, and holding "a large number." I said, for safety, 40; but, in fact, any over 35. My square or oblong tubes, to run various ways, were doubtless a clumsy, roundabout way for showing that no face of a box must be a honeycomb layer, nor any edge a close row; but these were points essential to prove, and which "G." has never even stated. So they could have nothing to do with covering retreat, "fireworks" or not. A shorter way, perhaps, ought to have sufficed—namely, pointing out that the close rows of balls run in six directions and no more, all being visible at the six edges of a tetrahedron pile; that each of these is perpendicular to the opposite one, but never to more than one, whereas the edges of a box are in three directions, each perpendicular to both the others. Hence no such three can ever be found among the former six, and as the three box-edge directions thus cannot all be those of close rows, "J. K. P." might conclude, on the "principle of sufficient reason," that none of them should be so. He needed no telling that each ball, in any layer, must touch four in that layer; but this by no means makes the square layer, as "G." says, merely one of those in a square-set pile "looked at diagonally." That in the pile is bordered all round by close rows, and turning this diagonally will not make a square, none of whose border balls are in contact. And the former consists always of a square number, which the latter never does. If square in plan, it has to contain either the half of an even square number, or half of an odd one ± ½. As for the directions that I called cleavage planes, though "the most uncleavable of all," if you choose to go "right through the centres of a plane of balls," that is necessarily so with all directions so called. I maintain it is their right name, nevertheless. A crystal of salt, fluor, or alum, doubtless thus built, does cleave in those seven directions only. "F.R.A.S." was mistaken about anything having been "only fun"—mine or anybody's.—E. L. G.

[59961.]—**Frosted Letters on Glass.**—Seeing no correct answer to this query, I recommend "D. R." to use fluoride of ammonium. It is easily made by adding carbonate of ammonia in crystals to hydrofluoric acid till effervescence ceases or nearly so. It will leave a matt surface instead of the clear and almost invisible lines left by liquid hydrofluoric acid. A common steel pen will answer in writing on glass. The action is almost instantaneous. A body may be given to the fluid by mixing in it finely-pulverised sulphate of baryta (heavy spar), lessening a tendency to spread from the pen. This mixture has been sold under the name of "Diamond Ink" in small bottles at an absurd price, as its composition has not been generally known. It will be found a great convenience by all experimenters using glassware, also for lettering microscope slides, &c.—W. MAIN.

[60005.]—**G.E. Locos (U.Q.)**—I can tell Mr. Campling that those engines in the Norwich accident were so broken up that they did not pay to rebuild, and were replaced by new ones. The others he refers to are not about to be broken up; there is a lot of good work in them yet.—G. E. R.

[60027.]—**Varnish for Violin.**—Many prefer to stain to the desired colour, and then French polish; but if you must have an oil varnish procure the best pale amber, such as is used by the coachmakers. A variety of recommendations will be found in back volumes, but most people, I think, prefer a spirit varnish. Recipes for stains and a varnish on p. 538, No. 776.—NUN. DOR.

[60029.]—**Specific Gravity of Liquid Potash.**—Procure a Twaddell (or Tweddell) hydrometer from dealers in instruments of the kind.—ALKALI.

[60044.]—**Pressure on Pipes.**—Most of the formulæ required to solve this problem have been recently given in other answers, but they can all be found in Molesworth's Pocket-book. As the query stands, it is a very pretty sum, which would take a little time to work out.—J. K. M.

[60045.]—**Estimation of Sugars.**—I would venture to recommend "G. J." to procure Landholt's "Handbook of the Polariscope," published by Macmillan. He will find it useful.—LIBRARIAN.

[60048.] — **American and other Tinned Meat and Fruits.**—The question has been frequently answered. The object is to raise steam inside the tin, which drives out the air, and when sealed and cool there is a partial vacuum. To do that the cans are placed in a bath of chloride of calcium or brine, or some other liquid which does not boil until a temperature greater than 212° Fahr. is reached, and when steam has issued freely from the hole for a minute or so a drop of solder is placed on it and the sealing is complete. Some of the fruits are, however, preserved in syrup.—NUN. DOR.

[60050.]—**Shot Paradox.**—The object of my putting the above query was to ascertain whether those who have evinced an interest in the subject of piling spheres were aware of the reason for what, in the "Book on Building," to which "E. L. G." first drew my attention, in note, p. 180, is called "singular"—viz., that the air-spaces are of the same capacity in either arrangement. This passage set me examining the subject at the drawing-board, and I soon discovered that the arrangement of the interior of a mass of spheres is the same in whichever of those ways you commence laying them, and this is what I thought must be the case if the "singular" circumstance of the equality of the air-space was a fact. I am even now not sure that "E. L. G.," or the other "G." either, has shown in his answers that he is aware of this, confessing, as I must, that I do not understand "E. L. G." on p. 583, when he talks of seven directions of cleavage, &c., which may possibly include the evidence. No doubt the honeycomb is the closest possible arrangement, but that does not exclude the "chequer" from being as close. I fancy that the calculus is required to show the fact of the honeycomb being the closest possible demonstration of which may be found in Hall's "Differential Calculus," p. 88, which may answer "Linkum Doddie." "E. L. G." has even now not given the solution of the "Shot Paradox." I concern myself with "space," not with boxes or tubes, or cubes, and asked for a solution out of mere curiosity.—J. K. P.

[60050.]—**Shot Paradox.**—The paradox is confined, as far as I now see, to pairs of numbers of which the larger is half of an odd cube + 1, as 365, or 666, or 1099. "Linkum Doddie" may readily see that the farther we depart from a cube, the more waste, because, as "J. K. P." said, and "G." more recently, planes through the centres of all the outer balls inclose a space within which there is no waste. Whatever its figure—cube, tetrahedron, octahedron, or part or prolongation of any of these—the matter will be the full maximum of ·74, &c. All the falling short of this ratio is confined to an outer layer, the depth of a ball's radius. Hence the fewer outside balls, compared to inside ones, the less waste. The only figures of box that will economise more than a cube are those coming nearer to a sphere—namely, with 14 faces, 6 squares (whose corners approach each other), and 8 either triangles or hexagons; preferably neither of these regular figures, but alternate-sided hexagons, as nearly equalling the squares as may be. The only rule I can suggest as to the number for a rectangular box, is that its double, or else its double less 1, must be resolvable in three factors, preferably all odd, and the nearer alike the better. Thus $2 (501) - 1 = 13 \times 11 \times 7$. There is more waste than in $2 (500) = 10^3$, because more outside balls.—E. L. G.

[60052.]—**Painting on Silk.**—Have you tried isinglass size?—T. P.

[60073.]—**Battery.**—To "G. D."—(See end of this No. in Replies, October 3, 1883). Leclanchés, so made up, with agglomerate blocks, are rather better than those with porous pots, because their internal resistance is less. Zinc plates give a larger current at any particular time than rods; but the total life of the cell is the same in either case, being just in proportion to the work done.—E. CONRY.

[60095.]—**Westinghouse Vacuum Brake.**—This brake was fitted to the Grosvenor locomotive and 15 carriages at the Newark brake trials in 1875. It requires an apparatus the same size as an air brake by use of the triple valve. It has a 1in. brake pipe. The Westinghouse Co. tell me it can either have a pump to work out the air or a steam ejector. It has an auxiliary reservoir. Certainly I should think it would give better results than the Gresham, because the triple valve is not so liable to stick as the ball-valve. From the description it can be seen that it can be worked with the air-brake.—TRIPLE VALVE.

[60136.] — **Galvanic Battery.** — "Holt's" queries have only just come under my notice, or I would have replied before. (1) I generally use the battery for about an hour and a half at one time, then lift out all the couples, and leave them till wanted again, and I find I can do this for ten or twelve times before it is absolutely necessary that I should clean and resilver them. (2) I have never found it necessary to encase the couples in any material, and I do not think it would have the desired effect. (3) My rack is merely a frame made of four pieces of wood with crossbars of same on which the couples are hung in such a position that each one will drop into its place when the rack is lowered. (4) A galvanometer is not necessary; the sensation experienced when the sponges are applied to the skin being a sufficient test. (5) A large number of cells is required, because intensity is required with very small quantity. No doubt a battery of Leclanché or any other cells would be equally useful, and the Leclanché far less trouble to keep clean, if they could be got small enough; but I think that a few cells of the ordinary size would raise sores on the flesh and yet not penetrate to the seat of the disorder. The battery I have in use at present consists of 56 cells. These cells are made of beeswax and blackened, a plan I adopted in order to economise space, and saves weight. The couples are ½in. wide and 2in. long, and can be lowered into the liquid just as far as can be borne without discomfort by the patient, and this will depend a great deal upon the cleanliness of the battery at the time, also the parts to be operated upon; the spine, for instance, taking a much stronger current than the face. With this battery I have cured scores of cases of neuralgia, and have never failed in any case; and if "Holt" is within reach of South London, and will advertise his address, I shall have pleasure in showing it to him, or even in curing his neuralgia, if he is so unfortunate as to have it.—W. S. W.

[60143.]—**Thames Steamers.**—I find I can answer some part of this query. I am told by the pier-men *Merlin* has been broken up—when, I don't know. The pier-men tell me *Citizen A* is still running, and *Citizen B* is still running, as I saw her on Wednesday night.—TRIPLE VALVE.

[60153.]—**Waggon Couplings.**—Seeing this query still unanswered, I give following description of Attock's coupling. The hand being placed on the rod, and then turning it, the coupling link becomes released from its position, and the rods, being actuated by a lever, the coupling can be stretched out to its full extent; or, if the waggon buffers are close together, full control is obtained over the links, so as to couple or uncouple in any position. One of the main advantages in the links being suspended on the drawhook is, that in cases when waggons are fitted with spring buffers and they are buffed up, the drawhooks sometimes become so close together that there is not space sufficient for the link to pass between them when the coupling is hanging below; in this case the engine will not have to separate the waggons before they can be coupled. On page 220 I gave "Inquirer" (letter 59460, p. 202) a description of Betteley's coupling. I could not give him a description of Wheeler's; but now will. The

following is the description of Wheeler's, in reply to above queries: The apparatus is fixed at each end of the waggon, immediately beneath the head-stock, by hangers or brackets, which are bolted thereto, and consists of a transverse bar, having keyed thereon a series of short levers consisting of four in number. A light transverse operating bar extends, and is attached, to these levers across and from side to side of the waggon, carrying in the centre two arms which have their fulcrum upon the extremity of two of the short arms or levers, which enables the operator, by moving the hand lever at either end of the cross-bar, to raise or depress these two arms, also to enable him to move them in a longitudinal direction. At the extreme of the arms is attached a simple and effective trunnion bolt, which grips the end link of the coupling chain centrally, and allows it to accommodate itself to any form of drawbar hook, thus assuring a successful operation to couple or uncouple without danger to operator.—TRIPLE VALVE.

[60160.]—**Varnish for Clay Pipes.**—If "O. W." will use a solution of silicate of potash, about as thick as gum, he will have a glaze which will suit him.—PAUL WARD.

[60167.]—**Working Drawings of G.N. Expresses.**—Mr. Lee, of 76, High Holborn, has a set of six detailed working drawings of the G.N. 8ft. single; full size of model 1in. to 1ft.; the price is £1 1s. I have no doubt Mr. Lee will be happy to supply further information to your correspondent. —TRIPLE VALVE.

[60175.]—**Induction Coil.**—If "Induction Coil" will tell me the exact disposition of his two lots of secondary, I will help him, if possible.—PAUL WARD.

[60179.]—**Gelatine.**—These sheets are made by pouring a solution (hot) of clear gelatine (coloured when desired by the anilines) on to sheets of glass properly levelled, if thick sheets are wanted. If thin, the glass is coated as a collodion negative, and the excess run off.—PAUL WARD.

[60186.]—**Mathematical.**—As I notice another correspondent ("Toodles") has given an answer identical with mine, I should like to point out that we have both apparently misunderstood the question, or overlooked the fact that the 3 balls can be arranged in a triangle but diagonally in the box, which would, therefore, be, as "E. L. G." says, $10\frac{1}{4}$in. each way. But there is a lot of waste space in it, and the other two sizes are alternative and smaller, but not cubical boxes.—T. C., Bristol.

[60190.]—**Leclanche for Quantity.**—Thanks to the friends who have noticed this query. I am sorry I cannot perform the suggested experiment with a short, thick coil galvanometer. The fact is, with one cell connected to my "quantity" instrument, the needle deflects to the full extent of the scale. To get it within readable limits, I have to insert 30 ohms. This gives a greater external resistance than the instrument referred to in my query. As I cannot get satisfactory results, would some one having the proper appliances please try the effect of increasing the size of the zincs, and publish the results at the first opportunity.—M.M.I.Sc.S.

[60194.]—**Strawberries.**—My experience of strawberry culture (supplementary to "Gardener's" reply) has proved that once in three years is often enough to dig up and remove the plants. The first "runners," if pegged down and slightly manured, ready for separation at the end of a couple of weeks, and not transplanted till the first wet day or two in early October, or late in September, *will bear fruit* the *next* year. If "our" "Lady" has her beds bordered with strawberry, she will need to renew *every third plant* each year, to maintain a fair supply of fruit. Decayed leaves, &c., must be removed as soon as decay sets in; but this year's leaves *should not* be cut down until the spring ones are well grown. The foliage of plants is a necessary provision of nature, like the bark of trees, for nourishment to the vital parts; and the shelter afforded to the heart of the plant by the broad, old summer leaves is essential to next year's vigorous growth. Guano—yes, if expense be no object; but everybody has command of quantities of liquid manure, in the house-slops, and the dirtier suds and rinsings are the more plant-nutriment is in them, and the more will they bear dilution with water. Of course, no one will let impure liquid touch the foliage or fruit.—H. P. B.

[60204.]—**G.E.R. Locos.**—With reference to the six-wheeled tanks, I know little more than I stated in letter 26129; but the older of the two classes of these engines was, I believe, designed by Mr. Johnson, and has leading and driving wheels coupled 5ft. 4in. diam., trailing wheels 3ft. 9in. The four-coupled express goods engines are Nos. 255—264, Hawthorn and Co., 1877, and Nos. 265—274, Dübs and Co., 1876. The 6ft. four-coupled outside cylinder engines run from 307 to 416, and of these the following have a bogie: 308, 311, 314, 317, 320, 324, 327, 329, 342, 349, 360, 366, 370, 381, 385, 406, 412, and 416. I believe there are one or two more; but the above are all I know. Nos. 140—145 (Hawthorn and Co., 1880), are front-coupled bogie tanks; and 686-689 (Stratford, 1884) are Mr. Worsdell's six-coupled goods engines. I have not a complete list of makers of 7ft. singles; but 0299—0304 were built by Schneider.—EAST ANGLIAN.

[60205.]—**Compound Engine.**—Thanks to "T. C., Bristol," and "Engineering, Manchester," for their replies to my query; I forgot to put the steam pressure, which will be 80lb. or 100lb. As room is no object, will it be advisable to make the engine a horizontal tandem, the l.p. cylinder behind the h.p. one. In your reply of Aug. 27 the pressure is taken at 50; with the extra pressure I am using will the l.p. cylinder have to be made larger than the size stated, viz., $3\frac{3}{4}$in.? Also, will a receiver be necessary for the steam; or can it be taken straight to the l.p. cylinder? Are two eccentrics necessary, or can it be worked from one? I have given up the idea of condensing as there will be too much work, and as I live in the country I can turn my steam where I like. Any information respecting the above will be gratefully received. I apologise for not thanking you last week (being away from home) for your interesting replies.—H. R. W.

[60237.]—**Steam Hammer.**—I simply gave a $2\frac{1}{2}$ H.P. boiler as being about the smallest size to put in a works, and it would really supply half a dozen hammers alone; but taking your figures as now supplied, the volume of steam required would be as follows:—Assuming cylinder 12in. × 7in., as I forget the size you named, volume of cylinder $= \frac{7^2 \times \cdot 7854 \times 1}{144} = \cdot 26$ of a cub. ft. multiplied by number of double strokes per min. $= 70 \times 2 = 140$. This makes only $140 \times \cdot 26 = 36$ cub. ft. of steam per min. at 60lb., neglecting cut off; but you would be a smart workman to keep the hammer going at that rate for any length of time.—T. C., Bristol.

[60244.]—**Air-Gun Trigger.**—The accompanying sketches are half size, and will show the arrangement without much explanation. The trigger

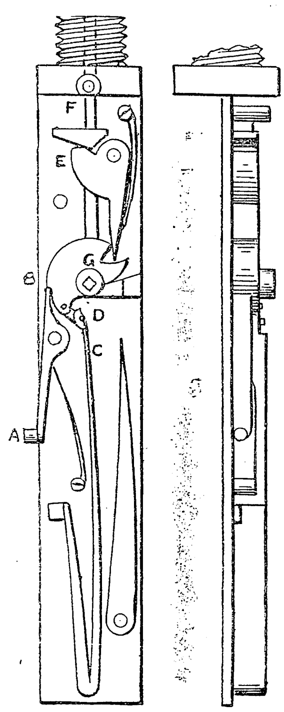
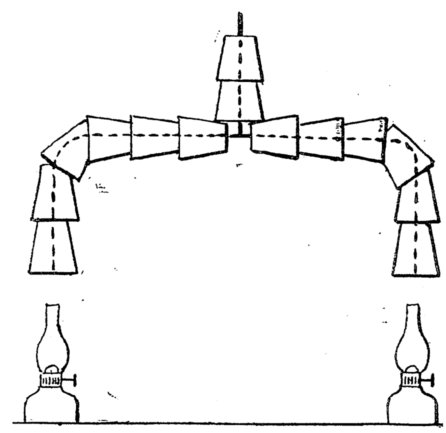


FIG. 1. FIG. 2.

is not attached to the valve, it (the valve) being on end of air chamber not shown. The plate for keeping parts in place is removed on purpose to show the levers and springs which are represented "full cock." On pressing the knob A, which projects through outer case of gun, it releases the lever B, the spring C pulling round lever B by a shackle D, throwing forward lever E, the gin F striking the point of valve. A spring on end of valve spindle instantly throws back pin and lever in readiness for cocking. The square hole G being used for that purpose, a key is inserted through outer case, and turned to the right. Fig. 1 is a side view of trigger.—R. L. READDIE.

[60246.]—**Heating Small Conservatory.**—Gas and petroleum are both successfully used to heat small conservatories; but as it does not do to burn the gas inside, it is used in connection with a boiler and hot water pipes. The boiler is either constructed of spiral tubing, which raises heat very quickly, or is of the ordinary saddle form. For the latter I would recommend Fletcher's oven burner (7s. 6d.) as the most economical. If the



greenhouse covers less than 100 square feet, ordinary petroleum lamps will suit, arranged with flower-pots in the above fashion:—B.SC., Plymouth.

[60247.]—**New Caledonian Single Engines.** —Dimensions of above—viz., Diam. of single driving wheels, 7ft.; diam. of bogie, 3ft. 6in.; diam of trailing wheels, 4ft. 6in.; boiler, 10ft. 3in. by 4ft. 3in.; 196 tubes, $1\frac{3}{4}$in. by 10ft. 7in. Heating surface:—Tubes 950, 36 sq. ft.; fire-box, 102·98 sq. ft.; total, 1,053·34 sq. ft.; area of grate, $17\frac{1}{4}$ sq. ft.; weight, empty, 37 tons 18cwt.; in working order 41 tons 19cwt. This engine has Adams's (of S.W. Railway) patent sand blast, which is worked by a jet of air from the Westinghouse air-pump, blowing the sand directly under the driving wheels. Seven of these engines are to be built for the Northern express traffic.—NORTH-WESTERN.

[60252.]—**Gravity.**—Your first supposition is nearly correct. The velocity of the weight would increase until it reached the centre of the earth, when it would be at its maximum. The velocity would now decrease until the weight had travelled past the circumference on the other side to a distance from the circumference equal to the height of the tower that the weight was originally dropped from. Then the velocity would be 0. The weight will now fall back again and continue to fall until it reaches the top of the tower again, when its velocity is again 0. The explanation of this is as follows. Let S be the distance from the top of the tower to the centre of the earth. Let V be the velocity of the weight after having traversed distance S, and let M be the mass of the body; then by the laws of falling bodies the kinetic energy stored up in the body when at the centre of the earth after having passed through $S = \frac{1}{2} M V^2$. This energy will carry the body on until it has travelled a distance S past the centre on the other side. Now the kinetic energy is all converted into potential energy, in virtue of which the body will commence to fall back again, and so on for ever, since no work is done, and therefore none of the energy in the body used up. But this would only hold good in a vacuum. For owing to the resistance offered by the air, the oscillations each side of the centre would get smaller and smaller, until at last the weight would come to rest at the centre of the earth. With regard to the second part of your query, the earth attracts a body as if the force was acting from the centre of gravity of the earth, i.e., the centre of the earth, so, as I have explained, the matter behind the body does not retard it, and the velocity only begins to decrease when past the centre. A body having no weight would not be attracted by the earth at all. I do not understand your last query. I should say that a leaden ball at the centre of the earth would still be a leaden ball. If I have not made this clear to "Angulus," I shall be happy to give him further information. —RED LIGHT.

[60254.]—**Tricycle Driving Gear.**—I am afraid that one great objection to the use of gut bands for above is that they would slip round pulleys without propelling machine, especially going up hill. Driving a tricycle is quite a different thing from driving a lathe or a sewing machine. —P. L. R.

[60255.]—**Hydrostatic Problem.**—"T. C." has mistaken my meaning entirely, though I thought that the query was explicit enough. Surely he might have known that I would not apply to the "E. M." simply to learn that $6 - 2 = 4$; nor would I have asked for both the length immersed and the depth below the surface, as they are identical when the rod is vertical. Suppose

now the rod is displaced from the vertical position, it will, as you say, tend to become horizontal, but cannot do so, as its upper end is fixed 2ft. above the surface of the water. Less and less of the rod will be immersed as the lower end rises towards the surface, until at last the upward pressure of the displaced water exactly balances the downward force due to the weight of the rod, and stable equilibrium results. I should be much obliged for a few hints how to find the length of rod immersed, and depth of lower end below water. It may simplify matters if I say that the sp. gr. of the wood is 820.—ALIOTH, Earl's Court.

[60257.]—**Curative Power of Magnets.**—This may be represented with sufficient accuracy for all practical purposes by a nine with the tail cut off.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60260.]—**Aneroid.**—The answer to this question involves a good deal more than perhaps "X." is aware of. For altitudes in arithmetical progression the density of the atmosphere decreases in geometrical progression, and therefore the value of 1-50th of an inch is not a fixed one. The temperature of the atmosphere also affects the calculation, so if "X." desires further information on the subject, I should advise him to buy "Surveying and Astronomical Instruments," published by Lockwood and Co. in Weale's Rudimentary Series, price 1s. 6d.—T. K. W.

[60268.]—**C.G.S. Units.**—According to Mr. E. Conry, page 20, this means one gramme lifted one centimètre high in one second. This is absolutely incorrect. The unit rate of working in the C.G.S. system is one erg per second; that is, a force of a dyne overcome through a distance of one centimètre in a second. One gramme lifted one centimètre in one second is not a C.G.S. unit at all.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60268.]—**C.G.S. Units.**—The centimètre gramme second units are the fundamental electrical units. The centimètre as the unit of length; the gramme as the unit of mass; the second as the unit of time. The C. is equal to 0·3937in. in length, and *nominally* represents $\frac{1}{1,000,000,000}$ (one thousandth-millionth) part of a quadrant of the earth. The gramme is equal to 15·432 grains, and represents the mass of a cubic centimètre of water at 4° C. The second is the time of one swing of a pendulum, making 86,164·09 swings in a sidereal day, or the 1-86400th part of a mean solar day.—J. LOW.

[60273.]—**Effervescent Drinks—Seidlitz Powders, &c.**—The aperient property of seidlitz powders is chiefly due to the tartrate of soda they contain (Rochelle salts). Each powder should contain 2 drachms of this ingredient, in addition to that which is formed by the combination of the other ingredients—carbonate of soda and tartaric acid. It is a curious error to suppose that these "destroy" each other.—PHARMACIST.

[60273.]—**Effervescent Drinks—Seidlitz Powders.**—These powders are generally composed of bicarbonate of soda and tartaric acid. 20 grains of commercial bicarbonate of soda neutralise about 18 grains of tartaric acid; but it is usual to have a slight excess of the soda. The gas generated (carbon dioxide, or carbonic acid gas) makes it an agreeable and refreshing drink, and the resultant tartrate of soda is partially digested by the system, and is converted into carbonate, which acts as an antacid.—M. ISADER, Lewes.

[60274.]—**Mushrooms and Salt.**—I can only repeat that a neighbour of mine dressed a field with salt in the spring of last year, and sure enough he had plenty of mushrooms in the autumn.—F. WYKES, Alvechurch.

[60281.]—**Bottle Stopper.**—Let "Happy Jack" put a little thin mineral oil, or, I might say, any thin oil on the stopper; or if a small bottle lay it altogether in oil, and let it remain a few days before he tries to remove it; if still fixed, let it remain a week or two and then try.—T. WILSON.

[60282.]—**Air Valve.**—The back pressure ought to force the valve even without the aid of a spring. The only thing that appears faulty, without knowing more of the apparatus, is the joint where pipe enters through disc. Is this tight?—P. L. R.

[60294.]—**Steam.**—Yes; the 4lb. at A are exhausted into the pipe, which acts as a receiver, and when port is opened for diag. No. 2 the steam is admitted and is the 2½lb. at C; there is always a reduction of pressure. The 7lb. at B is the same steam expanded to 4lb. at A; the diag. does not how the 17lb. you name at D, so that if it exists it would be caused by the cushioning of steam owing to closing of exhaust pipe, and is quite a usual thing. The l.p. cyl. should cut off later than the h.p. cyl. I presume these diags. are taken with engine throttled; as a single engine would be more economical if 17lb. boiler pressure is your regular working pressure.—T. C., Bristol.

[60295.]—**Battery and Lamp.**—TO MR. BOTTONE.—Yes; a 5c.p. lamp would light such a sized room, but not well. An ordinary fish-tail burner burning low gives 5c.p. You would want at least two fives, and if you used two of the specials mentioned by me in previous letters, having a resistance of about 7 ohms, you could light both with your six-cell battery. Do not use a box-form of battery, as it is sure to leak electrically. Cut your carbons with an old saw and sand. Make six cells, as figured by me in reply about Wonderful Lamp and Battery in the "E. M." for August 20th, and charge with chromic and sulphuric acids. Note that if you use all six cells on to one 5c.p. lamp you will burst it.—S. BOTTONE.

[60298.]—**Norway and Sweden.**—Between 66° and 68° of latitude you are near the Arctic circle, and will require a fur coat, cap, and fur-lined boots, which are far cheaper if bought on your way, viz., at Hamburg, Copenhagen, or Christiania, than if bought in this country. Buy "Baedeker's Guide," and it will give you all the information you require. If you are going to the mines or timber factories there will be provision made for your winter feeding; but if going about the country, you will have to depend very much on your gun for variety.—B.SC., Plymouth.

[60299.]—**Locomotives.**—Dimensions of Midland boilers, 1327 and 1740, have several times been given in back volumes; but I would refer G. D. Seaton either to the *Engineer* of 8th May, 1885, or to Mr. West's useful locomotive sheets for more minute particulars.—ANTI-VAC.

[60300.]—**Battery for Lamp.**—Why, chromic acid, of course. See p. 420, No. 1,111, where there is something about a wonderful lamp, which, strange to say, ceased to be a wonderful lamp on p. 16. Why do you want the zincs always to remain in solution? Why not lift them out?—A. S.

[60300.]—**Battery for Lamp.**—Carbon division—saturated solution of bichromate of potash; zinc division—1 part sulphuric acid to 10 water, keeping the zincs standing in a little trough or box, with some mercury in it. Do not put the mercury into the bottom loose. The above solution is one example; there are several good ones, all much about the same in value.—E. CONRY.

[60300.]—**Battery for Lamp.**—Make a paste of mercuric sulphate with water. Pour this round the carbon plates. In the cell containing the zinc place a dilute solution of sulphuric acid (1 acid, 10 water). Keep your zincs well amalgamated, and remember that this battery soon runs down, but recovers quickly when the circuit is broken.—S. BOTTONE.

[60301.]—**Electric Lighting.**—TO "RULE OF THUMB."—I quite sympathise with your remark about the electrical books published. The absence, in them, of any information that is really and practically useful is deplorable. As a rule, they are stuffed with long, useless, algebraical formula and high-flown scientific theories that would be useless if true, and one half of which are all nonsense. So far as my own acquaintance (a considerable one) with electric lighting literature goes, there is not a single table published that would enable an ordinary linesman by turning to it to see at once what gauge of wire he must use for a certain current and E.M.F. for any particular distance. The following may be of service to you. It is deduced from practical experience, and applies to all ordinary sized house installations, as, for instance, where the wires attached to the lamp have not to run more than at most 20 yards each way without merging into a larger gauge, and where none of the branches have a longer stretch than this without increasing their gauge.

No. 20 B.W.G.	wire	takes	¾ of an ampere
„ 18	„	„	1½ to 2½ amperes
„ 16	„	„	6 „
„ 14	„	„	11 „
„ 12	„	„	18 „
„ 10	„	„	24 „

This table applies to any E.M.F. If you have longer stretches than those described above you must use proportionately larger wire—*e.g.*, 16 for 18, 18 for 20, &c., bearing in mind that it is in the small wires, 16, 18, and 20, that the resistance mostly lies, more so in proportion than in the mains and larger wires. To apply this table, you must, of course, know what current a single lamp of the sort you are going to use takes.—E. CONRY.

[60302.]—**Pigmy Motor.**—TO MR. BOTTONE.—Field-magnet, 4in. long, 3in. diameter, $\frac{5}{16}$in. thick; armature 4in. long, 2in. diameter, ¼in. thick. Wind the armature with about ½lb. No. 20 d.c.c. wire, and the fields with about 1lb. No. 18.—S. BOTTONE.

[60303.]—**Captive Balloons.**—Probably Mr. Eric Bruce's balloon was spirited away from the Palace by the previous invention of Mr. Arthur Shipey, which was, according to the President of the Balloon Society, patented and exhibited by the latter gentleman in the year 1881, and lighted by electricity. Being present at a lecture given by General Bruce last month at the Royal Aquarium, the Brine system was explained by the general, which was at once criticised by Mr. Shipey, the original inventor, who said, although he claimed the so-called Bruce system as his, Mr. Bruce was welcome to it, as it was useless for military purposes, and gave a number of reasons why he had abandoned it. Pressure of business had prevented his completing a new invention; but he hoped to do so at an early date, when he would, as an electrician, introduce a system which he thought would meet the requirements of the War Office. I mention this fact as to him to whom honour is due as an original inventor. The fact should be recorded, and being an old balloonist I am a lover of fair play, and subscribe myself—SYCLONE.

[60304.]—**Circular Valves.**—Make ports equal 15 sq. in., say, 10in. by 1½in. If you mean "Corliss," 5in. diam. would suit for valve; but your query is not quite clear.—T. C., Bristol.

[60305.]—**Bending Thin Weldless Steel Tubing.**—Fill with sand pretty tight, stop both ends, heat, and then bend, when it will not flatten.—E. CONRY.

[60305.]—**Bending Thin Weldless Steel Tubing.**—For small tubes I have found the following plan answer. First fill the tube with lead, bend into proper shape, and then melt lead out again.—DUNDRENNAN.

[60307.]—**Analysis of Silver Alloys.**—The querist had better try this gravimetrically, as he finds difficulty with the volumetric process. Precipitate the silver as chloride, filter, wash, dry, ignite, and weigh; 143·5 grains of the chloride contain 108 grains of silver. I purposely refrain from giving minute details for two reasons: first, I do not think I could do so better than many textbooks on analysis; second, no amount of written instruction will enable "G. E." to do the operation unless he has had previous training in similar work.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60308.]—**Soundproof Doors.**—Thick curtains.—E. CONRY.

[60309.]—**Legal.**—"Shylock" has lent £100 to a widow on the security of her house, shop, &c.; but if the widow marries again the house goes to her daughter. The widow is going abroad, and her friends threaten that rather than continue this liability she will get married, and offer £30. "Shylock" must decide for himself whether he will accept this amount (I would not), or run the risk of the marriage, for if the marriage does take place "Shylock" has nothing to do with whether it is consummated or not, and he will never get it annulled on that ground. Again, there is no "conspiracy to defraud" in the widow getting married. When "Shylock" lent the money he knew of the condition on which she held the property, and he ought to have calculated on this probability.—B.SC. (and solicitor), Plymouth.

[60311.]—**Slide-Rest.**—Have the tool very slightly rounding in front; use soap and water, and give a very slow feed and a light cut; then, if everything is tight and the work does not spring, you should have a good result.—T. C., Bristol.

[60311.]—**Slide-Rest.**—The cause of the imperfection in the work is a little play in the rest. This you can easily rectify, or the makers would do it. I think if you use a spring tool to do your work, you will do it quite to your satisfaction, even without tightening. I have one of the Britannia Company's rests, and do not wish to see smoother work.—H. D.

[60311.]—**Slide-Rest.**—The marks complained of by "W. A. S." are caused by dulness of tool. Either it is placed too high in relation to work and angle of clearance, so allowing the tool to rub a little below cutting-edge, thus destroying its sharpness, or tool is too soft. Finishing-tools (having light duty) should be left "dead hard" or set down to a very light straw; but good steel properly heated will not fail if left as hard as can be made.—J. H. R.

[60313.]—**Ozone.**—TO MR. BOTTONE AND OTHERS.—Ozone may be prepared on a large scale, first by blowing a current of moist air through tubes containing phosphorus: secondly, by causing brush-discharges from specially-constructed Wimshurst machines to take place in oxygen (this latter mode gives it in the purest form); thirdly, by the action of strong sulphuric acid on permanganate of potassium. The cost of the plant would depend entirely on the output required. A good Wimshurst, capable of ozonifying to the highest point about one cubic foot of oxygen per hour, would cost about £3, and a small engine to drive this about £10.—S. BOTTONE.

[60315.]—**Salt in Steam Tubes, &c.**—You can only totally take the salt out of the water by evaporating it—i.e., by using a surface condensing engine, which would condense its own supply. A

bucketful of soda in a boiler would help materially to prevent the formation of scale, and to remove scale already there; but to absolutely remove such thick scale as you mention there is nothing for it but getting inside the boiler and chipping it out with a hammer and chisel. If the water is salt or dirty you should blow your boiler out frequently, and when it is blown out get inside and take up in a bucket any sediment that may be left on the bottom. Beware of "boiler compositions": nearly all of them are remedies worse than the disease.—E. CONRY.

[60316.]—**Electric Timeball.**—TO "WATCH-MAKER."—Will work out what you want, and send it next week.—E. CONRY.

[60319.]—**Chemical Salts.**—The best way is to dry the deliquescent salts; but it is necessary sometimes to be careful about the temperature. Ammonium thiocyanate melts at 147° and decomposes at a higher temperature; it keeps perfectly well in solution.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60320.]—**Fossils.**—The Silurian and Cambrian slates of Wales are purely of marine origin. And it is very doubtful if any ferns existed during the Cambrian and L. Silurian epochs. They certainly would not be found in the cleavage planes, much less in strata of marine origin. "Spes" has come across one of those cases in which the mineral kingdom somewhat roughly resembles the vegetable. He has not a fossil, but possibly a Dendritic marking—most likely a "manganese Dendrite"—which is most common in the N. Wales slates, and is built of crystals, probably from salts.—P. H. MARROW.

[60322.]—**S.E. Ry. Brakes.**—The brake on the S.E.R. seen by "G. N. R.," is the trial train with the automatic vacuum brake ball-valve pattern, like that used on the Lanc. and York. and L. and S.W.—ANTI-VAC.

[60325.]—**Polishing Celluloid.**—This is done by either "scraping" the surface, or working it down with glass paper of various grades (same as for ivory); use a "buff," with water and whiting, but no oil or spirit. When polished, wipe over with a clean rag, moistened with equal parts of methylated spirit and water. See advt., 6d. sale column, "Celluloid."—PAUL WARD.

[60326.]—**Weak Ankles.**—Try cold bathing once or twice a day for 10 or 15 days at the time, using a rough towel for drying with, smart rubbing until the skin is red, indicating a healthy reaction. This, with attention to the general health, should in time much improve the matter. Avoid all mechanical appliances, except as a last resource.—H. S.

[60327.]—**Electromotor.**—TO MR. BOTTONE.—Field-magnet cores 3in. diameter, 18in. long; massive standards, 18in. high, 4in. wide, 1½in. thick; armature, 9in. diameter, 5in. wide, 1in. thick. The size of wire used for winding will depend on the voltage of battery employed. With a voltage of about 100 you might series-wind the machine with No. 16 on the armature and No. 14 on the fields.—S. BOTTONE.

[60329.]—**Fire without Smoke.**—Get a spirit-lamp to burn with methylated spirits, or a Bunsen burner for air and gas from any ironmongers.—E. CONRY.

[60326.]—**Weak Ankle.**—The information given is so scanty that it is a matter of great difficulty to form any opinion on the case. If there be no history of rickets (in which case both feet are usually affected), it may be either talipes valgus or flat foot; if the former, manipulation under an anæsthetic may suffice in the early stages, but in confirmed cases an operation to divide certain tendons will be necessary, and a suitable boot will have to be worn. Flat foot arises from causes which over-tax the natural elasticity of the arch of the foot, such as prolonged standing, carrying heavy weights, or a lazy habit of sliding the feet along the ground in walking. Most frequently, those barbarous high-heeled boots are responsible for the mischief, the inner side of the heel wearing down more rapidly than the outer, tends to turn the sole of the foot outwards. The general health should be improved by means of tonics, and the causes of overstraining the foot removed. Large boots with wide toes and extra-large heels should be worn, and a convex pad of cork or indiarubber placed to support the arch of the foot; the upper leathers must be strong, reach well above the ankle and be laced firmly. To strengthen the ankles they may be rubbed with salt water twice a day, an elastic indiarubber bandage may be applied, or light iron supports worn. Possibly this strengthening treatment, and the adoption of a pair of boots which will outrage nature a little less than those which an idiotic set of shoemakers at present thrust upon us may preclude the necessity of recourse to more severe measures.—R. E. F.

[60329.]—**Fire without Smoke.**—Get a catalogue from Mr. Fletcher, Warrington, and select the article that you think will suit you best.—SAML. RAY.

[60331.]—**Signals by Means of High Potential Currents.**—The best way to effect this, with a minimum of cost, risk, and alteration of existing instruments, would be to shunt off a portion of the current from the main. This can easily be done, and to any desired extent.—S. BOTTONE.

[60332.]—**Ferments.**—I would suggest for perusal the paper entitled "Fermentation and its Bearings on Surgery and Medicine," by John Tyndall, F.R.S., &c., a discourse delivered before the Glasgow Science Lectures Association in the year 1876, and now incorporated in "Tyndall's Fragments of Science," sixth edition, Vol. II., published by Longmans, Green, and Co., London; this work is in every good library. The most exact information concerning the power of the microscope best adapted to this study, and also the proper works to study, may be obtained by addressing a query to any of the following (at the same time inclosing a stamped envelope for reply), viz.: Mr. William Crookes, F.R.S., 7, Kensington Park-gardens, London, W.; or Prof. Balfour Stewart, M.A., F.R.S., the Observatory, Cambridge; or Prof. Barrett, F.R.S.E., &c., 6, De Vesci-terrace, Kingstown, co. Dublin.—JOSEPH W. HAYES.

[60333.]—**Electro-Motor.**—TO MR. S. BOTTONE.—If wound in series, about 10lb. No. 16 on field, and 1lb. No. 20 on armature. I should not use such high tension as 55 volts; but if you must do so, and are driving from a dynamo, wind your motor as nearly like your dynamo as you can.—S. BOTTONE.

[60334.]—**Falling Bodies.**—The downward motion of a falling body in the first thousandth of a second may be found from the formula $S = \frac{1}{2} g t^2$. Taking g to be 32·18, the space fallen through is 16·09 × ·000001 = ·00001609ft. The motion to the eastward, due to the velocity imparted by the rotation of the earth, may be found independently of the latitude, if the height above the earth at which the body begins to fall is known. Let us suppose that the body is dropped from a height of one mile, then whatever the latitude of the place may be, or the size of the circle described by it, the body at the higher station will describe in 24 hours a circle which is 2π miles longer in circumference than that of a body at the earth's surface. For, let the radius of the circle described by a point on the earth's surface at any given latitude be x miles, and the body be dropped from a height of d miles, then the circle described by the point at the surface in 24 hours is $2\pi x$ in circumference, while that of the higher body is $2\pi(x + d)$, and the difference between them is $2\pi d$. From this the following formula can be obtained—

$$S_1 = \frac{2\pi d t}{8640}$$

Where S_1 is the eastward motion in feet during t seconds, and d the difference of height in feet, the circular arc being practically a straight line for small values of t. When d = ·00001609ft., t = ·001sec. S_1 = ·000000000012ft., that is the distance to the eastward. If we call θ the angle which the falling body makes with the horizon—

$$\text{Sin. } \theta = \frac{S}{\sqrt{S^2 + S_1^2}}$$

or more simply $\tan. \theta = \dfrac{S}{S_1}$

from which θ can readily be found.—R. E. F.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "G. E. R." has replied to 60005.

59847. G.E. Locos, p. 403.
55878. Medical Coil, 404.

60023. Pitch Circles, p. 491.
60039. To Mr. Stretton, 492.
60042. G.E.R. Locos, 492.
60057. Arc Lamp, 492.
60058. Fall of Potential, 492.
60059. G.N.R. Locos, 493.
60069. Railway Signal, 493.

M. BERTILLON, in the course of a lecture delivered at the Hygienic Exhibition in Paris, stated that out of every 1,000 inhabitants of Paris only 360 are natives of the city, 565 belonging to the departments of France or the colonies, and 75 being foreigners. There are in proportion, as well as in actual numbers, more foreigners in Paris than in most other large cities, the proportion being 75 in 1,000, as against 14 in 1,000 in Berlin and Trieste.

QUERIES.

[60335.]—**Turnbull Transmitters.**—Would any subscriber let in a little light on the following items relating to the Turnbull telephone transmitter, which was described in the "E. M." of Aug. 6? Are the carbon electrodes hung exactly upright, and, if not, how much inclination ought they to have? How are they (the carbon rods) kept from touching each other when hanging on the carbon pivot? Would ordinary electric-light carbons, about 5-16in. dia., do for the electrodes, or are they too smooth? What length are the rods? What thickness is the vibrating diaphragm? Any other items relating to this would be gratefully received by—TRANSMITTER.

[60336.]—**Keeping a Pony.**—Would some of your readers give some hints to an utter ignoramus who thinks of keeping a pony for the first time? Heads of information desired: best size of and market for animal, hints for building cheap substantial stable and coach-house, proper food, necessary quantities, and probable cost of same, how often to give it; how to clean the animal, harness necessary and cost of same; best sort of conveyance to keep and probable cost. The pony is to be kept simply to drive self and few other friends out occasionally, and will live in a grass country, where hay and grazing are cheap. A word or two on diseases of horses and simple remedies desirable; and please bear in mind querist's ignorance, and that consequently full details will be valued.—GEE UP!

[60337.]—**Small Compound Engine.**—Can any reader kindly tell me the best size and proportion between cylinders for a compound surface condensing engine to indicate one horse-power, or a little more, and the heating surface required? Also cooling surface in condenser?—A. L.

[60338.]—**Legal.**—A. becomes bankrupt, and goes into the court, but afterwards compounds with his creditors to pay 4s. in the pound, and gets two sureties, which arrangement his creditors, save one, accept. This one, B., holds a life assurance policy, which more than covers his amount, and with which he is content, refusing to join the other creditors. After A. gets clear of the court, B. offers him some business, on the condition of A.'s giving up to him half of the salary towards payment of the old debt, for which he holds policy as security. Should A. agree to this, will it bind him again to the old debt, and thus do away with all the benefits accruing from his compounding, or simply make A. liable to give half of whatever he may earn from B., and in no other way acknowledge the old debt? Having entered into such an arrangement, could B. claim other money?—COSMOS.

[60339.]—**Instantaneous Shutters.**—I am desirous to know the correct principle for landscape and marine? It has been stated that a longer exposure is required for foreground; yet the drop shutter, which does not give this, seems to be greatly used. The advice of an "expert" will be greatly esteemed.—AMATEUR PHOTOGRAPHER.

[60340.]—**M.R. and G N.R. Locomotives.**—Could any reader of the "E. M." give me the classes of the Midland or G.N. Railways? I see in last week's number someone says something about D class of the L.B. and S.C.R. Can you inform me if they call them by letters on the M.R. and G.N.R.?—H. VERNON.

[60341.]—**Mechanics.**—A capstan is worked by two men on opposite sides, each pressing a capstan bar with a force of 30lb., at a distance of 4ft. from the axis. The rope is wrapped round a drum, whose diam. is 1ft. What would be the pull on the rope which would balance the pressure on the capstan handles? Would any reader kindly show me how to make a diagram showing the action of the forces, and find the pressure upon the central shaft on which the capstan turns? Would this pressure be the sum of the two weights—that is, the two men = 60lb., and the tension of the rope, which I suppose would = (as the velocity ratio is 8 to 1) 480lb., would the pressure be 480 + 60 = 540lb., or would the pressure equal the moments round the centre of axis, 480 × 1 = 480, and 60 × 8 = 480? Would the sum of these two moments = pressure upon central shaft = 960lb.? Would anyone kindly favour with a rough sketch of section through the firebox of a locomotive boiler, showing particularly the method of supporting the flat surfaces, particularly the top of firebox? Could anyone tell me of a good book showing how to find the strains on different structures?—NOVICE.

[60342.]—**Green Stain for Furniture.**—Will some reader inform me how to make the green stain cabinet-makers use for furniture?—JOHN JONES.

[60343.]—**Heating Small Conservatory.**—If conservatory is heated by gas, or a lamp, is it necessary that there should be a pipe to take the fumes or heated air out of the building? Also, does the light damage plants, or should the light at night be screened off or shaded?—HOUSEHOLDER.

[60344.]—**Loco. Sand Blast.**—How does the sand blast work on Caledonian and Midland engines, and what advantage is there over the ordinary sand pipes?—INQUIRER.

[60345.]—**Brakes.**—Is it correct that Midland engines 824, 102, 1309 have both Westinghouse and vacuum brakes combined, so that if the rear guard applies the vacuum it puts on the Westinghouse on the engine wheels? If so, how is the arrangement managed?—ANTI-VAC.

[60346.]—**Charging Accumulators.**—For some time past, I have been trying to charge a 6-cell accumulator, but have not as yet met with much success. The battery in question is of the Planté type; each cell consists of eleven plates 4½in. by 4in., and charged with water ten parts and sulphuric acid one part. For charging, I employ a dynamo similar to that described by Mr. Bottone in the "E. M.," only it is fitted with one of Jones' laminated armatures instead of a cast-iron one. Size of armature, 1½in. by 4in. I find that the dynamo seems to work best when the cells are connected in two series of three each. Although I have charged the accumulators many times, reversing direction of charge, yet they do not acquire much storage capacity. After receiving charge for an hour, they would drive the dynamo as a motor for about five or six minutes. I also find that when left charged they very rapidly lose their charge. After charging them for about two hours, I put the whole of the cells in series, and connecting them for a minute to the dynamo, found that there was E.M.F

enough to drive it splendidly. I then disconnected it from dynamo; but in less than three-quarters of an hour the potential had fallen so low as to be scarcely high enough to drive the armature round at all. Ought this to be so? If not, I shall be obliged to any correspondent who will point out cause and cure. There is also a considerable sediment of a greyish-white colour deposited in the cells. What would this sediment probably be, and ought it to be there? When the cells are receiving charge, there is a tolerably free evolution of gas, which, I take it, is a sign that the dynamo is equal to the duty demanded of it. Any information from those who have had experience with cells of this kind will be most thankfully received by—IOTA.

[60347.]—**Westinghouse Brake.** — An express driver on one of the principal lines (G.E., I think) told a friend of mine the following: The brake when applied acts with full force on engine, tender, and 12 carriages. From thence to end of train (supposing such to be one of 26 carriages) the power gradually decreases till the last carriage practically has none applied. What I mean is that the brake is not applied with so much force on the rear of the train as on the engine. Is this the case with Webb's? If true, can these defects be remedied? I should be much obliged if you will tell me which No. of the MECHANIC the Crook accident, June 24th, 1884, was described in. I do not seem to see it in Vol. XXXVIII. I have looked through Vol. XLI., which gives all the Inventions Exhibition in it; but do not see any description of the duplex brake of 11, Queen Victoria-street. Could any of your numerous correspondents and readers, with your permission, give me a sketch or description of it?—TRIPLE VALVE.

[60348.]—**Testing Gold.**—What is a "test stone and studs" for testing gold? How is it used? Is it any good for testing unrefined gold?—F. A. R.

[60349.]—**Florida.**—Can any reader give me information respecting Florida—its climate, productions, industry, &c., &c.? The fullest information would oblige. What chances would a man have of making his way in the country without capital, but willing and able to work?—EX-TEUTON.

[60350.]—**Large Field Eyepiece.**—Will some practical brother please say what is the largest field of arc obtainable on a 5in. o.g., 7ft. focal length, with astro. eyepiece, and also erecting eyepiece? Rather low powers would do. Good definition and light desirable.—CORONA.

[60351.]—**Coil.**—TO MR. BOTTONE, OR OTHERS.—I have a single wire medical coil. Core, 3in. long, $\frac{1}{2}$ thick; reel ends, 1in., and $\frac{1}{4}$ wide. I wish to convert it into a $\frac{1}{2}$in. spark induction coil. What amount of wire and size of condenser must I use to get the above results with two double bichromates, pint size? Would that length of spark do for ordinary experiments?—J. M. PECKHAM.

[60352.]—**Fire Engine.** — Can any correspondent oblige me with the measurements of Shand and Mason—namely, bore and stroke of cylinder, bore of pump, length and diam. of air vessels, diam. of flywheel, boiler tapers from bottom to centre, diam. of bottom and centre, length from bottom to top, outside?—J. K.

[60353.]—**N.W. Drivers and Postal Trains.**—Can any correspondendent inform me the number of days worked per week by the Scotch and Irish mail trains on the N.W., and what remuneration they get? Is it the same as the Crewe-Carlise men get, which is 16s. per trip, four trips a week? Also wanted the places and times where the up and down postal trains stop.—NORTH WESTERN.

[60354.]—**Testing Water with Nessler.**—(1) A sample of water is tested with Nessler's test, and a rusty or amber-coloured precipitate is produced. What is the nature of this precipitate, and what does it indicate? (2) The same test is applied to another water, which at first turns milky, then a flocculent substance is formed, which retains its white colour, and partly floats in the water. What is this white matter, and does it show that the said water is a better or a worse water than the first sample?—INQUISITIVE.

[60355.]—**Vitriols.**—What weight of vitriol, 150 T., should be made in 24 hours per cubic yard of chamber space, from good brimstone and from good pyrites?—A. CRAGGS.

[60356.]—**Fitting Brass Bushes.**—Will any reader inform me what allowance is usually made in turning brass bushes, for spring of bush caused by driving on to mandrel and into the hole for which it is made? Size of bush, 4in. dia., 6in. long, $\frac{1}{2}$in. thick.—BRASS.

[60357.]—**Gulf Stream.**—A number of years ago an experiment was made, by means of hollow glass balls hermetically sealed, to ascertain the direction and speed of the Gulf Stream. Can any reader give full particulars as to the number of balls, how they were marked, by whom the experiment was made?—in fact, any information on the subject will be interesting to—HYPERBOREAN.

[60358.]—**Spherical Trigonometry.**—Would some mathematical reader of the "E. M." kindly solve the undermentioned problems for me? (1) A, B, C is a great circle of a sphere. AA′, BB′, CC′ are arcs of great circles drawn at right angles to A B C, and reckoned positive when they lie on the same side of it. Show that the condition of A′, B′, C′ lying in a great circle is tan AA′ sin BC + tan BB′ sin CA + tan CC′ sin AB = 0. (2) If a point on a sphere be referred to two great cirles at right angles to each other as axes, by means of the portions of these axes cut off by great circles drawn through the point and two points on the axes each 90° from their intersection, show that the equation to a great circle is: $\tan\theta\cot\alpha + \tan\phi\cot\beta = 1$. Either a full solution or hints as to the same in both cases will be extremely acceptable to—SPHERE.

[60359.] — **Freezing Meat.** — What mechanical appliances are used for the above purpose? Also for keeping curing cellars in a frigid state? Could any kind reader give any information respecting the mode adopted by the Atlantic steamers in keeping the mutton and meat frozen brought over by them?—W. H. S.

[60360.]—**To "F.R.A.S."** — What astro. eyepiece should I purchase for a $3\frac{1}{4}$in. achro.? I have two of 75 and 90. Should I have any lower than these for clusters, nebulæ, &c., and what higher powers? Also which form of eypieces would be the best? Present ones are ordinary Huyghenian.—A. R. B.

[60361.]—**Organ-Accordion.** — Will anyone who understands making stand and pedal for above kindly oblige by giving instructions how to make? A rough sketch would help. How are the bellows worked?—is where the hitch is with me.—SAMBONNEI.

[60362.]—**Cold Compressed Air.** — Could any of "ours" inform me whether machinery for producing cold compressed air is made of a size suitable for use in a large dairy for cooling cream and butter? Whether a special apartment is required for its use? What power is required — I mean, is steam necessary? — DOCTOR MEDICINÆ.

[60363.]—**Phonograph Mouthpiece.** — Will any correspondent who has a successful mouthpiece be good enough to give me the particulars of it, such as the size and thickness of diaphragm, shape of tracing point? Also the speed of the barrel and thickness of the coil to get the best effects? I have a very good barrel, but cannot get the mouthpiece to act.—PHONOGRAPH.

[60364.]—**Beach's Developer.**—Will Mr. Bottone, or some experienced friend, kindly give me full details how to make up and use this developer?—B. DAVIDSON.

[60365.]—**Printing.**—Will any of your readers who have worked platen machines say which they have found the best—those having a "dwell" on the type, or not?—PICA.

[60366.]—**Tile Setting.**—How should tile pavements be laid? Should the tiles be packed as close as possible, and should liquid Portland cement be swept into the crevices? Any hints will oblige—MURANO.

[60367.]—**Gas Query.**—TO MR. FLETCHER.—Kindly tell me if it is right for a dry gas meter to continually click while gas is burning. Mine does so, and I am of opinion I am charged for much more gas than I consume. How can I have meter tested privately, as I am of opinion mine registers fast? I am sure a few hints how to burn gas would be very acceptable just now to a great many besides—GAS.

[60368.]—**Exploding Spirit Lamp.**—Would one of your clear-headed and courteous subscribers favour me with an explanation of the following? My spirit lamp is one of the ordinary tin ones, purchased for about 1s., consisting of a cistern for containing the spirit, with handle and tripod attached. In the top of the cylindrical cistern is a hole, into which drops loosely a small hollow cylinder, forming the burner, resting on the bottom of the cistern and projecting about $1\frac{1}{2}$in. above the top. The bottom of this tube is open, and into it is inserted cotton wick, reaching nearly to the top of the tube, which is closed; but it is perforated round the side, close to the top. An annular wick also envelops the lower part of this tube, extending just outside the orifice in the cistern. This external wick being lighted, heats the projecting tube above, and, of course, ignites the gas escaping through the perforation mentioned. A proper metal extinguisher incloses the burner, and screws down to the top of the cistern, preventing evaporation. Now frequently on lighting this lamp, a very forcible explosion takes place, due doubtlessly to my having, by screwing down the extinguisher whilst the lamp was warm, retained a quantity of pent-up gas, which forces its way out on proceeding to re-kindle the lamp; and so I now take the precaution of first raising the burner to allow the gas to escape. The other day, however, my lamp being empty and quite cool, I charged it with fresh methylated spirits, and on applying a light the explosion again occurred. This I am at a loss to account for, as the lamp contained no pent-up gas excited by previous heating. If not beneath the consideration of your clever readers, an explanation of the above would very greatly oblige me. I may say that the only effect of the explosion is that the burner (which fits very loosely), accompanied by a muffled bang, darts up to the ceiling like a rocket, and returns to the ground still ablaze, whilst the spirit within the cistern burns away placidly enough. No mischief has as yet attended the accident.—PUZZLED.

[60369.]—**Delta Cygni.**— Can "F.R.A.S.," or some other reader give me reliable measures of Delta Cygni? I have been much puzzled with the different results in this month's *Observatory*. Mr. Sadler gives in the "Star Guide," page 37, this star as a test for a 4in. refractor, angle 318·5°, distance 1·68″, I suppose computed for 1886, as stated on page 9 of "Preface"; but on page 308 of *Observatory*, angle is given from two nights' measures as 313·0°, distance 0·8″. I can see small star well with 5in. refractor, and can even just see it on diffraction ring with 4in., so I do not think it can be so close as 0·8″; still this measure was made by a practised double-star observer. I see Dr. Copeland's and Mr. Tarrant's measures come much nearer angle and distance as given in "Star Guide," but I do not remember seeing many measures by these gentlemen. I should like to know the latest measures of 70 Ophiuchi, δ (Delta) Herculis, ξ Scorpii, Σ 2525 Cygni. The last one I cannot see double, if I have found right star. What is the distace of 46 Draconis (Webb, 4th ed., page 304), and where can I find full text of Secchi's remarks on page 385 of Webb, as some passages seem to be omitted. Will "F.R.A.S." please supply omitted parts, if the quotation is from some not very accessible book, and say whereabouts in Cygnus the other spots referred to by Secchi are?—H. ATKINSON.

[60370.]—**Dynamo.**—I have one of Jones's dynamos, which should light six 20c.p. lamps; but I don't want to light 20c.p. lamps at all. I am using 10c.p., volts 14, and I can light four of them well; but as soon as I put on one or two more lamps (same as above), I cannot light any of them more than red, and the engine runs away as if there is nothing for it to do, and as soon as I take off the 5th and 6th lamps, and leave four, the engine appears to have more work to do. Machine is compound wound and shunt with laminated armature. If Mr. Bottone, or others, can tell me what is the matter I should feel much obliged.—TROUBLE.

[60371.]—**High-Pressure Gauges.** — M. E. H. Amagat measures pressures up to 3,000 atmospheres with a gauge on the principle of the manometer, with differential pistons. In order to obtain accurate results, the condition has to be realised of maintaining the pistons in complete action while keeping them perfectly air-tight. Will someone kindly state how the differential pistons work, and is Amagat's gauge of any practical use for a pressure of 20 tons per square inch? Are there any printed particulars about it?—R. T.

[60372.]—**Roller for Steam Launch.**—To "R. N." —Will you please kindly help me? I am building boat for steam launch, 22ft. long, for river work. Say what kind of engine is best and size suitable, best mode of condensing, size of cylinders and ports, length of valve, and travel of same. Boiler to be made of copper; say how thick it should be to stand 100lb. pressure, or more. Also the best way to make it, and what size. Give size of shaft and propeller and pitch. I want it to be a good fast boat, and I want to start the right way to do it; or if I advertise my address, will you give me rough drawings? and oblige—C. L. T.

[60373.]—**Battery Zinc.**—TO MR. BOTTONE, "SIGMA," AND OTHERS.—I have a battery of 18 cells, the zincs and carbons of which are 6in. long, $1\frac{1}{2}$in. wide; two carbons to one zinc. I find, after being in use a short time, that the zinc is nearly worn through in the middle, whilst the bottom appears to have been acted upon very little. Why is this? Would it be better to have the zinc shorter, say 4in. instead of 6in.? I have been using bichromic solution, but intend using the chromic, as I find it gives far better results than the bichromic.—QUIEPPE.

[60374.] — **Solder for Platinum.** — Will someone kindly oblige with particulars for soldering platinum to the ends of brass and steel screws, and other connections for electrical purposes?—WALTHAMSTOW.

[60375.]—**Lifting Power of Engine.**—Would any correspondent kindly answer the following question? A single engine with one 36in. cylinder, and a pair of coupled engines with two cylinders, each 24in. diam., each engine to have the same length of stroke; which engine will lift the most dead weight?—A. R.

[60376.]—**Trumpet Stop.**—I should feel obliged if Mr. Audsley, or any one of your organ-building correspondents, could help me out of a difficulty I have with my trumpet stop. Two of the pipes will not tune up. I get them very near, when suddenly they rise an octave. I have tried new reeds, but they serve me the same. I should like to know if cutting the pipe would effect my object.—QUINT.

[60377.]—**Breaking Strain of Cable.**—If a steamer of 560ft. in length, 52ft. beam, drawing 26ft. water, be at anchor with 90 fathoms of chain cable out in 7 fathoms of water, and a tide running 7 knots, what would be the horizontal pull on the steamer, chain, and anchor? What will be the vertical depressing on the bow? What is the rule to find this? Suppose the testing strain on a $2\frac{1}{2}$in. cable be 70 tons, what should be the breaking strain?—SAILOR.

[60378.]—**Beer-Raising Apparatus.**—Will someone kindly give description of apparatus worked by water for raising beer or other liquors from cellar to shop? Height of beer tap, 12ft. above barrel; pressure of water available, 60lb. to sq. in., and apparatus to be automatic.—VINO.

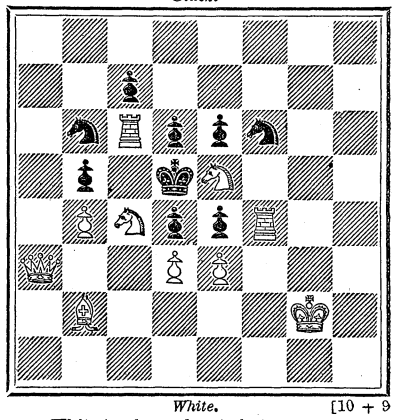
[60379.]—**Model Schooner.**— Will any of "ours" kindly give specifications for a model schooner, a good sailer, boat to be 2ft. long? Should like to know full particulars.—ATALANTA.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MVIII.—BY T. H. BILLINGTON.

Black.



White. [10 + 9

White to play and mate in two moves.

SOLUTION TO 1006.

White.	*Black.*
1. Kt-K B 5.	1. Anything.
2. Kt or B mates.	

(Three variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,006, by J. Mackenzie, G. A. A. Walker, I. M. B., A. Dean, T. Quilliam, G. T. Stringfellow, "——," A. Bolus, Link, A Beginner; to 1,005, by Link (3), A. Bolus (8, including author's), F. W. S., G. T. Stringfellow (4), M. Blackmore (3), T. Quilliam, I. M. B. (8, with duals), A Beginner.

G. A. A. W.—Duals noted in 1,005.

E. F. GEARHTY, R. Pilkington, and C. J. Lambert are thanked for games.

WE should be glad to receive some original problems from our contributors.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 8, and unacknowledged elsewhere :—

F. PEARSON.—R. T. Omond.—Dr. N. B. Sizer.—Alvan Clark.—Medical Battery Co.—Cymro.—T. Wood.—A. S. I.—F. E. A.—Ampere-meter.—Pontoon.—Z. Y. X.—D. Booth.—Dubliniensis.—X.—A. J. W.—Organist.—Ajax.—G. R. Primrose.—E. Conry.—R. E. F.—W. Habgood.—Paul Ward.—W. Cooper.—S. E. Peal.

A YOUNG ENGINEER. (You should procure Reed's "Engineer's Handbook," published by T. Reed and Co., Sunderland.)—FRANCOIS. (They are manufactured from any cheap raw material which contains gelatine, and dried on plates. The best is prepared from picked cuttings, which are treated by sulphurous acid previous to extracting the gelatine.)—J. T. SMITH. (You will find many recipes for marking ink in back volumes. Perhaps you did not expose the other to the light. It is the action of the light that is supposed to render it indelible.)—J. FRANK STONE, Bethlehem, Pa. (If you cannot find them in Nystrom's or Trautwine's works, we do not know where to look for them. It is much a matter for experiment. 2. We do not know of any work specially devoted to roll turning. 3. There are some enamels in the market (mostly asphaltum varnishes) which dry quickly in the cold; but the best work is done by what is known as japanning, which requires a stove.)—BRONCHITIS. (You can have hot-water heating apparatus, paraffin oil-stoves, or coal-gas. Look through the indices, or procure catalogues from those who supply heating apparatus.)—NOSE MACHINE. (One of the little paper clips sold at the stationers will do.)—LITTLE JIM. (Better send it to the plater's and have it done properly and cheaply. If you want to know how it is done, see Vol. XXXIV. pp. 193, 237, 261, 381, and the indices of most back volumes.)—GEO. GRIFFITHS. (You can only apply to the locomotive superintendents. As a rule, you will find, that when they want men, they ask some of the engine builders in this country to recommend workmen whose abilities are known.)—ARIES. (We do not know, but presume the secretary of the society will forward them. The address is Paris, we believe.)—J. LOW. (If the signal never moves, it seems certain that it is not used now, but is left in case at any time it should be wanted.)—DISPAIR. (Consult a medical man. He will give you "a phosphoric vital restorative," if he thinks one necessary.)—RESERVOIR. (Tests are of little use in the case of water; it must be a complete analysis. See p. 434, No. 1060, and the indices of back volumes. 2. "Chemical Analysis," by Fresenius, 2 vols., Churchill; Valentin's work, same publishers.)—DUPLEX. (Doubtful if it can be done without a blast, unless you build a sort of furnace such as was illustrated in No. 1031, p. 373.)—HARMONIUM. (Cover one side of a piece of wood with swansdown, fluffy side outwards, and fix that over the sound holes. You should have given some idea of the dimensions, or the make, as it may be impossible or unsightly to adopt the above. If so, take it to a harmonium-tuner and ask him to soften the tone.)—YOUNG ENGINEER. (What is an "engineer"? Say which branch you mean; but at any rate try and get a berth before starting. You must apply to the shipping agents for terms. The advertisements will be found on the second page of the *Times*.)—WM. WASS. (Consult the teacher at your class. It is not one of the subjects of the Science and Art Department, but is in the list of the City and Guilds Institute. You will find "works of reference" recommended in the Programme.)—JUMBO. (A simple apparatus for the limelight was illustrated so recently as June 18 last, No. 1108.)—K. (One of the special preparations known as indestructible; otherwise a good red-lead paint, well covered with two coats of copal varnish.)—CONSTANT READER. (A "former" is an arrangement of pieces of wood with the ribs or folds cut on them, and supported through the centre by plugs. On removing the latter the side pieces can be taken out. If you only want to make one bellows see p. 224, No. 894, which contains illustrations.)—BROSCENICUS. (We should think so. 2. The jars can be used, but it rests with you what kind of battery.)—X. (The question about the thermometer was actually answered the week before last; see p. 583, No. 1118. If "shade" meant "night," night temperature would be the words used. 2. An optical delusion.)—S. N. D. (Do you not understand that you are asking for something that has not yet been invented? If the proprietors could make that preparation flexible, they would. See p. 84, Vol. XXXVIII., and many recipes in back volumes.)—AN AMATEUR. (The Upward battery was described on p. 384, No. 1110. Why should you use a battery to charge an accumulator which is to furnish current for two or three lamps in a bedroom one hour every night? Why not use a battery direct? As you have the accumulators, get them charged by some one who has a dynamo.)—A. L. (You can see a stereoscope at any optician's. See No. 895, p. 233, for a new form of reversible stereoscope. Are your lenses suitable, or will they require cutting in halves?)—AMATEUR. (See p. 206, No. 1,050; p. 94, No. 914; p. 116, No. 915, the indices of back volumes, and any of the cheap handbooks.)—ANXIOUS. (See previous answer.)—F. C. S. (The address of the Institution of Naval Architects is 5, Adelphi-terrace, W.C. The Earl of Ravensworth is the president.)—T. C. RHONDDA. (There are no regulations of the Board of Trade in connection with that matter. There are what are called the "conditions" of an efficient brake, and they have been frequently given.)—TESIG. (See p. 92, No. 1,071, or examine the valve of any gas-engine.)—J. W. B. (Bronzing gun barrels was explained as fully as possible in No. 1,035; but see also Nos. 1,044, 1,045.)—ALIOTH. (It simply means that a train must not enter a section until the driver receives the order to do so, by the lowering of the signal. The permissive system would allow him to run past if he saw the line was clear.)—TEMPLE. (It is simply a little piece of leather-faced wood hinged at one end, with a bit of wire and a lead weight at the other. A small hole permits the passage of wind, and the valve "trembles.")—J. S. C. (Certainly not; what has the lighting up to do with the number of streaks? 2. Tyndall's Belfast address will be found in Nos. 491, 492; It is also in "Fragments of Science," Vol. II., published by Longmans, and the same firm, we believe, issue it in a separate form.)—CONSUMPTIVE. (If you can get "any amount of cod's livers," don't waste them in making oil. Eat them. Epicures say they are delicious baked, fried, or boiled. If you must have the oil, cut the livers up and clean from blood, wash, and drain. Place with a small quantity of water in a vessel heated by steam. As the heat increases, the oil will rise to the surface; and can be skimmed off. Allow it to cool and settle, then filter two or three times through flannel, and finally through white blotting paper.)—M. SPENCE. (There is no work of the kind; but you will find information in Kemp's "Yacht Designing," and also in back volumes.)—PENDLETON. (For shocking coil, see p. 433, No. 1034; p. 152, No. 1047, and the indices generally.)—A. IRELAND. (Your query shall appear next week; we really do not undertake to reply to queries by telegraph.)—R. A. R. BENNETT. (Not an uncommon trick with unscrupulous publishers. Your friend's remedy is to apply for an injunction to stop publication, and then sue the publisher for damages.)

Pottery in the United States.—The report of the United States Potters' Association states that while in 1860 pottery was in a miserable condition, there are now about 275 kilns in operation in the United States. The total capital engaged in the industry is about 8,000,000dols. The amount of wages paid to the thousands of pottery hands is placed at from 4,000,000dols. to 5,000,000dols. per annum; and the annual value of the American pottery produced is upwards of 8,000,000dols. Up to 1863 there was no duty on imported crockery, but from that date a gradually increasing tariff has been imposed, until by the last addition it has reached the protective standard of 25, 55, and 60 per cent., the lowest rate being on common stoneware, and the highest on decorated porcelain. The imports of earthen, stone, and china ware, which reached the value of 8,693,273dols. in 1883, dropped under the blow of the last tariff levy to 4,368,531dols. They rallied a little in 1885, but they were still 2,207,903dols. less than in 1882. The best American makes include the opaque china of Trenton, made up after the models of the delicate French shapes; the Royal Worcester, also made at Trenton; the decorated table ware, which is admitted to equal much of the better French goods in design, tint, and colour; the hard French porcelain of Green Point, New York: the "Barboline" and "Limoges" made at Tarrytown; and the fine tiles of Chelsea, Trenton, and Pittsburg.

Cedar.—A correspondent of *Notes and Queries* states that the name cedar has been given very indiscriminately to cedars, cypresses, and junipers. It ought to be confined to that noble tree, the cedar of Lebanon, to which it was first given. This genus has but one true species, for the C. Atlantica, C. Taurica, and C. deodora, are mere varieties of the C. Libani. Their cones are indistinguishable. This I learned from the late Sir W. Hooker, and his son, Sir Joseph Hooker, has confirmed it. There is no higher authority. The timber is of extraordinary durability, but it is quite devoid of fragrance. The sweet-smelling wood of which so-called cedar pencils are made is a juniper, commonly called the Bermuda cedar.

AT the last meeting of the South Wales Institute of Engineers Mr. Archibald Wood, the president, gave some salutary advice to coalowners on economic washing, and remarked that in these days, when new motive powers were sought in electricity and in petroleum, too much caution could not be shown.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday, to insure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Tricycle, Coventry, 2-track, 50in. wheels, double-steerer, good condition. Offers in exchange.—FORD, 75, St. Paul's-road, Camden, N.W.

Want to exchange a 52in. **Bicycle** for 54in. ditto, value £7.—W. BARKER, Chepstow-road, Croydon.

Working Model Electric **Paddle Boat**, powerful Bichromate Battery, well made Motor, whole in faultless condition. What offers?—F. M., 41, Barnsbury-street, Islington.

Commutator, 48 sections, nicely fitted, small Gramme Dynamo, 10 am., 35 Volts. Offers, electric,—NELSON, 13, Orr-street, Glasgow.

Six-cell **Bichromate Battery**, carbons 2½ wide, polished mahogany frame, 16 by 12 by 4, for triple-wick Lantern. Mutual approval.—WRIGHT, 47, Blandford-street West, Ashton-under-Lyne.

Magic Lantern Slides.—Advertiser wishes to exchange for fresh ones. Comic slipping, Scripture, and a set—The History of a Grain of Rice; about 24 in all.—WALTON MOFFATT, Hexham.

Will exchange five solid **Steel Dies**, sizes from ⅜ to 1¼, for new 4in. Hot Water Piping.—Particulars from T. TIPPING, Painswick, Gloucestershire.

Remington **Type Writer**, prints capitals, cost £18, as good as new. Offers, by letter only, to W., 67, Azenby-square, Peckham.

Will exchange "**Bourne's Treatise on the Steam** ENGINE," 1846, 23 plates, good condition; for Vols. XXXVI. and XXXVII. ENGLISH MECHANIC, unbound.—A. HALE, 41, Tremlett-grove, Junction-road, London, N.

"**English Mechanic,**" large number of volumes, unbound. Wanted, light double-geared Head Stocks, 4½ or 5in. centre.—W., 22, York-road, Birkdale, Southport.

What offers? Half-horse Horizontal **Engine and** BOILER. Engine has governors, pump, &c. Boiler has all fittings complete.—PORTER, 62, Mantle-street, Wellington, Somerset.

Launch Engine, 3½in. link motion, and new gun-metal pump, wants putting together. Exchange offers.—SMITH, Stanley Villa, High-road, Gunnersbury.

Smee's **Battery** (gal.), lot of Steel and Agate Burnishers for plated goods, &c. Want good Leg Vice.—ELEY, 6, Edgar-road, Bromley-by-Bow.

Melodeons and Concertinas considerably under cost price. Melodions, 4s. 6d., 6s. 6d., with stop and bell, 10 keys, or exchange.—37, Tyneham-road, Lavender-hill, Battersea.

Flutes, several concert, 6 keys, tuning slide, 10s. 6d., each. F Flutes, 5 and 6 keys, 8s. 6d. Piccolos, 4s. 6d. and 6s. 6d., 5 and 6 keys. What offers?—37, Tyneham-road, Lavender-hill, Battersea.

Emery Wheels, three, 6in., 8in., and 10in. Exchange offers requested. Seen at RODGERS', 152, Bermondsey-street, S.E.

Steam Gauge, up to 100lb. pressure. Exchange offers.—RODGERS, 152, Bermondsey-street, S.E.

Engine, 2 H.P. vertical, wants little repairs, with pump. Exchange offer.—RODGERS, 152, Bermondsey-street, S.E.

$8\frac{3}{4}$in. **Metal Speculum** $2\frac{1}{2}$in. Achromatic O.G. Exchange. Offers requested.—W., 28, Hall-street, Bilston, Staffs.

Smee's Battery, six pint cells, amalgamated zincs, complete. What offers? Beginner's photographic set wanted.—R. HUGHES, 5, Lakefield-place, Llanelly.

Pair **Horizontal Engines**, 1in. bore, 2in. stroke, excellent working order. Exchange pair lathe heads.—HUNTER, Daisy-hill, Chester-le-Street.

Locomotive Engine.—Splendid set of Castings for the above, 15in. long, cylinder bored, &c., cost 50s., take half. Wanted a vertical boiler, 3ft. by 2ft.—R. P., 102, Teviot-street, Poplar, E.

Handsome **Gun**, central double breech, rebounding locks, left choke, horn heel plate, spring forend. Exchange for lathe or vice, &c.—GRIMSHAW, Paxton-street, Accrington.

Bench Drilling Machine, hand or power, drill to $\frac{3}{4}$, selffeed motion. Also Ditting Pillar, Ratchet, Pipe, Wrench, and a large modern Engineering Book, with 520 wood engravings. Will exchange for 1-H.P. Boiler, in good order, or offers. Particulars on application.—G. HOUNSELL, South-street, Bridport, Dorset.

For sale, splendid **Slide Valve Cylinders**, 2in. stroke, also 4 eccentrics, and 3 shafts, intended for loco., cost 36s. Exchange for Castings for a Launch Engine, 6in. stroke, single cylinder, or anything useful.—R. P., 102, Teviot-street, Poplar.

Strong **Fly Press**, 2in. screw. Offers requested.—H. B., 21, Pembroke-street, Copenhagen-street, Islington.

Burning Glass, 18in. diameter, melts lead in sun's rays, powerful condenser for any illuminant. Cost £20. Exchange offers requested.—W., 28, Hall-street, Bilston.

Rubber Stamp Apparatus, type, and full instructions. Cost 50s. Exchange offers.—W., 28, Hall-street, Bilston.

Six **Quart Cells**, zinc cylinders, about $3\frac{1}{2}$lb. each. Carbons, 8, $1\frac{1}{2}$, 1in. What offers?—WALKER, 37, Garnethill-street, Glasgow.

6in. **Lathe Head, T Rest**, back centre; also Jones' £9 Sewing Machine. Exchange for photographic apparatus or printing press.—JONES, 346, Upper-street, Islington.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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FRIDAY, SEPTEMBER 17, 1886.

NOTES ON THE CHAMBER ORGAN.—IV.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

CONSIDERABLE diversity of opinion obtains amongst organ builders and organists respecting the composition of Mixtures; but it is not my intention, in these Notes, to enter on any kind of discussion connected with the subject. I shall content myself by giving the composition of two Mixtures which I have tested and found to be perfectly suitable for introduction in the Chamber Organ. The first is of three ranks, composed as follows:—

C C to Gamut B	15 ...	19 ...	22
Tenor C to Fiddle B	12 ...	17 ...	22
Middle c^1 to b^1	12 ...	15 ...	17
c^2 to a^3	8 ...	12 ...	15

If the compass of the manual extends to c^4, five octaves, the highest octave—c^3 to c^4—should be composed of 1 ... 5 ... 10. This Mixture, if of small scale and carefully voiced, produces a pleasant bell-like quality; indeed, it was named by its originator—an organist of great celebrity—a "Carillon." The second Mixture is of five ranks, composed thus:—

C C to Gamut B......	19 ...	22 ...	24 ...	26 ...	29
Tenor C to Fiddle B.	12 ...	15 ...	17 ...	19 ...	22
Middle c^1 to b^1	8 ...	12 ...	17 ...	19 ...	22
c^2 to a^3 (or c^4)	1 ...	8 ...	10 ...	12 ..	15

This Mixture should be made of very small scaled (*Dulciana*) pipes, voiced to yield a delicate "silvery" tone, and regulated to the utmost nicety. When so treated it is most effective in both full and soft combinations. It is the Mixture I have introduced in my own organ, and which, as has been already said, can be played, in full chords, in combination with the softest unison stop of the instrument, producing an effect of the most charming character. In all respects it is preferable to the three-rank mixture first given. A stop comprising 290 pipes of so small a scale, all carefully voiced and regulated, is, of necessity, a rather troublesome and costly affair. On this account it will not be commonly introduced in Chamber Organs; but, from my own experience, I consider it well worth the money and trouble it costs. Its "harmonic-corroborating" tendency imparts great richness to the full organ tone, while it invests numerous soft combinations with almost indescribable charms.

Enough has been said, for the purposes of the present Notes, on the ordinary organ-toned and flute-toned stops, so a few remarks may now be passed on the string-toned registers, namely, those of the Viola-da-Gamba species, which more or less satisfactorily imitate the orchestral stringed instruments. A properly schemed Chamber Organ should contain either two or three stops of this class, of bright and assertive tones. They will frequently be used in rendering passages originally written for the violin or violoncello, and in producing, in combination, certain characteristic orchestral effects. For general remarks anent string-toned registers and their appropriate nomenclature, I may refer the reader to my article, entitled "*Suggestions for the Introduction of a Systematic Organ Stop Nomenclature*," on page 365 of the preceding volume. When a stop in imitation of the violin is introduced, it need not go below Fiddle G. If carried down to C C it becomes, strictly speaking, a Violoncello. Instead, however, of adding the bass to the manual register, where it will be most inconvenient on account of the space it requires, it will be advisable to insert a Violoncello in the Pedal department. In this case it should be a small-scaled, square, wood stop, on the Schulze model. I may mention that the late E. Schulze, of Paulenzelle, produced 8ft. and 16ft. registers of beautiful and strongly imitative quality, chiefly by a peculiar treatment of the caps of the pipes, and by the addition of a bridge-piece adjoining the mouths. Most effective examples of this class of stop exist, in the organ by him, at Hindley, Lancashire.

The chief difficulty attending the introduction of a Violoncello of this type is to voice it successfully on a light wind, that is, sufficiently soft for a Chamber Organ. The softer it is made the more it loses the string quality, and that peculiar rasping effect (like the bow on the string) which so materially aids the imitation aimed at.

The old-fashioned Viola-da-Gamba (conical pipes surmounted by bells), and certain small-scaled, cylindrical, pierced, and slotted Gambas are perfectly suitable for the Chamber Organ. They must be voiced, like all the other stops, to produce tones of a refined and delicate character; and must be very prompt of speech. Slow-speaking registers are of little value in a Chamber Organ. This is an important fact to bear in view.

It is the practice of some builders, as in the case of M. Cavaillé-Coll, to insert in nearly all their organs the stop designated *Voix Célestes*. In large instruments space may be spared for this purely fancy stop, but in small organs, and in Chamber-Organs in particular, the introduction of a stop of so little use is to be strongly condemned. It is formed of a rank of small-scaled metal pipes, drawn with the Viola-da-Gamba or some other soft-toned metal unison; and, through being made slightly sharper, produces with it a compound tone of a peculiar wavy or tremulous character. As I have remarked in a previous article (p. 342, Vol. XLIII.), "this stop cannot be said to be complimentary to the 'celestial voice,' at least, if it implies that it is affected with an everlasting vibrato; or that two celestial voices never sing together in perfect accord." However this may be, I am settled in my conviction that no stop which is invariably and systematically *out of tune* should be inserted in a small Chamber-Organ. The *Voix Célestes*, as an organ stop, is, to my mind, a specimen of trickery almost as paltry and undignified as the celebrated "barrel of pebbles" in the Lucerne organ. Perhaps there is some sort of relationship in their origin, seeing that both the "celestial voice" and showers of rain come from above. I have always been at a loss to understand what it is that has made the *Voix Célestes* so great a favourite with organ builders at home and abroad; and, I presume, from its frequent use, with organists also. To my ears, its prolonged use has a most irritating effect; but anything out of tune is, or ought to be, extremely unpleasant to a musical ear. Nothing in reason would induce me to introduce the *Voix Célestes* in my own organ, and, accordingly, I strongly advise it be omitted from the tonal schemes of all organs of a similar class. I dwell somewhat forcibly on this subject, for I have observed so frequently an absurd partiality on the part of organ builders for this specimen of out-of-tuneism. I have seen specifications for small organs of only four or five manual stops comprising the *Voix Célestes*. Could absurdity be carried further in the scheming of such small instruments?

In the construction of reed stops for the Chamber Organ the greatest care and skill must be exercised; for it is obvious that in an instrument which has to be listened to at a few yards distance at most, and generally only at a few feet from the keys, such assertive registers must be voiced with a degree of refinement altogether unnecessary in those intended for church and concert-room instruments. Distance, and the acoustic effect exercised by large buildings on the tones of organ pipes rarely fail to remove the harshness which may exist in reed and other loudly-voiced registers; but Chamber Organ stops are never, under ordinary circumstances at least, heard under the charm of distance or the advantage of any modifying acoustic effect. An apartment of moderate dimensions, carpeted, curtained, and in all probability overcrowded with stuffed furniture, is about the worst possible locality for such an instrument as an organ; it is entirely unsympathetic with aught that may be beautiful in its tones, while it provokingly accentuates its every imperfection. Let the reader imagine an organ containing about one thousand pipes, and in all essentials properly appointed, placed in a drawing-room measuring only 23ft. by 17ft., and 11ft. high, also containing a grand pianoforte and the usual drawing room furniture, and he will realise the full significance of the remarks just made. Yet I have known a Chamber-Organ of the size hinted at, and practically under the conditions detailed, so voiced as to be in all respects satisfactory; indeed, just as if it was made for its locality and no other.

Of the ordinary reed stops in the manual departments, the Trumpet, Oboe, and Clarionet are unquestionably the most suitable for the Chamber Organ; and all being unison registers, they impart great richness and dignity to the fuller combinations. As solo stops they are of the first rank. An octave reed stop is not of any real value in a Chamber Organ, and need never be introduced.

The Trumpet should be made to a medium scale, and voiced to yield a clear ringing quality of tone, free from that harsh, brassy character which appears to be aimed at by the generality of reed voicers. The diameter at the top of the C C pipe should not exceed 3½in., allowing for a wind-pressure of 2½in. or 2⅝in. The reeds used should be "open." As the tubes of the Trumpet can be mitred in any direction, generally with advantage to the tone, there is no difficulty, even in swell-boxes of only 5ft. internal height, in carrying the stop down to C C. On no account should such an important stop be inserted in an incomplete form, for the absence of the bass octave seriously impairs the general utility of the stop, and denudes it of the chief element of its grandeur.

The Oboe is a stop which should find an honoured place in every Chamber Organ, being invaluable in combinations of medium strength, and as a solo register. It ought to be of medium scale, shaded, and voiced with "closed" reeds. As the Oboe can also be mitred, it should, if possible, be of the full compass; but it is not so necessary as in the case of the Trumpet, that it should be carried down to C C. It may commence at Tenor C. This stop is usually voiced in two ways: one producing a soft, normal, reed tone of pleasing quality, mixing well with all classes of flue tone, and the other yielding a delicate sound closely imitating the orchestral instrument. The selection of either of these qualities may be left to individual taste in the generality of cases; but it may be pointed out that if a generally useful reed is aimed at, the former type is to be preferred: if a characteristic solo stop is desired, the Orchestral Oboe, as the latter variety is commonly called, is certainly the one to be selected. It produces charming effects in music of a light and pastoral character, and imparts an orchestral colouring to numerous combinations. In an instrument furnished with a Trumpet, as above described, the Orchestral Oboe is decidedly the most appropriate. As I have already said in an earlier series of articles (page 365, Vol. XLIII.), "The orchestral oboe only goes a note or two

below Middle c¹; accordingly the greater part of the two lower octaves of the organ Oboe has no relation to the instrument. As the fagotto furnishes the true bass to the oboe in the orchestra, the complete organ register may be termed Oboe and Fagotto, or, if preferred, Hautboy and Bassoon. The two octaves of bassoon quality thus obtained are of the highest value in a Chamber Organ, and in voicing the pipes every endeavour should be made to render their tones as imitative as possible.

As an imitative stop perhaps the Clarinet may be considered the most satisfactory of all the reeds yet introduced in organ building. On this account it should invariably find a place in every Chamber Organ worthy of the name. As its pipes occupy less room than those of any other reed stop—the CC pipe, producing the 8ft. tone, being only about 4ft. 10in. in total length and 1⅝in. in diameter—it can conveniently be carried throughout the manual compass. This stop is frequently labelled "Clarinet and Bassoon," the organ builder being apparently under the impression that the bassoon gives the true bass to the clarinet, or that the orchestral clarinets do not descend to the bass octave of the organ unison pitch. The orchestral clarinets, including the bass clarinet, cover the entire range of the organ manual keys. When skilfully voiced and regulated the Clarinet is a most charming solo stop, and also a valuable combination register. To enable it to be properly regulated throughout its compass, all its tubes, which are cylindrical in form, must be provided with sliding pieces at top, so as to allow of them being lengthened or shortened at will. On the perfect smoothness and equality of the tone, from the lowest to the highest note, depend much of the peculiar beauty and winning character of this stop.

The reed register next in importance (for a Chamber Organ) to those above mentioned is that known as the Vox Humana, and in which, as the name implies, the imitation of the human voice has been attempted. It must be granted that the insertion of this stop in a Chamber Organ is a matter deserving more than ordinary consideration. If good in tone, and perfectly adapted for its position, there can be no question as to its interest and value; but if it is voiced to yield the usual harsh, nasal sounds, and requires distance to lend enchantment to its tones, then it is an abomination in a room beyond the power of moderate language to describe. The expedient of giving artificial distance to this stop, by inclosing it in a separate box placed within the main swell-box, has only been to a small degree successful. By such means the tones of the stop are literally smothered; and it becomes a question if the cure, if so it may be called, is not worse than the disease. While I aim at imparting to the organ the highest possible powers of expression, I utterly condemn everything that muffles or circumscribes its free speech. If a Vox Humana is to be inserted in a Chamber Organ, it must be one made and voiced by the hand of a master specially for the position it is to occupy. All the delicacy and character required must be inherent in the stop itself; and, while distance cannot but impart additional charms to its tones, they must be independent of its ameliorating influence. That such a stop can be made I have satisfactory proof. It is well known that the imitative quality of the Vox Humana is almost altogether dependent on the vibrato effect imparted to it by the Tremulant, while it is vastly improved by the union of a very soft unison Flute; but it is not commonly realised that a well-voiced Vox Humana, without the Tremulant, is a valuable reed stop in combination with a variety of other registers. Such, however, is the case; and it is evident that the Vox Humana which is perfectly satisfactory in its dual capacity is the one to be adopted for a Chamber Organ.

In my opinion it is much to be regretted that English organ-builders have not given the construction of *free reed* stops their earnest attention; for had they done so the list of registers suitable for the Chamber Organ would certainly have been materially enriched. In this, as in some other directions connected with the art of organ building, it is apparently left to American builders to distinguish themselves. They are certainly producing some fine examples of free reed organ stops. In the Pedal department of my own Chamber Organ I have a very charming Euphonium, made by the king of American organ builders, Hilborne L. Roosevelt, of New York. Its tone is singularly pure, and, if one may be allowed the simile, as smooth as a piece of velvet. I am, of course, aware that examples of free reed stops have been inserted in English organs; but they present themselves to my mind as tentative essays, timid, and not altogether successful. The orchestral corno Inglese has usually been considered the instrument most easily imitated by free reeds; but how many examples are to be met with in this country I am unable to say. One appears in the Swell department of the organ in the Town Hall, Leeds. In the Choir of the same instrument is a free reed "Euphone" of 16ft. tone. Several free reed stops are known to me in Continental organs, notably those in the cathedrals of Lucerne and Fribourg, in Switzerland. In the former, the Fagotto & Clarinet and the Physharmonica, 8ft. tone; and, in the latter, the Physharmonica, 16ft. tone, and the Physharmonica 8ft. tone are constructed with free reeds. On examining these registers, I found the Physharmonica in the Lucerne organ to be of free reeds, inclosed in a special swell-box, but devoid of pipes*; while those in the Fribourg instrument are furnished with short inverted conical tubes, and also inclosed in a special swell-box. A stop of the latter class would be very suitable for a Chamber Organ; and, if voiced by some master hand in one of the "American organ" factories, would, I am sure, be a most pleasing addition to the ordinary organ tone. The Fagotto & Clarinet, in the Lucerne organ, has short pipes of tin rising from large square wooden boots.

With the above sparse and, I fear, unsatisfactory hints regarding the stops most suitable for the manual departments, I must conclude the present instalment. In my next I shall say a few words anent the registers to be recommended for the Pedal department of the Chamber Organ.

(*To be continued.*)

* It may be interesting to some readers to know that this Physharmonica was made by J. and P. Schiedmayer, of Stuttgart, a firm still in existence.

THE AMATEUR WORKSHOP.—XXV.

Self-acting Lathes.—(*Continued.*)

BACK-GEARED head-stocks may be made to mould in three different ways: one, in which the pattern is jointed in the longitudinal direction, is shown in Vol. XXXVIII. p. 164. In the other two the pattern is unjointed, and moulds either downwards or sideways. When moulding downwards—that is, upside down—drawback plates are necessary to lift away the sand over the lugs, or a single drawback plate can be used over the longer lugs, the shorter ones being skewered on. This is not a good plan with so small a pattern as ours. The other alternative is to mould sideways, the moulder's sand joint being made to follow the top edge of the pattern, while the hold-down boss, the bosses for the mandrel collars, and the lugs for adjustment, are skewered on. Fig. 269 shows the pattern thus made. This is given as an alternative to the method shown on p. 164 just now referred to, and although I have drawn pocket core prints, it would be as well, if power drills are available, to cast no holes in, but leave the bosses plain and solid. Still, if it is preferred to core them out, and the job is put into the hands of a careful moulder, he will stop them over neatly enough. There is, perhaps, rather less trouble in moulding from a jointed pattern; but the line of jointure will show in the casting, while in this case there would be no joint to show. Allowances for machining must be added to the dimensions given.

The pattern of the poppet can also be jointed, as in the instance figured on p. 164, or as an alternative it can be unjointed and moulded upon its side, on the same principle as the head-stock, or moulded instead, barrel downwards, the barrel being dowelled on loosely. Say we make the barrel in the bottom, then the pattern will have the appearance of Fig. 270, and this is a very common practice, everything being in favour of delivery, and the barrel is the only loose portion. The only hole cored will be one for the mandrel, ⅞in. in diameter, in the barrel.

In the matter of boring and facing, there are two courses open to our choice, one being to bore each casting with a fair regard to height of centres, &c., then to thread the two on a mandrel, and plane the bottoms of both head-stock and poppet off together. The other is to face the bottoms first, line out the centres, and bore them each in place, and preferably at one time. Assuming that the first course were adopted, the holes in headstock and poppet could be bored with a drill and broached out, the operation being done either in a lathe or on a drilling machine, or if preferred, instead of broaching the drilled holes, they could be finished with cutters set in a bar in the lathe. But perhaps the use of a planing machine had better not be taken for granted, and the making of a mandrel to carry the heads, and the setting of the same, and properly clamping down without the springing of either head out of truth, takes much time, and is not done without much care. Hence the readiest way is undoubtedly, in my opinion, to face the feet first of all, then to bolt the heads down to their own bed, line out the centres, drill holes through, under a machine, and finally bore and finish the holes with a boring bar and cutters. To obtain the correct centres, and to insure that they are alike for height, and also coincident with the centre of the lathe bed, the simplest way which I should recommend would be to make a templet of sheet metal (Fig. 271), as being better than attempting to scribe directly off from the bed with a scribing block on the four ends of the two heads. The templet will not be turned round, but always kept with one edge outwards when marking off each of the four centres. A small hole will be drilled as shown, and the centres marked directly therefrom with a scriber point through that hole.

Supposing the heads to be cast solid, which is preferable when power is obtainable for drilling, the centres will be marked directly on to the metal. Where holes are cored they must be bridged with hard wood, and the centres marked thereon. Strike the circles representing the holes, from these centres, centre pop carefully at intervals, and proceed to drill. After drilling, clamp the two heads down upon the bed in readiness for boring. Prepare two, or better still, three blocks of hard wood, and bolt these also down upon the bed, one at each outside end of the heads, and the third between the two, holes having been previously bored in each block corresponding exactly with the centres of the heads to be bored, the holes in the blocks being of such a size as to receive the cutter bar which will be used for boring the heads. The blocks will be marked off from the same templet as that employed for the actual heads. The bar is shown in Fig. 272. Three cutters corresponding with the holes in the poppet cylinder, and in the front and back of the headstock respectively, are inserted and fastened with wedges. The smallest hole to be bored is that in the poppet cylinder, 1in. in diameter, hence we cannot have a bar larger than ¾in. in diameter, and it should not be less. We could have stiffer cutters by boring headstock and poppet separately, using the same wooden blocks for both, and having the boring bar proportionally shorter. If bored together with ordinary care, their alignment must be practically perfect; if bored separately with the

FIG. 269.

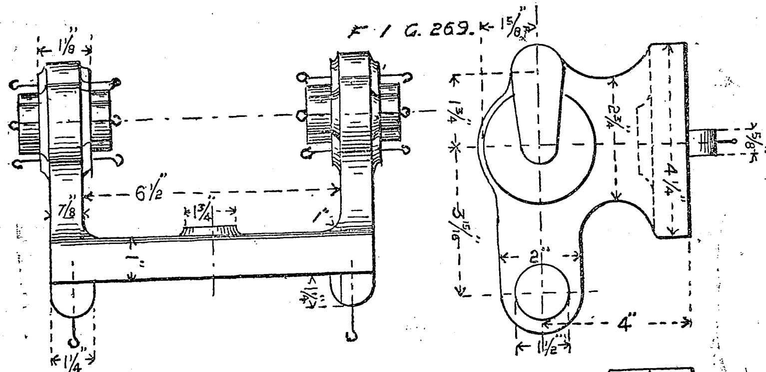


FIG. 270

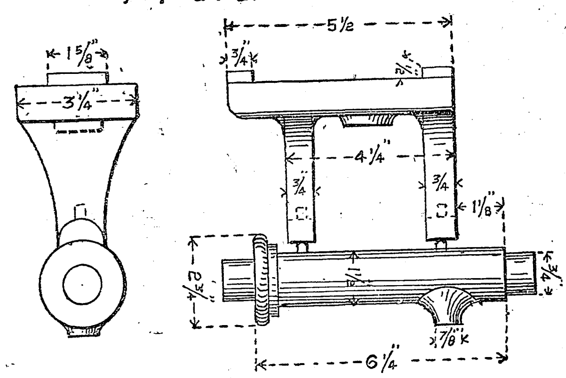


FIG. 272.

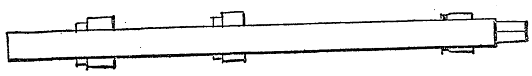


FIG. 271

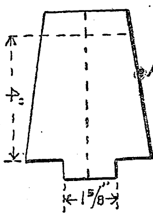


FIG. 275.

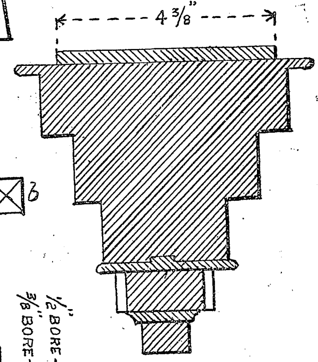


FIG. 277.

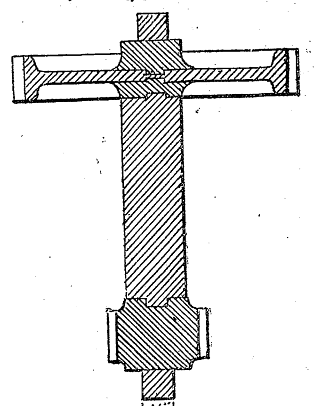


FIG. 273. SECTIONAL PLAN.

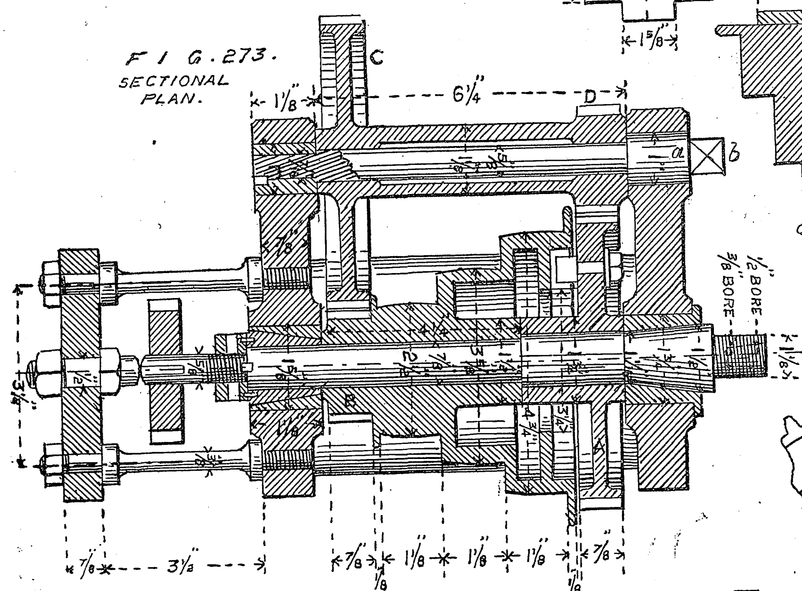
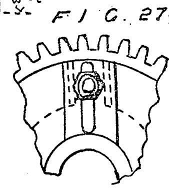


FIG. 274.



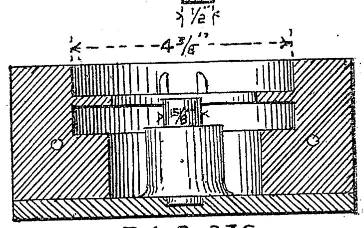


FIG. 276.

FIG. 278.

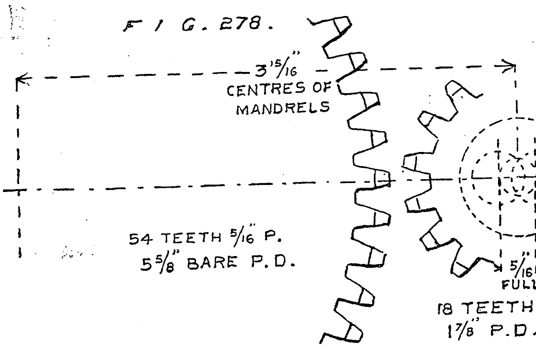
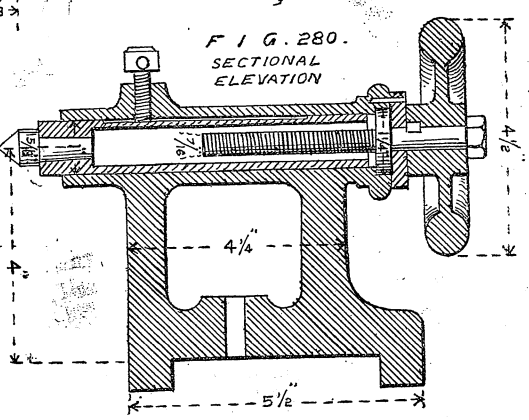


FIG. 280. SECTIONAL ELEVATION



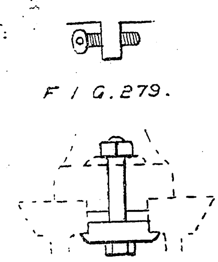


FIG. 279.

same blocks properly held down and not turned round, the same results ought to be attained, so that I think there is little to choose between the two methods. In respect to the manner of feeding the bar and cutters, at least three ways could be employed. One is to file one end square to take a spanner, and so turn the bar at the same time that it is fed forward by the poppet mandrel of a lathe, either of the same centres, or if of higher centres having the heads blocked up. Another is to let the squared end fit into a square hole chuck, and boring one head only at a time, bolt it to the saddle of a slide-rest, and so feed it against the cutters. A third will be to have the heads, either singly or both at once, bolted to a lathe bed, and the thrust of the boring bar taken by a block set at one end, the bar being traversed by means of a ratchet brace, which receives the squared end of the bar in its drill socket. This mode is shown in Vol. XXXVIII. p. 372. The cutters themselves may be made to cut at both edges, one edge being about $\frac{1}{64}$th in advance of the other, or on one edge only, as shown. The slot holes for cutters and keys will be first drilled, then filed out. The enlarged recess at the back of the poppet cylinder will be bored by setting one of the cutters out to the proper radius, and the faces of the various bosses will be turned with a broad-face cutter, right and left in turn.

I should recommend the fitting of hard gunmetal cone bearings to a lathe of this description in preference to those of steel. I know hardened steel cones are the orthodox thing, but nine-tenths of those not practically conversant with smith's and engineer's work would make a mess of the task, and unless properly done, they are better left alone. Gunmetal cones are, on the other hand, very easily fitted. Steel cones have to be welded as rings, or if small, bored from the solid, from shear or double shear steel, then turned, worst of all hardened, driven in, and ground in place. Gunmetal cones are cast, bored, and turned, and driven into place as simply as doing plain bushing, and they may be scraped or ground to a fit with the mandrel easily enough. The cones must not be made of common brass, but of good gunmetal, such as is used for bearings by good firms. Or if sent to the Phosphor Bronze Company, Summer-street, S.E., splendid bushes, tough, and almost everlasting, will be supplied in about a week. For the mandrel, a piece of steel rod of good quality is to be preferred to wrought iron simply, or to wrought iron having a steel neck welded on. The mandrel is turned to the dimensions in Fig. 273, and the coned neck and the end against which the back centre wears is hardened. In hardening, the nose is to be incased in clay to localise the heat, and preserve all but the coned neck as soft as possible. The colour for hardening should be a low red, and the mandrel should be immersed slowly and perpendicularly in water. After hardening, the coned neck should be ground in the lathe with a divided wood or lead lap, furnished with two handles for compression. The taper of the lap should be the same as the neck; consequently, there can be scarcely any longitudinal traverse, but there must be the least possible amount, just sufficient to prevent grooving by the emery.

The construction of the hinder cones is shown in Fig. 273. The headstock is there seen to be bushed with a cone driven tightly in, similarly to the one in front. Into this fits a reverse cone, which is bored also to fit the mandrel. Against the back of this abuts a collar furnished with a couple of projecting pins fitting into corresponding holes in the cone. The collar also slides on endways over a raised stud

or short feather sunk firmly into the mandrel at that point. At the back of the collar are two lock nuts. The collar, therefore, must revolve with the mandrel, and through the medium of the pins must drive the mandrel cone, and it cannot slacken back because the lock nuts hold it up to its work. These nuts are turned either with an ordinary thin spanner embracing flatted portions, or being circular, are furnished with holes for a tommy. The thrust of the back centre is taken by the bridge, which is retained in place by two pillars. The bridge can be slid off the pillars for the convenience of changing driver wheels for screw-cutting. A feather at the back of the mandrel receives these wheels. Another feather near the front end takes the main cog-wheel. The mandrel nose is screwed with eight threads to the inch, and the front bored up conical to the dimensions given, to receive the cone point.

I will now describe in as few words as possible the principle and the mode of construction of the mandrel-wheels and back-gear arrangements. The purpose of back-gear, I need scarcely say, is to cause an increase in cutting power with a corresponding diminution in speed. Whatever be the speed of the cone-pulleys, this increase and diminution takes place in the ratio of 9 to 1 in our example, the wheels and pinions numbering 54 and 18 teeth respectively. The back-gear spindle is thrown out of gear backwards in this instance by means of an eccentric, according to the common practice, instead of sliding endways, as is frequently the case in small lathes. The sectional view, Fig. 273, illustrates how the lathe is driven, either with or without back-gear. In the figure, the backgear is shown out —that is, the wheel A, which is slid on the sunk feather in the mandrel, is connected with the speed pulley, the locking nut being slid into contact with the grooves in the pulley face (see Fig. 274, showing front of wheel), and the backgear spindle is thrown back, so that its wheels are altogether out of contact with the wheels on the cone mandrel. Hence the mandrel is driven directly from the cone-pulley and at the same speed.

But when the wheel A is disconnected from the speed-pulley, the locking nut being slid out of contact with the grooves on the pulley face, into the open or clear space, the driving-belt turning the pulley carries with it the pinion-wheel B cast with it. This drives the wheel C on back spindle, and its pinion D also, because the two are cast on one sleeve. Pinion D drives wheel A, and the mandrel along with it, nine times slower than the cone pulley.

So much for the principle, now for the construction. Two gear-wheel patterns only will be required, one for the wheels A and C, and one for the pinions B and D. Let the wheel pattern be plated for convenience of alteration of bosses (see Vol. XLI. p. 250, where instructions are given for making wheels of this kind). Cut the pinion out of solid stuff according to the method described on p. 160 of the same volume. Turn the steps of the speed-pulley without giving any rounding in the pattern, and turn a plain stem for the connecting sleeve of the backgear wheels. Prepare the pattern of the pinion with the speed-pulley to be cast first, we will suppose, jointing the parts together with central turned studs, loosely fitting, for convenience of separation and delivery in the mould (see Fig. 275). The interior of the pulley will be cored out, the core box (shown in half-section in Fig. 276) being jointed longitudinally, and the strips being put on the ring in the box. To carry the core, a print 4⅜in. in diameter will be put on the one side, and one ⅝in. in diameter on the other. After this is cast, the wheel and pinion will be cast on the sleeve (Fig. 277), a boss being cast also on the front of the wheel. The core will be a chambered one (see Fig. 273), and carried by the two prints. Afterwards the wheel A, Fig. 273, will be cast singly, with bosses on back and front, and a thickening-up strip being fastened to the web, and a core print and core box for the slot hole being made. (See Fig. 274.)

The portions of these wheels which are necessarily machined are those in actual contact with bearing parts, as the bores and the faces of the bosses. But all other parts are turned up bright for the sake of true running and for good appearance. Hence slight allowances must be made for these in the patterns. It will be best in each case to bore the wheels first, and then to turn them upon an iron mandrel. Both operations require to be carefully done. A twist drill driven through with a light feed will answer for the holes, but it would be still better to impart a finish with a broach. A slight rounding is put upon the speed-pulleys, and a key-way is filed in the boss of the wheel to slide over the feather on the mandrel.

The mandrel for the back shaft has a solid eccentric turned at one end (Fig. 273, *a*). At the end opposite, a similar eccentric is keyed on. The mandrel is prolonged at *b*, into a square end, in order to allow of a spanner being used to throw the mandrel into and out of gear, and the amount of eccentricity is to be sufficient to allow the points of the teeth to clear, say, by ⅛in., when out of gear. As I have drawn the wheels, Fig. 278, the eccentric has a throw of $\frac{5}{16}$in. full at its extreme positions, so that the centres of the holes for the headstock and back spindle mandrels are 3$\frac{5}{16}$in. But it will be well not to drill the holes in the back-gear lugs until the wheel castings are made, and then to try these in gear, and take off their exact centres with compasses, both when in and when well out of gear, and take the mean for the centres of the holes, and half the amount of difference for the radius of eccentricity.

The back centre is simply a parallel, double-ended screw of steel, having a feather sliding in a key-way in the central hole of the bridge, which is of cast iron. The wearing end of the centre is hardened. The pillarets which carry the bridge are of wrought iron. Setting screws and hold-down bolt and washer (Fig. 279) complete the headstock.

At the present stage we suppose that the poppet cylinder has been bored truly in line with the headstock. The poppet mandrel can either be bored up out of a bit of solid wrought iron or steel rod, or it can be made from a piece of solid drawn hydraulic tube, into each of whose ends a bit of rod is either welded or screwed to form a collar of metal around the smaller holes to be subsequently drilled in it. The section (Fig. 280) shows this mode of formation, together with dimensions. The mechanism of the mandrel movement is also shown clearly in the same section, and requires no explanation. The screw may be either square or angular-threaded. The only portion of this work which is hardened is the centre point, the centre being, therefore, of steel.

HOW TO MAKE A MEDICAL COIL: WITH PRIMARY AND SECONDARY CIRCUITS AND REGULATORS TO BOTH.

By S. R. BOTTONE.

1. PROCURE a well-seasoned board of walnut about 21½in. in length, 3in. wide, and ⅜in. thick. From this cut one length 12in. long for the base board (Fig. 5) and three pieces 3in. square (like Fig. 4) for the coil heads; when cut, a fillet 8in. long must be nailed or screwed on the two sides of the base board (as shown at Fig. 5); these fillets should be ½in. square section. Corresponding square nicks must be cut of *two* of the square heads (as shown at *a*, *a*, *a*, *a*, Fig. 6). All the woodwork when thus squared and finished, should be soaked for a quarter of an hour in melted paraffin wax, and then rubbed dry while still warm.

2. Procure a thin brass tube (known in the trade as "triblet tubing") about ½in. diameter, 4½in. long; turn up a short plug and button to fit one end of this tube and serve as a handle (see Fig. 1, *a*). This may be fastened to the tube by driving in three fine brass brads, and filing off the heads flush with the tube.

3. Now cut up about 100 lengths of straight iron wire (best soft annealed) No. 22 gauge, say, about 4½in. in length; fill the brass tube with them as tight as you can fit them; cut them all to the same length (they must protrude a little beyond the tube). Now draw out about a couple of inches of the iron bundle, and wrap it tightly round with twine, leaving about ½in. free. Draw more out, and continue wrapping until you have wrapped to within ½in. at each end of the bundle. Tie the string, and withdraw the bundle from the brass tube. Melt a little solder in a ladle, dip the ends of the iron bundle into soldering fluid (zinc dissolved in hydrochloric acid), and then at once into the melted solder. Allow the bundle to cool; file off the superfluous solder, so that the bundle will just enter freely into the tube. It should appear like Fig 2 when the string has been removed.

4. The next operation is to make a good stout paper tube, also about 4½in. in length, into which the brass tube (Fig. 1) can slide easily. To make this, put a few turns of soaped writing paper round the tube No. 1, then roll and glue seven turns of good, stout brown paper, 4½in. in length, round this writing-paper, or else it will be difficult to draw out of the tube. This paper tube (Fig. 3) must be allowed to dry thoroughly while still on the brass tube (Fig. 1). When *quite* dry, it must be slipped off, the writing-paper lining drawn out, and then it must be soaked for a few minutes in melted paraffin wax.

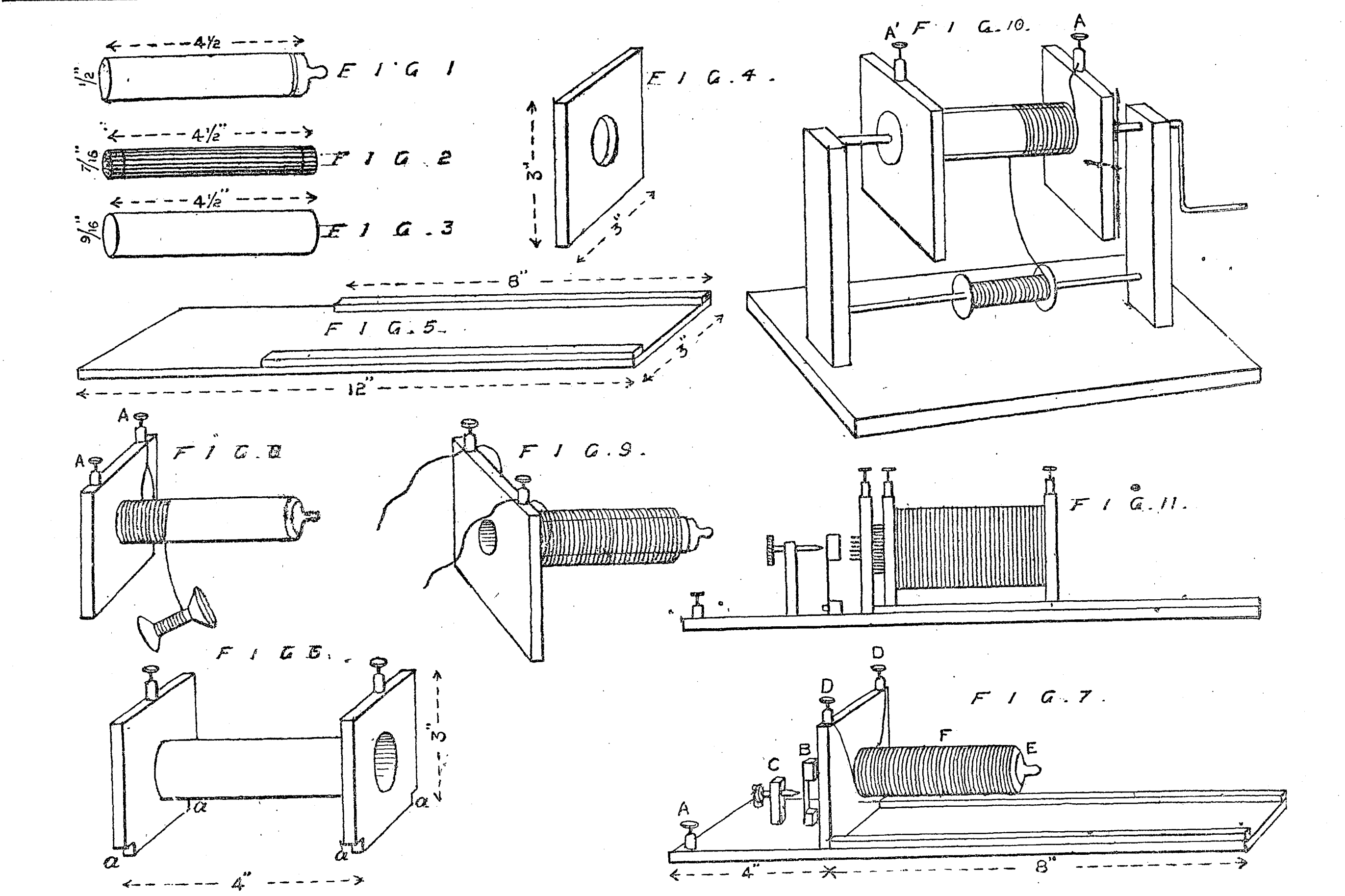
5. The iron bundle should also be allowed to stand in melted paraffin wax for some time, and then stood up to drain in a warm place. This will prevent rusting. When quite cold, all superfluous paraffin having been removed, a strip of brown paper, ½in. wide, is rolled round one extremity of the iron bundle, until it is of such a diameter as to fit tightly into the paper tube, Fig. 3. This paper strip must be cut off at this point, and glued tightly round the end of the iron bundle. The brass tube (Fig. 1) is then slipped over the iron bundle, until it just reaches the little paper collar just made. The brass tube and bundle together are pushed, button end first, into the paper tube Fig. 3, and when the paper collar around the iron bundle is just about to enter the paper tube, it is to be well served with hot glue and forced into the tube. The whole must now be allowed to dry and set thoroughly.

6. Taking one of the 3in. heads (the one which has not any nicks in the sides) we bore a central hole with a brace and centre bit, just large enough for the paper tube (Fig. 3), with its iron core, to fit tightly (see Fig. 4). Putting a little thin good hot glue round the free extremity (the end opposite that at which the brass enters), we push it into the hole in the square head, until it projects about ⅛in. on the other side. This must be allowed to dry thoroughly before proceeding to the next operation.

7. We may now proceed to wind the primary coil. To this end, we take about ½lb. of No. 24 silk-covered copper wire, and wind it round the tube, as shown at Fig. 8, from end to end in continuous layers, taking care to put a sheet of paraffined paper between each layer, and also to baste each layer with melted paraffin wax before winding on another. About four layers will thus be got on, and an even number of layers must be aimed at, so as to get the two ends of the wire at the same extremity, so as to be able to fasten them *under* the binding screws A A (Fig. 8). To effect this, before screwing down the said screws, the ends of the copper wire are stripped of their covering and wound once round the screw of the binder. Free ends of wire, at least 6in. in length, must be left for attachments, &c. This is shown at Fig. 9.

8. This primary coil, with its iron core, sliding brass tube regulator, &c., may now be fastened to the baseboard by means of two screws from underneath, as shown at Fig. 7, at 4in. from one end, and therefore 8in. from the other. One of the free ends of the primary wire is brought to one of the binding screws A, while the other connects to the clapper B. A short piece of wire connects the platinum screw pillar C to the other binding screw, which is not visible, as it is behind the platinum pillar. At this point it will be well to try the working of the primary coil. For this purpose couple up the two binding screws on the base board with a good bichromate cell. Connect the two binding screws D D (Fig. 7) with the two brass handles intended for use. Screw up the platinum screw C until the clapper B begins to vibrate. Now hold the handles in your hand. As long as the brass tube E is entirely over the iron core little or no sensation is perceptible. If an assistant pull out the tube, little by little, the current will be found to increase in strength until the regulator tube is quite out.

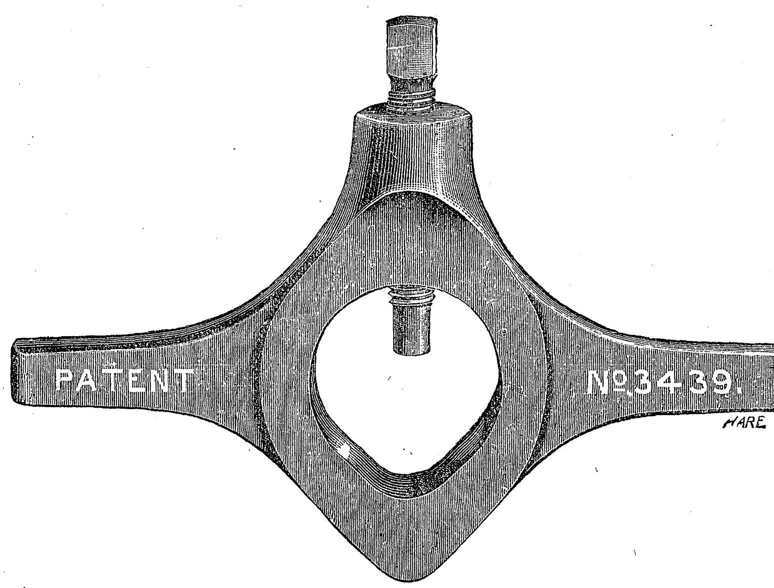
9. The secondary coil now demands our attention. A paper tube, precisely similar to Fig. 3, but of such a size as to slide *easily* over



the primary coil E, (Fig. 7), is prepared, and paraffined. This must be cut exactly the length of the coil F, leaving the knob E projecting. The two square pieces of board in which the nicks were cut (Fig. 6) must then have central holes cut in them to take this paper tube, and then glued, one at each end of the said tube, as shown at Fig. 6. Two small binding-screws are then to be inserted in the centre of the upper edge of each square. A bung is now placed in each end of the tube, and a ¼in. iron rod pushed through both, to serve as an axle. This is then mounted on two standards, as shown at Fig. 10, and beginning by attaching one end of the uncovered wire to the binding screw A, about ½lb. No. 36 silk-covered copper-wire is now carefully coiled on, being most diligent in avoiding kinks, breaks, or flaws of every description. Each layer must be paraffined and separated from its neighbour by paraffined paper. When the quantum of wire has been laid on, the finishing end is connected to the binding screw A¹ Fig. 10. The last coil should be covered with paraffined paper, and finally covered with a jacket of good silk velvet. The secondary coil is then complete, and may be slid in its place over the primary coil (see Fig. 11). When it is quite over the primary the secondary current will be at its strongest, if the metal tube regulator is drawn out; it will be weaker as the metal tube regulator is more and more inserted; or may be even more delicately regulated by sliding the secondary coil itself more or less over the primary. The secondary coil, while the primary is being excited with a freshly-made pint bichromate, will give a ½in. spark, when the regulator is out, and the secondary coil right over the primary. This will pass easily through a dozen persons.

DOUBLE DRIVING LATHE-CARRIER.

THE Britannia Company, of Colchester, have recently brought out a new patent double driving lathe-carrier, shown in the illustration annexed, the advantages of which will be seen at a glance. These carriers are in use in all sizes, from Nos. 1 to 6, at Woolwich Arsenal, and have found considerable favour elsewhere. The advantages claimed are—1. They equalise the strain, and reduce the thrust upon the lathe centres, thereby reducing the wear of lathe. When the lathe has not a Clement's driver an extra stud in the face-plate is required. 2. By their use truer work can be produced and saving of time effected. 3. They prevent the work being thrown out of the centres. 4. They are especially valuable when the work to be done is of large diameter. 5. The position of the grip screw prevents it being sheared off through being improperly used as



a driver, as is frequently done by the ordinary carrier. 6. They are made of steel, with steel set screws, and will be found to be the most handy and durable carrier yet introduced. 7. The price is but a trifle higher than the ordinary carrier. 8. The two wings act as handles, and are very useful as such when the work is heavy.

THE INVENTION OF RAILWAY COUPLINGS.

THE following remarks on railway couplings are from the *American Journal of Railway Appliances*:—There is something almost melancholy in the ignorance of the average coupler inventor and the public generally, relative to the state of the art, the amount of work that has been done, and the number of patents that have been issued for inventions of this class.

This multiplicity has been brought about to a great extent by the casual ventilation that the matter has received in the newspapers. A great deal has been printed about the necessity of having some form of automatic coupler that will protect the trainman from injury, and Railroad Commissioners and State Legislatures have been urged to take some action in the matter. Yet while all this was said and written not one word has been printed by these same journals regarding the requirements that must be met by the successful inventor.

That it is an easy matter to construct a device that will attach itself to another of the same sort, when the two are brought in contact, is witnessed by the four or five thousand patents that have been issued. Farmers, doctors, lawyers, merchants, and a very few railroad men have entered the race; and each has been encouraged by the patent lawyer to whom the application was intrusted to prosecute the claim and pay the fee. And now that the ball has started there seems to be no

chance of a stoppage. In the past two months of May and June the Patent-office issued sixty-two patents on car-couplers. Now, when the thousands that have preceded are taken into consideration it seems like a farce to think that any one of these sixty-two patents can embody any new or valuable features; and even if they do, what chance have they of success? Ignorance of the essentials, we repeat, is the probable cause of the trouble. What does the outsider, whose only contact with a railway has been as a passenger, know of the true coupler requirements? He simply knows that the coupler must fasten two cars together automatically, and be released from the outside, but knows nothing of the strength of the draw-bar, the cushion in drawing and backing, the slack required for starting, the necessity of being automatic with all kinds and degrees of draw-heads, and above all, of the absolute necessity for few working parts. The result of the travail is a complicated piece of watchwork that is no more suited to the purpose than a baby carriage would be for freight service.

This was particularly evidenced by the hook coupler that was on exhibition at the recent Master Car Builders' Convention at Niagara, and which, by the very multiplicity of its parts and utter unsuitableness, attracted a great deal of attention. The inventor brought it on, all the way from Kansas, and had evidently strained his resources to the utmost in order to meet his expenses, confident that could this child of his be once seen, the whole railroad world would be at his feet for the privilege of adopting it. His contact with the cold, hard facts that confronted him and told him that he was far behind in the race, must have been a staggering blow, and yet it is what all but a dozen or more of our sanguine five thousand patentees must receive. The coupler fiend which has so long been the terror of our railroad officials must soon become one to the Patent Commissioners, unless a little honesty is infused into the average of patent lawyers, and they can be induced to advise their clients not to try for a prize that is so far beyond their reach. But as this is a moral impossibility, it only remains to wait until the fever has run its course and died a natural death.

COLOUR VISION.

THE discussion on Colour Vision at the British Association was, as promised, carried on with some vigour, Lord Rayleigh opening by observing that the subject of colour vision having two sides had been treated rather from two opposite or divergent points, and it might be said that the recognised views on the matter were not altogether in harmony. From the purely physical point of view all light of defined refrangibility was one and undecomposable if the phenomena of polarisation are set aside. If that were the end of the matter the result would be in one sense very simple, and in another complicated. It would be conceivable with various mixtures of different kinds of light taken from different parts of the spectrum that each mixture might produce a perfectly definite effect. That, however, was not the case. No amount of practice in colour-matching or observation would allow the unaided eye to tell exactly what was the physical composition of a mixed light presented to it. It was well known that ordinary white light, as we had it from the clouds of the sun, was highly composite. It was possible to produce other kinds of white light than that by taking various kinds of light and mixing them together, and the unaided eye could not distinguish those various whites from the original white of the sun. However, we were able to make some distinctions. We recognised light as variously coloured, and the question of colour vision was to examine and analyse in what the power of the eye to distinguish chief kinds of light consisted. In that sense it was a physiological question, dependent entirely upon the properties of the eye. On the other hand it so happened that some of the methods by which the examination was most easily pursued was by physicists, and they had accordingly interested themselves in it. The first point established by the labours of various workers was that colour vision was threefold; that in ordinary people colours might be different in three ways. Perhaps the easiest way to understand that was to distinguish the differences of colour as dependent upon dilution with white and colour proper, or hue. The distinction of brightness everyone would understand—it was simply a question of more or less. Then there was the distinction, as for instance, between red and pink (using the words in a vague sense); and, thirdly, the colour distinction, by which was meant, for instance, distinction between the fundamental colours of red, yellow, green, blue, and violet. To prove that the ordinary colour vision was threefold, and threefold only, it was necessary to match colours. One of the simplest ways was by means of coloured discs so overlapping one another as to expose on the circumference sufficient of each colour to produce the desired effect. Lord Rayleigh gave several illustrations, and by means of Maxwell's triangle explained the relationship of one colour to another. Red and green give a yellow, so that yellow could not be a primary colour sensation; but the red and green, so far, might be. In this manner all colours but red, green, and violet might be proved not to be primary; but of course, it only proved negatively, not absolutely, that the three colours mentioned were primary themselves. The main difference between Hering's theory and Young's theory was in the latter's assumption that a mixture was more complicated than its ingredients. Then there was a further field in those described as colour-blind people. The term was incorrect, for these cases were only instances of partial colour-blindness. By comparing these defective colour visions with the ordinary colour visions complicated questions would arise, and to these Lord Rayleigh devoted the remainder of his paper, pointing out the arguments *pro* and *con.* in regard to some of the theories raised.

Dr. König said one could explain all phenomena of colour perception by supposing that each surface element of the retina consisted of three constituents, each of which when affected caused a different colour sensation. On this supposition all the various shades of colour were resultant of three fundamental sensations originating in those constituents. Young proposed red, green, and violet as the fundamental sensations, and a self-evident conclusion was that the sensation of white was the resultant of the simultaneous action of all three constituents. The knowledge of facts was too meagre to prove the ideas of Thomas Young till thirty years ago, when Maxwell and Helmholtz saved those ideas from utter oblivion. The results of the former's investigations must be greatly valued, because they contained the first measurements of spectral light. Latterly, more exact measurements had been carried out, and they were now extended to the whole spectrum by himself and his colleague, Dr. Dieterici. Dr. König detailed the method adopted to secure these measurements, and described the apparatus used. There were persons, he said, who could distinguish no different shades of colour, having one elementary sensation only. Another and more numerous class of persons were those called colour-blind, in whose case the whole spectrum could be divided into two parts. The third and very large class included all those not belonging to the former two. At great length Dr. König detailed the technical results of his researches, which, he contended, served to prove that Young's views, slightly modified by modern experiments, were perfectly correct.

Dr. Michael Foster discussed the subject from the physiologist's point of view, which he said was in antagonism to the physicist's in several radical points. He mentioned that the "pernicious practice of smoking" had the result, if persisted in for a long time, and particularly if the smoker confined himself to a particular kind of tobacco, of producing colour-blindness in the very central field of the red. We all of us were more or less colour-blind in the outside of the pupil; but those people who were called colour-blind really had, as it were, a patch cut out in the middle of their retina where they were colour-blind. They could not see red, or they could not see green; they called green yellow, and so on, and there was the further stage where they had no sense of colour at all. The more physiologists knew about the living body, the nearer they drew to the completion of the theory that there were two processes always going on in the body—a building up and breaking down. In the theory of colour perception this idea was carried out in the supposition that certain rays of light acting on the retina broke down its substance, and produced the sensation of colour from these rays, and certain other rays broke down the substance of the retina and produced another sensation of colour. When the breaking down went on, the sensation produced was yellow, and when blue rays fell upon the same substance of the retina it was built up. Then they came to a point where the breaking-down and the building-up neutralised each other, and they had no sensation of colour at all, or, in other words, colour-blindness. He alluded to the difficulty experienced by people partially colour-blind not being willing to submit to experiments. He could not come to the conclusion that yellow was a mixed sensation, and Hering's theory pleased him because it reserved colour from that degraded position.

Mr. J. Tennant, referring to Hering's and Young's theories of colour vision, pointed out that they had three independent variables, and led to the same general results. Dealing with the point of simultaneous contrast, he said that the only possibility of deception of the judgment lay in the fallibility of the memory. Simultaneous contrast was a real and not an illusory effect, and demanded a physiological explanation. Without accepting Hering's theory as established, he said that it formed the best working hypothesis in the immediate future.

Prof. Haycraft said he was no wiser after the discussion, and he did not believe anyone else was.

BRITISH ASSOCIATION.

ABSTRACTS OF REPORTS, PAPERS, &c.

Tidal Observations.

THE report of a committee consisting of Profs. G. H. Darwin and J. C. Adams, stated that the Indian tidal results, and those given in the various reports to the British Association, had been reduced by Major Baird to the standard form recommended in 1883. To these had been added the results derived by the United States Coast Survey, and the whole had been published in the *Proceedings* of the Royal Society. In the course of the Indian tidal observations a discussion had arisen as to the determination of a datum level for tide-tables. The custom of the Admiralty was to refer the tides to "the mean low-water mark of ordinary spring tides." This datum had not a precise scientific meaning. It was now proposed to adopt as the datum level of any new ports in India for which tide-tables were to be issued an authoritative datum, to be called "the Indian spring low-water mark." This datum was found to agree pretty nearly with the Admiralty datum, but was usually a few inches lower. The committee also presented a report on the "Harmonic Analysis of Tidal Observations." The report showed how harmonic analysis might be applied to the reduction of a short series of tidal observations, such as might be made when a ship lay for a fortnight or a month in a port. The examples given afforded evidence of the utility of even so short a series of hourly observations as would extend over a fortnight. An attempt was made to detect the 19-yearly tide. There were but few ports for which a sufficient map of accurate observations were accumulated to make the detection of the 19-yearly tide possible. From calculations founded on the values of the mean sea-level at Karachi for fifteen years (supplied by Major Baird), it was obvious at a glance that the oscillations of sea-level were not due to astronomical causes. The figure obtained showed that the actual change of sea-level between 1870 and 1873 was nearly 0·25ft., and this was just about nine times the range of the 19-yearly tide—viz., 0·028ft. It was thus obvious that this tide must be entirely masked by changes of sea-level arising from meteorological causes. It seemed unlikely that what was true of Karachi and Bombay was untrue at other ports, and therefore they must regard it as extremely improbable that the 19-yearly tide would ever be detected.

Electrical Standards.

The report of the committee on Electrical Standards was presented by Mr. R. T. Glazebrook, F.R.S. It contained the results of observations on the values of standard resistance coils by himself, Mr. T. C. Fitzpatrick, and Mr. J. T. Bottomley. Eighteen standard coils had been tested during the year, and certificates of their value issued. The attention of the secretary was called to the fact that the paraffin in some of the coils showed a trace of green colouration round the edges. This had been shown to arise from the action of a small amount of acid left in the paraffin on the copper of the case and connecting rods, and the committee were considering how to deal with the difficulty. At present the insulation resistance of the coils was extremely high, amounting to as much as 8,000 megohms. The committee expressed their sense of the great desirability of establishing a national standardising laboratory for electrical instruments on a permanent basis, and their readiness to co-operate in securing the same. The committee applied for reappointment, and for a grant of £50.

Report of Electrolysis Committee.

As the result of the discussion on electrolysis which took place last year at Aberdeen, a committee was appointed to investigate the subject. A number of observers have been working independently, and a few of their researches were communicated as an interim report. These papers will be printed and circulated among the members of the committee before appearing in the annual report of the association.—Prof. Oliver J. Lodge gave an account of his investigations on the migration of ions, as tending to confirm by direct experiment the velocity numbers calculated by Kohlrausch from conductivity data.

Magnetic Observations.

Prof. Balfour Stewart brought up the second report of the committee appointed for the purpose of considering the best means of comparing and reducing magnetic observations. Since the last meeting of the Association Mr. G. M. Whipple had made a comparison between the method of obtaining the solar diurnal variation of declination adopted by Sir E. Sabine, and that of Mr. Wild. These methods were applied to three years' observations at the Kew Observatory, and the results were compared with those deduced by the As-

tronomer Royal from the same three years at Greenwich. The committee thought that this comparison deserved careful study, but they did not feel themselves able to pronounce as yet upon the comparative merits of these various methods. Nevertheless, they were of opinion that it is highly desirable to record the daily mean values (undisturbed) of the three magnetic elements side by side with their solar-diurnal variations. After giving the results of observations, comparisons, and calculations made by various members of the committee, the report stated that extensive comparisons between the simultaneous traces of magnetographs in various places, combined with the Greenwich results obtained by Sir G. B. Airy, Astronomer Royal (who with other eminent observers had been added to the committee), seemed to show that an easy approximate method of recording earth currents might be obtained from magnetograph indicators. Observations by Prof. Stewart and Lant Carpenter appeared to show that there was some relation between solar disturbances and wind values. Prof. Stewart had pointed out certain general considerations which appeared to indicate that the solar diurnal variation might, perhaps, be caused by electric currents in the upper atmospheric regions. Dr. Schuster had made a preliminary application of the Gaussian analysis tending to confirm this hypothesis. His conclusions were sufficiently well-confirmed by observations, and thus rendered hopeful the first attempt to apply the Gaussian analysis to the solar-diurnal variations.

Fossil Plants.

Prof. H. Woodward read the report of the committee appointed for the purpose of reporting on the fossil plants of the tertiary and secondary beds of the United Kingdom. The results of their researches pointed to the conclusion that while the section known as Gymnospermus, to which the Coniferæ belong, was of the highest antiquity, being almost coeval with the first definite remains of plants in the Palæozoic age, there were no Angiospermous plants in British rocks of greater antiquity than the secondary period, except the problematic plant known as Spirangium. The same absence of Angiosperms, so far as British rocks are concerned, is continuous throughout the Neocomian and Gault, and it was only in the white chalk that they met with any indications of them, and these only took the form of a more than suspicious impression of a net-veined leaf, in the Jermyn-street Museum, and of some structureless bodies which were apparently some kind of fruit. Amongst the most interesting of recent discoveries was that of a plant remains in a small sandpit at Colden Common between Bishopstoke and Winchester, the first locality in the Hampshire basin that had yielded any of Woolwich and Reading age. Fruits and even flowers were comparatively abundant at Bournemouth, and the series now obtained numbered nearly one hundred specimens, being by far the richest of fossil Smilaceæ perhaps of any family ever brought together. Sir William Dawson read a paper on "Canadian Examples of Supposed Fossil Algæ." He explained that markings of various kinds on the surfaces of stratified rocks have been loosely referred to algæ or Fucoids under a great variety of names; and when recently the attempt was made in Europe more critically to define and classify these objects, a great divergence of opinion developed itself, of which the recent memoirs of Nathorst, Williamson, and others might be taken as examples. The author, acting on a suggestion of Sir R. Owen, was enabled, in 1862 and 1864, by the study of the footprints of the recent Limulus polyphemus, to show that not merely the impressions known as Protichnites and Climactichnites, but also the supposed fucoids of the genera Rusophycus, Arthrophycus, and Cruziana are really tracks of Crustacea, and not improbably of Trilobites and Limuloids. He had subsequently applied similar explanations to a variety of other impressions found on Palæozoic rocks.

Report on Underground Waters.

Mr. C. E. De Rance, F.G.S., read the report of the committee of inquiry into underground waters. During the thirteen years that investigation had been going on, much accurate and valuable information had been obtained. The complete dependence of the supply of underground waters to the proportion of annual rainfall varying with the amount of rainfall and the character and porosity of the strata on which the rain fell, had been completely established; varying from 1in. to 12in. of rainfall annually absorbed on each square mile, 1in. of rain giving 40,000 gallons per day for each square mile of surface exposed. The great value of underground supplies had been shown during severe drought, the dry-weather flow of the streams and rivers being wholly dependent on underground supplies issuing as a deep-seated spring. That a large quantity of water could be obtained by deep wells in suitable situations was well shown by the Corporation supply at Birmingham.

Evidence of Pre-Glacial Man in North Wales.

Dr. H. Hicks, F.R.S., read a paper on "Evidence of Pre-Glacial Man in North Wales." He described the conditions under which some flint implements had been discovered during researches carried on by Mr. E. B. Luxmore and himself in the Ffynnon Beuno and Cae Gwyn caves in the Vale of Clwyd in the years 1884-86. These caverns were explored by himself and friends for the first time in 1884, and some of the results were given by him in a paper at the last meeting of the British Association. The facts then obtained had led him to the conclusion that pleistocene animals and man must have occupied the caverns before the glacial beds which occur in the area had been deposited, as it had been found that, although the caverns are now 400ft. above Ordnance datum, the materials within them had been disturbed by marine action since the pleistocene animals and man had occupied them. Moreover, deposits with foreign pebbles, similar to those in the glacial beds, were found in the caverns, overlying the bones. Last year a grant was made by the British Association for the purpose of carrying on the exploration, chiefly with the object of getting further evidence as to the age of the deposits in the caverns. The results obtained this year were highly confirmatory of his views, and had an important bearing on the antiquity of man in Britain. It was found that the main entrance to the Cae Gwyn Cave had been blocked up by a considerable thickness of glacial beds, which must have been deposited subsequently to the occupation of the cave by the pleistocene mammals. A shaft was dug through these beds in front of the entrance to a depth of over 20ft., and in the bone earth which extended outwards under the glacial beds on the south side of the entrance a small, well-worked flint flake was discovered, its position being about 18in. beneath the lowest bed of sand. It seemed clear that the contents of the cavern must have been washed out by marine action during the great submergence in mid-glacial times, and then covered by marine sand and an upper boulder clay. He believed that the flint implements, lance heads, and scrapers found in the caverns were also of the same age as the flint flake—hence that they must all have been the work of pre-glacial man.—Prof. Boyd Dawkins said those who had read his works would know that he was not in favour of accepting evidence on this question of the antiquity of man that was not absolutely conclusive, but he must say that he fully accepted the conclusions which Dr. Hicks had so well put before them. The small splinter of flint which was found was as good evidence of the presence of man in the preglacial time as if they had found a watch; and thus they were driven to the conclusion that man was living in the Vale of Clwyd before the deposits took place.—Mr. Durance expressed a similar opinion, and Mr. W. Pengelly said the first flint implements found were nodule tools, and then came flake tools. It was therefore possible for a mere flake to be evidence of human existence, and he believed this was a case of the kind. Though he should not call it an implement, he as firmly believed in its artificial origin as that a tailor made the coat he wore. To him it was a delicious discovery, inasmuch as he had for long stood to a great extent alone in the opinion that the nodule flint tools in Kent's Cavern were of pre-glacial make.—Prof. Lebour suggested that for the sake of accuracy Dr. Hicks should substitute the word interglacial for pre-glacial in his paper.—Dr. Garson remarked that the questions which would naturally occur to the minds of those who had listened to Dr. Hicks's paper would be—what was the date of the glacial period? How long back had they evidence of man's existence? The secular variations of climate had been shown to be caused indirectly by changes in the eccentricity of the earth's orbit. This gave the means of ascertaining the date and duration of the glacial period. If it was found that these flints were the work of pre-glacial or even inter-glacial man, as there seemed to be very little doubt, after what they had heard, they had direct evidence of the long period during which man had existed; and the opinions of human morphologists were confirmed by independent and direct geological evidence.

Westward Extension of the Coal-Measures.

Prof. Boyd Dawkins, M.A., F.R.S., read a paper on "The Westward Extension of the Coal-Measures into South-Eastern England." He said that geological evidence is conclusive that the valuable coalfields of South Wales and of Somerset are connected with the equally valuable coalfields of North France and of Belgium, some 1,200 square miles in extent, by a series of isolated fields or basins concealed by the newer rocks. The strata of the North French and Belgian carboniferous rocks, if carried westwards into South-eastern England, as Mr. Godwin Austen has shown, would bring them into the district between Hythe and Sandwich. The probability that the coal-measures will be struck in this district is rendered greater by the discovery of a mass of bituminous mineral in a fissure in the chalk north of Dover, that has probably, as Mr. Godwin Austen pointed out in his evidence before the Coal Commission, been derived from the coal-measures below. By the kindness of the council of the Geological Society the writer had been allowed to make a minute examination of Mr. Austen's specimens, and he found that the mineral is a pitch which has resulted from the distillation of coal. The interest attaching to the experimental boring undertaken by the Directors of the South-Eastern Railway is very great. If the coal-measures are proved, a discovery of vast importance will be made. If, on the other hand, rocks older than the carboniferous are struck, they will offer a basis for further borings, which will ultimately result in the discovery of the hidden coalfields of South-eastern England, and cause as great an economic revolution in that region as that which has been caused in France and Belgium by the discovery of the coalfields underneath the chalk.

A New Sunshine Recorder.

Mr. W. E. Wilson explained a new sunshine recorder. The instrument consists of two parts, one of which—the indicator—is affected by the sunshine, and the other registers the indications. The indicating apparatus was a differential metallic thermometer, made of a spiral of two metals (zinc and steel) soldered together. Half of the spiral is right-handed, and the other half is left-handed. The complete spiral is fixed at its upper end. At its lower end a lever or pointer is attached. The upper half, or right-handed portion, of the spiral projects through the roof of a ventilated box, and is exposed to the sunshine. The lower or left-handed half is in the shade. Any change in the temperature of the air does not cause the lever or pointer to move, as the upper half of the spiral tends to move it as much in one direction as the lower half tends to move it in the other. When the sun shines on the exposed upper half, the lever moves and completes an electric circuit, which passes through the recording part of the apparatus. The recorder consists of a drum, driven by a clock. The drum revolves once in 24 hours, and is mounted on an axis, with a screw of ten threads to an inch, which turns in a nut. This gives the drum a slight longitudinal motion, as well as its motion of rotation. The clock makes an electric contact once every minute, and the electric circuit is led through an eletro-magnet, which causes a pricker to strike the drum when the circuit is complete. The circuit is led through the lever, &c., of the bi-metallic indicator, and is only closed when the sunshine causes the lever to close it. When the circuit is complete the electro-magnet pricks off dots every minute, which represent so many minutes of sunshine. The drum is of such a length that it holds the daily record of sunshine for three months. The instrument is also made to give the total time during which the sun shone in the day.

Photometric Standards.

Mr. Stepney Rawson contributed a comparison of the "Harcourt and Methven Standards of Light." The author explained the growing necessity for a reliable Governmental standard of light, remarking that the time-honoured "Parliamentary candle" was the last standard which scientific men would dream of making compulsory. He showed two of the standards to which reference was made in the report of a committee appointed by the Board of Trade in 1881. These were the Harcourt air-gas lamp and the Methven screen. The improvements made in the former since the last meeting of the British Association consisted in an adjustable black background screen for protecting the eye from the light of all but the upper point of the flame when regulating the height, and thereby enabling the exact height to be determined more accurately; also in a rack and pinion movement, with a scale engraved in millimètres, for setting the height of the platinum wire. Besides these there was an entirely new method of preserving an accurately even rate of drop of pentane for feeding the lamp in the portable form exhibited. This device consists in producing a perfectly constant head by providing an overflow outlet from which the excess of pentane drops into a small bottle, which can be removed when necessary and emptied into the main reservoir, which is on the top of the lamp, the bottle forming a stopper to the reservoir to prevent evaporation. The rate of drop into the lamp is regulated with great delicacy by letting the pentane flow down a glass tube, in which there is a constricted passage which can be more or less closed by a fine platinum wire, which can be screwed in or out of it by means of a screw-thread working in a cap at the top of the tube. The method is due to Mr. W. F. Donkin. In other respects the lamp remains exactly as described by Mr. Vernon Harcourt at previous meetings of the Association. The Methven screen is one of the form as now constructed, but differing from that upon which the committee reported in 1881. The author showed by a diagram the errors intro-

duced by the alteration of form, amounting to fully 16 per cent. below its normal value. He gave the result of observations made by Mr. W. F. Donkin and himself, and showed that the errors may be determined theoretically, and were practically coincident with the result of observations.

Electric Illumination of Lighthouses.

The first paper was by Mr. Hopkinson, M.A., D.Sc., F.R.S., upon "Electric Illumination of Lighthouses." The paper related to the cost of the electric light in lighthouses, and suggested a method of reducing the same. It had hitherto been supposed, the writer said, that it was not possible to establish and maintain an electric lighthouse at anything like the expense of a first-class light in which paraffin-oil was used in the ordinary way. The high expense of the electric light arose in great measure from the fact that the machinery was placed at a distance from the lantern, so that two attendants were always required on duty. The writer's suggestion was that a small gas-engine and dynamo should be provided in a room immediately below the lantern for use in fairly clear weather, and much more powerful machinery, for use only in thick weather, be provided outside the tower. It would then only be necessary that two attendants should be on duty in thick weather. It was shown that, so arranged, an electric lighthouse would involve an expense, initial and annual, approximately the same as that of a first-order light of ordinary construction, with the advantage of enormously greater power in thick weather.—Mr. J. R. Wigham concurred with the writer of the paper with regard to the advantage of using large lenticular lights for the illumination of lighthouses. He had advocated long-focus lenses for many years. As to the question of cost, he said it was highly desirable that they should endeavour to bring down the cost of all powerful lights. Mr. Hopkinson's method of doing this seemed promising. There was a divergence of opinion as to the extent to which the electric light exceeded other lights in fogs. It would be well for the maritime public to withhold its judgment, and not to expect that the electric light was more powerful in fog than any other light. For his own part he had great doubts on the subject.—Sir William Thomson said that many people were under the impression that the electric light was less potent for penetrating fog than gas-light. He thought he was right in saying that there was no discoverable difference in penetrating power in either lights. When the fog was such as to redden the sun or moon, then for piercing power gas or oil would be found to be of superior quality, but when the fog left the sun white there was no sensible difference in either light.

Mr. J. R. Wigham read a paper on points connected with the illumination of lighthouses. He spoke, first, of a new method of burning oil, by surrounding the flames of the lamp with cylindrical walls of air instead of glass; and next of a new form of light for lighthouses. The new form of light was a group-flashing light of a different kind to those now in use. Instead of causing the lenses to revolve round a central light, he caused two, three, or more lights to revolve with the lenses, the relative positions of light and lenses being maintained. By this arrangement he was enabled to give the full power of each light to the mariner, and at the same time materially to reduce the cost of lenticular apparatus. He used two instead of eight or six lenses, while by intermitting the lights he had a combination of a striking and perfectly novel character. He also referred to a new illuminant for lighthouses, and remarked that in connection with his gas-light he used a solid carbonaceous body, converted into vapour, and made to produce intensely white light by compressed oxygen. He used the oxygen at a pressure of about 1,000lb. to the square inch. The naked light of a triform on this principle would have an illuminating power quite as great as the highest power of the most powerful electric light or combination of electric lights.

Delany's Multiplex Telegraph.

Mr. W. H. Preece explained "Delany's System of Multiplex Telegraphy." The growth of electricity, he said, thanks greatly to the introduction of the halfpenny-a-word tariff, had been so great that the Post Office had been compelled to adopt every possible contrivance that has been suggested or invented to improve the capacity of wires for the conveyance of messages. It was thought a very wonderful thing many years ago that two messages could be sent along a wire at the same time; but this was eclipsed when it was shown that it was quite possible to transmit four messages on one wire at the same time. This system has now been improved, and they were able to transmit messages at from 400 to 450 words per minute, and to send two, three, four, five, or six messages in one direction or another at the same time, by a method which they called the hexode. The new method was based on the principle of distribution. All the existing apparatus could be utilised. Synchronism was for the first time rendered almost perfect. It was quite possible to send 72 messages on one wire at the same time, but the rate at which they could be transmitted would be very slow. The maximum work which they got out of the wire now was when six messages were sent. A cause of disturbance in the working was due to electro-static induction, caused by the authorities being compelled to put wires underground. This was a matter of very serious consequence to the Telegraph Department. It slowed the rate at which currents passed; it diminished the capacity of the apparatus in question, and whilst they had no difficulty in sending six messages between Birmingham and London, they could only send four between London and Manchester, and places of an equal distance.—Sir William Thomson said the method was one of the most beautiful and practical realisations in telegraphy. [We described Delany's system in No. 992, p. 69.]

Stellar Spectra.

Prof. E. C. Pickering, in the course of a paper on this subject, said the spectra of ordinary stars, whether examined directly by the eye or indirectly by means of photography, presented little variety. The comparatively few cases of deviation, therefore, were particularly interesting, and the occurrence of bright lines in a stellar spectrum constituted, perhaps, the most singular exception to the general rule. The photographic observations which had been undertaken at Harvard College observatory, included a series of photographs of the spectra of all moderately-bright stars visible in that latitude, and four other spectra with bright lines had been brought to the knowledge of the observers.

Induction in Telegraph Wires.

Mr. W. H. Preece, F.R.S., gave an account of some experiments on electric induction between wire and wire. He prefaced his remarks by stating that along the Gray's Inn-road, London, the Post Office had a line of iron pipes buried underground, carrying many telegraph wires. The United Telephone Company had a line of open wires along the same route over the housetops, situate 80ft. from the underground wires. Considerable disturbances were experienced on the telephone circuits, and even Morse signals were read which were said to be caused by the continuous and parallel telegraph circuits. A very careful series of experiments proved unmistakably that it was so, and that the well-known pattering disturbances due to induction were experienced at a much greater distance than was anticipated. With a view of finding out how far these effects could be detected, experiments were conducted on the Newcastle Town Moor. The area of the disturbance was extended to a distance of 3,000ft., while the effects were detected on parallel lines of telegraph between Durham and Darlington at a distance of 10½ miles. But the greatest distance experimented upon was between the east and west coast of the border, where two lines of wire 40 miles apart were affected, the one by the other; sounds produced at Newcastle on the Jedburgh line being distinctly heard at Gretna, on a parallel line, though no wires connected the two places. Careful experiments had also been made to show that the effects were quite independent of the earth, and were probably inductive effects through the air. In one case a circuit of copper wire, sheathed with gutta-percha, was laid on the ground forming a quarter of a mile square. At a distance of a quarter of a mile another square of similar dimensions was formed. It was then found possible to hold distinct conversation by telephone through the air without any connecting wire between the two squares. This distance it was thought could probably be much exceeded. It was not even necessary that air should be the medium between the two wires. Since those experiments were made the English cable to the Scilly Islands was broken at a certain part. Half a mile from the damaged cable there was another belonging to one of the submarine companies, and extending to Brest. These two cables were half a mile apart in the water, and they did not approach each other on shore, yet signals on the Scilly cable were heard distinctly on the French one.—Prof. Thompson said he must enter a mild protest against the somewhat miscellaneous use of the word induction. In the experiments from square to square he did not doubt that the results were produced by genuine induction; but in the other experiments, notably the forty-miles one, he believed the greater portion of the effect was due to the earth returns.

Manufacture of Soft Steel.

Mr. W. Hutchinson, of the South Staffordshire Ingot Iron Company, Bilston, read a paper descriptive of "The Manufacture of Soft Steel by the Bessemer Basic Process in South Staffordshire." The plant consists of three Bessemer vessels of the ordinary description, and of about six tons capacity—one of which is lined with gannister bricks, and the other two with basic material. The converting process differs from that at other basic works in England, owing to the pig-iron used being more variable in its content of silicon. To meet this it has been found advantageous to use the acid-lined vessel as a refinery for desiliconising the metal, which is brought in a liquid state from the adjoining blast furnaces. From four to eight minutes' blowing in this vessel is sufficient to reduce the silicon to a point at which it can be dealt with in the basic vessel. The refined metal is then transferred to one of the basic vessels into which about 20 per cent. (of the charge of metal) of freshly burnt lime has previously been placed, and the charge is blown in the ordinary way until the carbon has disappeared, which is indicated by a sudden diminution or dropping of the flame. Up to this point very little of the phosphorus has been removed; but the blowing is continued for a few minutes longer, and dephosphorisation proceeds rapidly. After about five minutes of this so-called "after-blow" the converter is turned down, part of the slag poured off, and a sample of the metal taken, hammered out, quenched in water, and broken. From the fracture of this the blower judges if the phosphorus is sufficiently removed, and if not continues the blow for a few seconds longer. The finishing metal, consisting usually of rich ferro-manganese, is then added, and the charge poured in the ordinary way. The following is an average analysis of the soft steel usually produced: Carbon ·080, silicon ·004, phosphorus ·050, manganese ·430, sulphur ·045, and iron (by diff.) 99·391 per cent. The slag formed during the process bids fair to become an important manure, as experiments recently carried out by Prof. Wrightson and Dr. Munro have shown that on certain soils it is equal to the best superphosphates and other phosphatic manures.

Mr. George Hatton (Brighton) read a paper on the "Production of Soft Steel in a New Type of Fixed Converter," in which he said that the fixed converter was not a new invention: Sir Henry Bessemer conducted his early experiments in one, and it had been used somewhat extensively in Sweden for many years, making steel of very high quality. In using the old type of fixed converter a great difficulty experienced had been the necessity for keeping the full pressure of blast on during the tapping out of the metal after the process of conversion was completed, with the risk of more or less oxidation of the bath of metal, which oxidation would of necessity be continued till the last of the steel ran from the converter, owing to tuyeres being fixed on a level with the converter bottom. Mr. Hatton has designed a fixed converter with which twenty blows per shift of twelve hours have been done, but with more efficient casting-pit arrangements this output could be very considerably increased. The usual numbers of Bessemer hæmatite pig iron were used, the percentage of silicon preferred in the mixture being about 1¾ per cent. to 2 per cent. When working rapidly with surplus heat a considerable quantity of scrap was added during the blow. The steel produced by this process was of the highest quality, remarkably soft, and particularly adapted for welding, it being largely in demand for lap-welded boiler tubes and other similar purposes; it was also made into boiler plates, and was largely made into stamping sheets and tin plates for difficult work.

Electric Safety-Lamps.

Mr. J. W. Swan, M.A., read a paper on "Improvements in Electric Safety-Lamps," in which he stated that since last year he had improved his safety-lamp in various ways. The objects he had in view were:—(1) To reduce the weight as much as possible consistently with the giving of sufficient light; (2) to simplify the construction with a view to minimising the cost of manufacture, and the cost of keeping in order; (3) to make the lamp better able to resist a blow; (4) to seal in the liquid, so that the lamp could be held in any position; (5) to add a fire-damp indicator. The latter was a novel feature. By turning a switch the current from the battery could be sent through a fine platinum wire contained in a small glass tube. The presence of fire-damp was indicated by the heated wire becoming abnormally bright in one case, and in another by the rise of liquid in a gauge-tube (communicating with the hot wire tube) after the cooling of the hot wire. The total cost would not exceed 5d. per week where several hundred lamps were in use. He thought he had produced a lamp having the advantage of absolute safety.

Antarctic Explorations.

Dr. John Murray, of the *Challenger* expedition, made a few observations on "The Exploration of the Antarctic Regions." He said that the appointment of a committee at the Aberdeen meeting last year to consider what steps should be taken with the view of promoting further exploration in the Antarctic regions had had the effect of again directing much attention to those unexplored regions. In reviewing the existing state of our knowledge concerning the Antarctic regions, he said that five expeditions had been despatched from this and other countries to explore those regions. Only three navigators, however, succeeded in cross-

ing the parallel of 70deg. south, Ross crossing that parallel three times in three different years. No steam vessel had visited the Antarctic area except the *Challenger*, and she was quite unprotected for ice work. Ross and D'Urville were the only two navigators who had succeeded in setting foot on land within the Antarctic Circle, and neither remained longer on shore than was sufficient to allow them to gather a few specimens of rocks. With the exception of some off-lying islands, all the land was described as being completely ice-bound. Where the coast was low there was a line of perpendicular icy cliffs, 150ft. to 200ft. high, rendering hopeless any attempt at landing, and that was known as the ice-barrier. It had been conclusively proved that there was a great mass of continental land within the Antarctic Circle, but we had much more definite information about the Antarctic and Southern Ocean than about the Antarctic Continent, although fuller knowledge of those waters was very desirable. The committee appointed to consider this matter reported that before approaching the Government, a plan of operations should be carefully drawn up and submitted to the Association for the approval of the Council.

Capt. Ettrick W. Creak, R.N., F.R.S., contributed a paper on "The Advantages to the Science of Terrestrial Magnetism to be Obtained from an Expedition to the Region within the Antarctic Circle." He showed that at present we have data to make satisfactory charts of the earth's magnetism for all parts between 60 N. latitude and 50 S. except in some parts of North Africa and Central Asia. Farther south than the point mentioned we have practically had no observations since Ross's expeditions in 1840-43. Somewhat recent observations, especially those in connection with the *Challenger*, showed that at about 50 South latitude the magnetism in that neighbourhood had changed since the records were made by Ross, so that the data obtained then could not be relied upon at the present time.

American and English Railways.

Mr. W. P. Marshall, M.I.C.E., read a paper on "American and English Railways in reference to Couplings, Buffers, and Gauge, with a Suggested Improvement in Couplings." He said the railways of North America were of particular interest on account of their very great extent, amounting to nearly one-half of the total railway mileage of the world. Their standard gauge was the same as in England; but there were formerly five other gauges in extensive use in North America, three of them larger than the standard, 5ft., 5ft. 6in., and 6ft., and two smaller, 3ft. 6in. and 3ft. The standard gauge had now become so far universal as to include about 80 per cent. of all the railways of the world. In reference to buffers, on the American railways the striking difference was seen of single centre-buffers universally used instead of the double side-buffers of this country and the Continent; and this was a point that called for special consideration, because, although centre-buffers were so unfamiliar in this country, they were really in the majority as regarded the length of railways upon which they were used. In the English carriage couplings there was no provision against the telescoping of the carriages in a collision, which was the great source of injury in train collisions, the coupling being flexible vertically as well as horizontally; but the American carriage coupling most extensively used was rigid vertically, preventing displacement beyond the limited range required for variation in heights of carriage frames, and it formed a direct provision for preventing one frame mounting upon the next one in a collision, and the consequent telescoping of the carriage bodies. This coupling had a strong metal bar projecting from the end of each carriage frame under the next carriage, which must be broken away before either carriage could mount. This coupling was automatic, and was worked by bumping the carriages together; the coupling jaws are wedged apart horizontally by the striking together of the projecting tapered ends, and then engaged together by springing back to the central position. There was, however, no means of tightening up this coupling beyond the original compression of the buffers in bumping up; and although the carriages were usually held very steady in running, it happened not unfrequently, with the extra stretch of the draw-springs in a heavy train, that the buffer-faces got slack or even separated, allowing a side oscillation of the carriages, which could not be checked, and which was a serious defect in the coupling.

The Hardness of Metals.

Mr. Thomas Turner described an apparatus which he has invented for determining the hardness of metals. He said hitherto there had been few attempts to determine the relative hardness of metals. The method adopted by the United States Government in 1856 consisted in the punching of a hole by a tool in the form of a pyramid and under a constant pressure. The indentation was carefully measured, its capacity calculated, and in this way relative hardness was expressed. But it had been shown that the results obtained really depended upon combined tenacity and hardness, and so were not accurate representations of hardness. The apparatus recommended by the author was an adaptation of the method which had already been employed in determinations of the hardness of minerals, namely, by scratching the surface with a weighted diamond. The diamond is attached to a gradulated beam arranged so as to allow of motion in both a horizontal and a vertical plane. By means of a sliding weight sufficient pressure is applied to cause a distinct scratch on drawing the diamond over a smooth surface of the metal to be tested. The weight is then moved until the diamond just ceases to produce a visible scratch, when the position of the weight on the scale is observed. Some experience and care were necessary in observing the scratch; but when that had been obtained the apparatus gave uniform results. The author's experiments with cast iron had shown the common idea that hardness and tenacity necessarily accompanied each other was erroneous. Very soft cast iron could be obtained with a high tensile strength, while hard cast iron had very often a low tensile strength. When metal had to be worked unnecessary hardness led to useless expenditure of power and loss of tools, and in such circumstances a soft metal was much to be desired. The apparatus was intended to be used in connection with tensile tests of the metal, and in that way afforded valuable information as to the mechanical properties of the material.

Gilded Chrysalides.

Mr. E. B. Poulton read a paper in which he stated that for some years he had been working upon the colour of caterpillars in relation to the colour of their surroundings, and he had shown that the colour could be modified in one generation by the appropriate alterations of their surroundings. It seemed certain that through some sensory surface, possibly the eye, caterpillars were affected by their external relations, and a corresponding effect was produced in colour. It was probable that the colour was produced by the effect upon the caterpillar before it turned to the chrysalis. Experiments were therefore made by Mr. Poulton to put the fact itself beyond dispute. That was done first by the use of caterpillars of the peacock butterfly and the common tortoiseshell butterfly. It was found by allowing them to turn to chrysalides upon a white or black screen very different results were produced. Those upon white paper were often brilliantly golden, although the chrysalides of the tortoise-shell were not quite so golden. Gilded specimens were sometimes found, but their appearances seemed to be produced as a disease.

Preservation of Gases over Mercury.

Prof. H. B. Dixon, F.R.S., read an interesting note on the preservation of gases over mercury. In the life of Faraday, written by Dr. Bence Jones, an account is given of a dispute which arose between Faraday and Sir H. Davy as to whether gases could be preserved indefinitely over mercury without undergoing change. Faraday commenced his first experiments in this direction in 1823, examining the gases he had preserved in 1824, and concluded that gases could not be efficiently preserved over mercury. On the other hand, we find that the last entry in the laboratory note-book of the Royal Institution in the handwriting of Sir H. Davy stated that he had confined hydrogen over mercury for a considerable period, and on examination the gas was not contaminated by air. Faraday, however, collected gas in 1825, which was examined after fifteen months, and found that it was much contaminated by air; he, therefore, concluded that gases could not be kept over mercury. Mr. Dixon has examined various gases, including hydrogen, cyanogen, sulphur dioxide, and electrolytic gas, which had been kept over mercury for periods ranging from 2½ to 9½ years, and concludes that the gases when examined were in the same condition as when collected. Mr. Crookes considered these results somewhat startling, and suggested that the influence of the purity of mercury was very important. Sir H. Roscoe, F.R.S., said they were much indebted to Mr. Dixon for his researches into a subject of such practical value to chemists. He believed the effect observed depended on the formation of a film between the mercury and the glass in some cases. Mr. Dixon, by using clean vessels and hot, pure mercury had prevented this formation, and hence diffusion had been prevented. Prof. Vernon Harcourt, F.R.S., said it might have been supposed that dirty mercury, from its known property of adhering to glass, would have been most efficient in preventing diffusion. This, however, did not appear to be the case, but he suggested that experiments should be made in which dirty mercury should be employed. Mr. Turner said that the experience of Dr. Franklin confirmed the experiments of Mr. Dixon, and the opinions of Sir H. Roscoe that diffusion did or did not take place according to the state of the mercury and the containing vessel. After some remarks by Dr. Russell, Dr. Gladstone, F.R.S., stated that when talking of this matter some years ago to a friend, he was answered that if gas could not be retained without diffusion, then we could have no mercurial barometer. Prof. McLeod, F.R.S., said that in the case of dirty mercury the metal was not in contact with the glass, though it appeared to be so. The standard barometer at Kew was prepared with hot mercury, and though it was years since it was made it was still believed to be perfectly accurate. Dr. S. Young said his experience with barometers, which was pretty considerable, showed that some barometers remained perfectly correct, while others did not, though apparently prepared with equal care.

Waves and Bores.

Sir William Thomson, F.R.S., gave an account of some observations on stationary waves in flowing water. The subject, he explained, includes the beautiful wave-pattern produced by a steamer under way in smooth water. But the communication was limited to another interesting and well-known phenomenon, the rippling of the surface of a natural rivulet, or of water in a mill-stream or trough or conduit of any kind. It had been observed, for instance, that where there was a rise in the bottom there was a corresponding depression of the surface of the water immediately above, while where the bottom was depressed the surface of the water rose to a corresponding height above the mean level. Sir William explained the dynamical theory of the steady motion observed in all the cases mentioned above.—Some facts with relation to the phenomenon of the "bore," observed in the Severn and other streams, were detailed by Sir William Thomson. Observations made by Prof. Stokes, he said, had shown that it was almost certain that there was some proportion of broken water in a bore, and that the bore was not a phenomenon of steady motion of a perfect fluid. An apparatus, devised by the reader of the paper for producing artificially a standing bore, was exhibited in action, and excited much interest, its operation tending to prove the fact just alluded to.—In a paper on the velocity of advance of a natural bore, Sir William Thomson said that a natural bore consisted of a precipice of water advancing through water almost steady. Whenever a bore passed through the shallow water, the water deepened and flowed on behind the bore at a speed which was less than that of the bore. At present they had not been able to determine mathematically the relations of these two speeds and other problems suggested by these observations. Some graphical illustrations of deep-sea wave-groups were exhibited by Sir William Thomson, who explained how they bore also on the theory of light.

Distribution of Germs.

Dr. Percy Frankland contributed a paper on "The Distribution of Micro-organisms in the Air of Town, Country, and Buildings." It contained the results of a number of experiments which the author had made on the relative abundance of micro-organisms in the air of different places, and of the same place at different times. In these experiments the number of microbes contained in a given volume of air had been supplemented by the determination of the number falling upon a unit of horizontal surface (one square foot) in a unit of time (one minute). The air on the roof of the Science Schools was very considerably richer in micro-organisms than that collected in the London Parks, and this again than that of the country. The gradual attenuation of the microbes in ascending St. Paul's and the spire of Norwich Cathedral was also very striking. The figures obtained in museums, railway carriages, and hospitals for consumption showed how in confined spaces the number of micro-organisms present in the air was influenced by the number of persons moving about.

THE TREATMENT OF SECONDARY BATTERIES.*

THE possession of a reliable means of storing electrical power is now universally recognised. For electric lighting, whether temporary or permanent, whether domestic or public, it is almost an essential; for the commercial application of electricity to motive power it is a necessity. The theory of secondary batteries or accumulators, by means of which this storage is attained, has already been so ably dealt with, and is probably so well-known to all present, that it is unnecessary to enter into it in this short paper, the object of which is to bring to your notice some practical points of treatment which are essential, in order to render secondary batteries commercially reliable. The three main difficulties which we had to encounter were:—1. The destruction of the lead grid or con-

* Extracted from a paper by Messrs. BERNARD DRAKE and J. MARSHALL GORHAM, read in Section G, British Association.

ctor. 2. The buckling or warping of the plates. 3. The falling out of the active material. These three failings, principally affecting the peroxide plates, militated seriously against the commercial success of accumulators, of which durability forms so important a factor. We, therefore, carried out a large number of experiments, with a view to ascertain their various causes, and, by removing them, to render the secondary battery, with which we had to do, as reliable for durability as it already was in other respects.

Here I may mention that these failings, although common, were by no means universal. For instance, the E.P.S. accumulators in the Bank of England have been in use more than $2\frac{1}{2}$ years, and continue to give excellent results. That they do so confirms the conclusions to which experiment has led us. We will take first:—1. The destruction of the lead grid or conductor. This was the most serious difficulty to face, as on it depended the life of the battery.

The prevalent idea was that it was due to overcharging; that after the peroxide plate was fully charged any further charge caused an evolution of oxygen which rapidly destroyed the grid. We, therefore, proceeded to charge some cells without cessation, in order to ascertain the exact amount of current which would entirely destroy the lead conductor or grid. It was soon evident that the process was, at any rate, a slow one; but the experiment was continued, until the full prescribed current had been passed through, for more than two months. At the end of that time it was found that the lead conductor was practically as sound as before charging; the coating of fine peroxide formed on the surface was very thin; there was no sign whatever of buckling, and, further, the specific gravity of the solution, when the cells were left in their fully-charged condition, remained absolutely unaltered. The conclusion thence drawn was that the oxidisation of the grid caused by charging only penetrated to a very limited depth, and then ceased entirely, and that the coating of fine peroxide formed actually protected the grid, not only from deterioration by overcharging, but also from local action hitherto supposed to be unavoidable.

It was then established that the life of the grids was not proportional to the amount of charging—*i.e.*, to the number of ampère-hours put into a cell. Was it due to the number taken out? To ascertain this was the object of the next experiment. For this purpose a battery was divided into two halves, one of which (A) was repeatedly run out, and the other (B) was never discharged beyond the point at which the E.M.F. commenced to drop. This experiment also extended over a considerable time, but gave the instructive result that when exactly the same number of ampère-hours had been taken out of each half, the plates in the first half (A) showed signs of expansion or growing, whereas in those of the second half (B) no change could be detected. The life of the grid then was also not dependent on the amount of ampère-hours taken out, or on the work done, but on the treatment of the plates, first as to charging up, and afterwards as to total or partial exhaustion. Further, it was satisfactorily proved that there was no necessity to employ a conductor of unoxidisable material, providing the simple precautions were taken, first, to fully charge the cells; second, to avoid discharging them entirely.

The second point to be considered is:—2. The buckling of the plates.

This had hitherto been attributed to two or three causes — charging too rapidly, discharging too rapidly, impurities in the acid or oxides employed. Experiment soon showed that the real cause must be sought for elsewhere.

We found that the buckling was almost invariably accompanied by a hard white enamel (sulphate of lead) on the face of the plates, and, further, that where the extra cells in a battery had received more charging than the remainder, the plates in these cells were frequently quite free from sulphate, and the consequent tendency to buckle, while the rest of the battery had failed. This proved that the enamelling could be prevented by charging, and was not due to impurities in the oxides or acid used; further, that when the plates were free from sulphate there was no tendency to buckle. Experiment also showed that in the case of the first use of cells, when the acid was first put in, the specific gravity dropped in spite of the charging, indicating the formation of sulphate; by persevering in charging the sulphate disappeared, and with it the tendency to buckle. The conclusion was then that, in order to avoid buckling of the peroxide plates, cells on their first use (whether new or after long disuse) should be charged incessantly until they are considerably overcharged. Hence the radical change in the instructions issued to users of the E.P.S. batteries. Whereas, hitherto, they had been specially cautioned against overcharging, they are now urgently required to overcharge new cells, and to charge incessantly.

3. The separation of the active material. In almost every case where this occurred, the plugs of active material fell out of the plates in complete halves, and in a very hard condition; and analysis showed that they contained an excess of sulphate, due, as before explained, to insufficient charging. On the other hand, in a few instances, the active material was found to have become disintegrated and fallen off in a fine powder, and this was specially observable when, on account of a leak in the receiving vessel, and consequent frequent addition of water, the solution had become extremely weak. In this case, practically no sulphate was present, and the mass lost cohesiveness. The conclusion is then that a certain proportion of sulphate in the material is necessary to bind it together; but that excess must be avoided. This due proportion once ascertained, the third difficulty is overcome for all the ordinary work of secondary batteries.

It should be mentioned, however, that there is a constant demand for an accumulator which can be discharged without injury at an abnormal rate for special purposes. Such rapid discharge results at present in the scaling off of the oxides and destruction of the plates; but as it causes the formation of sulphate, which is the binding, not the disintegrating, agent, the cause of the scaling, and therefore its remedy, must be sought elsewhere, and on this point discussion is invited.

The conclusions to which our experiments have led us, are:—1. That the life of the leaden grids or conductors, and their freedom from buckling, are in no way dependent either on the amount of charging or discharging of the cells. 2. That cells on the occasion of their first use, and also after long intervals of idleness, should be very fully charged, and in the first case incessantly. 3. That they should never, under any circumstances, be entirely run out, and in fact should not be discharged below the point at which the E.M.F. begins to drop perceptibly. 4. That the coating of fine peroxide formed during charging is actually a protection to the plate against the injurious effect of overcharging, and against local action. 5. That a certain small proportion of sulphate is necessary to give cohesiveness to the active material, but an excess of it causes the oxide to separate bodily from the conductor. If the precautions here indicated be taken, we believe that the accumulators now made by the Company with which we are connected will answer every ordinary commercial requirement during a very considerable time; but an accumulator is not at present known which, without sacrificing capacity and efficiency, will stand the extraordinary rate of discharge sometimes demanded.

TOOL-POST GRINDER.

THE tool-post grinder shown in the annexed engravings has been in use for some time by Mr. F. H. Colvin, of Philadelphia, who sends it to the *American Machinist* for the benefit of all interested. Mr. Colvin says:—

Fig. 1 is a side view, Fig. 2 a front view, these

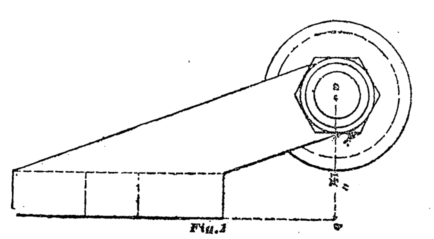


Fig. 1

being sufficient, I think, to give a clear idea of the attachment. I will give the sizes I used, though some of them may have to be altered to suit the lathe used. The height *a b*, Fig. 1, in my case $1\frac{3}{4}$in., should be made the same height as the lathe

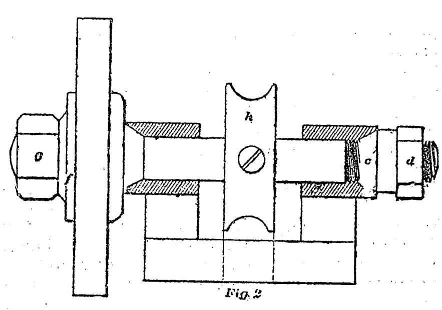


Fig. 2

centres. The cones *c c'*, Fig. 2, are bronze, *c'* being adjustable, as seen by drrwing; *e* is the emery wheel, *f* and *g* the collar and nut respectively, *h* the pulley, $1\frac{3}{4}$in. diameter, driven by $\frac{5}{16}$ round belts. The spindle can be reversed by taking off *c' d* and slacking the pulley screw. This is very convenient, as sometimes we wish to work close to either end. It is bolted in place of tool post; and with a "compound rest" on my lathe a great variety of work can be done, from grinding centres to backing off a fluted reamer. I hope I have made it clear, and that it will be of use to your readers in general.

18in. GLASS SPECULA.

THE following is an extract from a paper read before the Royal Society of N.S. Wales (Sydney) on July 7th entitled "Notes on the Process of Polishing and Figuring 18in. Glass Specula by Hand, and Experiments with Flat Surfaces," by Mr. H. F. Madsen. It is kindly forwarded by Mr. F. B. Kyngdon, the hon. sec. The author exhibited a silvered specula and the glass tool upon which it was ground. This glass tool was composed of three plates of rough glass 1in. thick by $18\frac{1}{2}$in. diam. These were ground together to fit one another, and then cemented into a solid block, the top being formed of a $\frac{1}{4}$ more convexity than the required concavity of the speculum, the latter being partly hollowed out by the use of a leaden weight and rough emery. The tool and the glass being ground together soon formed themselves into perfect spherical surfaces, and very nearly of the proper curvature; the mirror was bright enough to reflect the image of the sun at an almost perpendicular incidence, and the true and regular surface left nothing to be desired. The speculum at this stage having an absolutely true curve, the polishing was proceeded with, using rouge upon pitch, the speculum being uppermost, and continued until no emery holes or scratches could be seen. With the ordinary pitch polisher the surface is graduated into squares, and requires an extra side motion in working in order to avoid concentric grooves or rings. Mr. Madsen graduated his polisher in a wavy or volute manner, with the advantage of being able to polish for hours without side motion or the trace of a ring. The 18in. speculum took $5\frac{1}{2}$ hours to polish, no pressure being used—simply revolving it upon the tool. By Foucault's test the 1-millionth of an inch variation can be detected at the centre of curvature, and a true spherical surface having been obtained, the most delicate part of the process commences in changing it into a paraboloid of revolution—e.g., the correction of spherical aberration (Fig. 1). There are several methods of accomplishing this, Lassell's system of local polishing being perhaps the one most used. The author prefers the pitch polisher graduated in a correct system (Fig. 2), and figured his glass upon the plan of the parabolic curve coming into contact with the spherical surface at an intermediate point. Both polisher and glass having been regularly raised in temperature were left together until cool, after which the usual stroke for keeping the spherical form was proceeded with for about 10 minutes, when the correction was found sufficient. The glass was simply revolved on the polisher A perfectly even temperature must be maintained, and the polishing powder be evenly distributed with uniform contact at every point between the two surfaces. M. Foucault's artificial star or minute pinhole test at the centre of curvature was used to determine the exact time when the paraboloid had been developed. The rate of decrease required in the amount of correction is very rapid with the increase of radius of curvature, and supposing a theoretically perfect speculum to be obtained with from 20—40ft. focus, the slightest touch or variation in temperature would be sufficient to destroy its good definition. By decreasing the focal length, the rays cross at a less acute angle, and small variations in the reflecting surface have not so detrimental an effect. Mr. Madsen found that an extra thick film of silver deposited on the specula might impair the efficacy of the reflector. He, therefore, determined to measure the thickness of these films, and has confirmed Dr. Draper's calculation of $\frac{1}{200000}$in. obtained by depositing on a large surface, and estimating it by chemical methods. To compare the thickness of the silver film with a ray of light was the optical method used. To do this, two perfectly flat surfaces were required for Mr. Brashear's colour test, and monochromatic light falling at an angle of 65° upon two placed over each other produced straight dark and coloured bands (Fig. 3). If by reason of irregularity of pressure or form a deviation from theoretical flatness be produced, it can be rigidly calculated by measuring the curves or bends in the bands in comparison with the distance between them, which should be as large possibly as half an inch (Fig. 4). The equation for calculating these films is as follows:—

λ = ray of $\frac{1}{44000}$ wave length;
δ = thickness required;
Angle of light = ϕ.

The deviation in thickness between two dark bands is represented by x. $x = \frac{\lambda}{2}$ sec. ϕ, and the smallest displacement can be calculated so

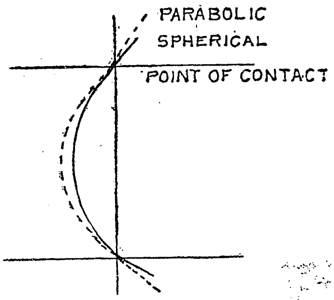
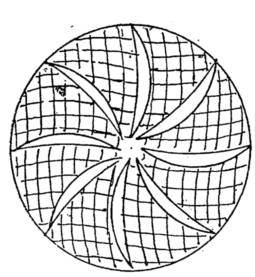
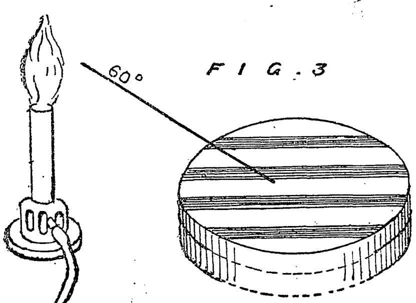


FIG. 1



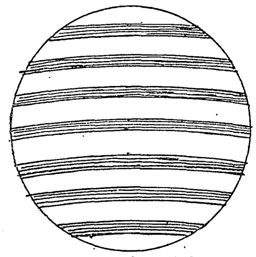
PITCH. POLISHER GRADUATED
FIG. 2.

FIG. 3



FLAT

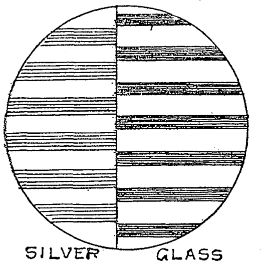
FIG. 4.



IRREGULAR

that defects of less than $\frac{1}{300000}$in. can be seen. By silvering half the upper surface of one of these glasses (Fig. 5), and letting light, say, at an angle of

FIG. 5.



SILVER GLASS

30° fall upon the whole glass, the bands were found to be broken or displaced at the edge of the silver a distance about $\frac{2}{5}x = \delta = \frac{\lambda}{5}$ sec. $30° = 0{\cdot}00000525$, a result nearly agreeing with Dr. Draper. Several single films gave results less than $\frac{1}{3000000}$in. To ascertain the effects of heat and pressure upon these glasses, they were placed upon a 2in. wooden chuck, and observed a uniform colour at 65°. When the finger was placed on the centre without pressure, the colour instantly changed to regular concentric rings, and by lowering the point of sight these rings travelled towards the centre, proving the glass to have become concave, and that by a measurable quantity. By substituting an iron support for the wooden one, the chill in less than one minute produced convexity in the middle surfaces to $\frac{1}{30000}$in. A pressure of 8lb. applied to the centre caused two wide bands of colour to cross in the middle, showing that the glasses had become strained in two directions, and their figure destroyed. These experiments prove that regularity of temperature is the most important factor in the production of any true glass surface, and that in finished specula the least irregularity of temperature at their sides will produce serious defects in their defining power.

THE SENSE OF HEARING.

THE Monday evening discourse before the British Association was delivered by Dr. W. Rutherford, F.R.S., who commenced by describing the vibrations which constitute sound, explaining the difference between simple and compound vibrations, the latter being illustrated by the simultaneous sounding of notes of different pitch. Infinitely more complex, he said, were the vibrations produced by an orchestra with a chorus of human voices and solo singers associated. The mind fails in the effort to grasp the wave-form of the flood of complex vibrations that pours into the ear at every movement. The highest and lowest tones were heard; the qualities of the notes produced by the strings, the wind instruments, and the voices are all discernible. The theory offered by Helmholtz in explanation of this wonderful property of hearing is that the terminations of the nerves in our ears can analyse complex vibrations. It was maintained by Helmholtz and others that in the ear every audible tone throws into sympathetic vibration one or more of the nerve terminations, and that all complex tones are analysed by them into simple pendular vibrations, which affect different nerve terminations according to their frequency of vibration. The lecturer, however, said that he would presently show good reason for doubting that theory. He then proceeded to deal with the organ of hearing, describing the peripheral mechanism which receives the sound vibrations and transforms them into nerve impulses, the nerve fibres that conduct the nerve impulse to the brain, and the sensory nerve cells in the brain which are thrown into action by the arrival of those impulses, giving rise to that state of consciousness termed sensation. They must add to this sensory mechanism other nerve cells in the brain concerned in perception—an intellectual fact far higher than mere sensation, whereby the consciousness examines the various sensations of sound, and attaches to them various significations, with which they are afterwards associated. Having described at length and with minuteness the structure of the ear of a vertebrate animal, the lecturer said that the basilar membrane is covered on both surfaces by epithelial cells. Very many of those on the upper surfaces are hair cells with ordinary or somewhat modified epithelial cells placed between them, to support them in their places. There is an immense number of these hair cells in the cochlea of the cat; four rows of them run the whole length of the cochlear canal in the human subject. There are five or six rows of them, and the total number of the cells is estimated at about 15,000. These hair cells of the cochlea seemed placed in a position of advantage, inasmuch as they are supported on a membrane that can vibrate with the sound wave. It is otherwise with the hair cells of the otolith sacs, which are planted on a membrane that is fixed in the periosteum lining the bony wall of the labyrinth. Immediately over the free ends of the hair cells there is a thin covering membrane, the use of which it is difficult to comprehend. The function of the covering membrane is quite obscure, and must remain so until we know its position with reference to the hairs. The sound waves come into the cochlean canal on the side of this covering membrane, and travel through it to reach the auditory hairs. The lecturer proceeded to criticise the generally accepted theory of the action of the cochlea in the reception of sound, to point out its shortcomings, and to offer for consideration a new theory. Helmholtz, in his great work on "The Sensations of Tone," supported the theory that the nerves terminated in the cochlea are affected by sound on the principle of sympathetic vibration—that is to say, there is a finely graduated series of nerve terminations that individually respond to tones of a pitch varying from 16 to many thousands of vibrations in a second. That theory is based on the analogy of the sympathetic vibration of tuning forks and strings. No doubt it had been shown by Professor Hensen, of Kiel, that the free auditory hairs of some crustaceans vary in length, and that, when he sounded different notes with a horn, some hairs vibrated more than others to particular notes. But Professor Henson admitted that when he sounded any note very loudly, all the hairs vibrated. But when we turn to the cochlean hair cells, especially those of mamals, we find that the hairs are all nearly of the same length, and all exceedingly short. It would take from 120 to 220 of them, placed end to end, to make the breadth of one millimètre. The shaft of an ordinary pin is just about the breadth of a millimètre. The variation in length of these hairs is so trivial that no one has ever suggested that the different hairs can be expected to make a selective response to sounds of different pitch. But in all animals auditory hairs are the recipients of sound vibrations. In the organ of taste also delicate hairs at the free ends of epithelial cells are the parts impressed by molecular motion. Why, then, the lecturer asked, is the theory still maintained, although the condition of the auditory hairs gives no countenance to it? Hensen had endeavoured to show that as the fibres of the basilar membrane slightly increased in length from the base to the apex of the cochlea, they answer the conditions required for that sympathetic response to the tones of different pitch. But the fibres are at most very short, and their variation in length very short. They vary from one-fifth to rather more than a third of a millimètre. That is to say, it would take from five to nearly three of them put end to end to make the breadth of a common pin, and yet within the limits of dimensions so minute we are expected to find a series of vibrating bodies, that with unfailing precision select particular vibrations, varying from 16,000 to 40,000 in a second. But the fibres of that basilar membrane were regarded by no one as the termination of nerves, and although an attempt had been made to show how the vibrations of particular fibres may be communicated to certain hair cells, the explanation was so far-fetched that he need not trouble his audience with it. The lecturer was convinced that this theory of sound analysis in the cochlea or in any other part of the peripheral mechanism of the ear must be abandoned. After illustrating the difficulties and inconsistencies of the accepted theory of sound sensation, he said, before he substituted another theory, he would pay a humble but sincere tribute to that genius of Helmholtz whose magnificent services to science had long since placed his name among those of the immortals. Some five years ago it struck the lecturer that the case of the telephone might throw light on these difficulties regarding the sense of hearing. When sound-waves fall on the plate of one of the telephones, it vibrates. The vibrations of the iron near the magnet affect the magnetism, and so induce in the wire currents of electricity, whose frequency and amplitude correspond to those of the vibrations of the iron produced by the sound. The currents travel to the second telephone, and induce oscillation of its magnetism, which in turn causes its iron plate to vibrate and produce sounds similar to those communicated to the first telephone. There is no analysis of the sound-waves. The transmitting telephone takes up simple or complex vibrations. The harmonies of an orchestra may fall upon it, and it does not fail to convert the complex sound vibrations into electrical vibrations, and these again into the complex sound of the orchestra in the receiving telephone. The theory which the lecturer had arrived at, and which he published that night for the first time, might be termed the telephone theory of the sense of hearing—the theory that the cochlea does not act on the principle of sympathetic vibration, but that the hairs of all its auditory cells vibrate to every tone just as the drum of the ear does, that there is no analysis of complex vibrations in the cochlea or elsewhere in the peripheral mechanism of the ear, that the hair cells transform sound-vibrations into nerve-vibrations, similar in frequency and amplitude to the sound-vibrations, that simple and complex vibrations of nerve energy arrive in the sensory cells of the brain, and there produce, not sound again, of course, but the sensation of sound, the nature of which depends not upon the stimulation of different sensory cells, but on the frequency, amplitude, and form of the vibrations coming into the cells, probably through the fibres of the auditory nerve. On such a theory the physical cause of harmony and discord is carried into the brain, and the mathematical principles of acoustics find an entrance into the obscure region of consciousness. Now, if nerve energy were only electricity, that theory would probably be accepted at once; but nerve motion is very sluggish when compared with electricity. The lecturer for five years had kept this theory back, because he felt that he had no evidence of the possibility of sending a rapid succession of vibrations along a nerve. It cost him a good deal of thought and experimental observation to find the evidence he required. If we give to a motor nerve of a frog or rabbit ten instantaneous shocks of induced electricity in a second, ten impulses will pass along the nerve to the muscle, and produce ten distinct contractions in the same period. If we send 40 impulses along the nerve, we get, not 40 contractions of the muscle, but a single continuous contraction, because the several contractions are fused together. Now, if

we listen to the muscle so stimulated one hears a musical note having the pitch of 40 vibrations per second. If we stimulate the nerve, say, 200 times per second, causing a tuning-fork to make and break the primary circuit of an induction machine, and so send 200 shocks per second into the nerve, the pitch of the note in the muscle exactly corresponds. It has the same pitch as the fork. The lecturer had experimented in this way, and eventually found that he could send as many as 352 impulses per second along the nerve, and get a note from the muscle of the pitch of 352 vibrations per second—that is to say, a note of the F on the lowest space of the treble clef. But when he tried by more rapid stimulation of the nerve to get a higher note from the muscle he failed. There was nothing but a noise heard. That a musical note is produced by a contracting muscle is known to every physiologist. One can hear it if he firmly clench the jaws during the stillness of night, when other sounds are hushed. It is the low note with a frequency of vibration less than 40 per second. There is, therefore, nothing new, the lecturer said, in the statement that a note may be heard in a muscle; the new point is that the pitch of the note may be increased by a more rapid stimulation of the nerves, and retain their individuality so sharply that they can produce a note in a muscle having a pitch number of 352. That new fact, he thought, would lend much support to a vibrational theory of nerve energy. Was he to conclude that because he failed to get a higher note than one of 352 vibrations from the muscle it was not possible to send more than 352 vibrations per second along a nerve? By no means, the lecturer said; the fibres of a muscle are very different from those of a nerve, and also very different from nerve cells. The molecules in both of them can probably vibrate far more rapidly than 352 times per second. He had, therefore, directly proved that vibrations of the same frequency as all the lower tones of the scale, from the lower F of the treble clef downwards, can be transmitted by a nerve. He had therefore a very significant piece of evidence in support of his telephone theory of sound sensation, and he could not but think that the evidence in favour of it would increase. In dealing with methods so difficult and obscure they must beware of dogmatism; but it was the duty of the scientist to frame theories which seemed to explain phenomena. One might, and often did, err in holding back a theory, lest it should give pain to the author of some theory which it was destined to oppose, forgetting that the suggestion of a new line of thought might, in some other mind, lead to ideas still further in advance. Should his theory of the sense of hearing find acceptance, it would lead to a reconstitution of theories regarding the other sense organs.

SCIENTIFIC NEWS.

THE death is announced of the distinguished African traveller, M. Paul Soleillet, at the age of 44 years. Latterly his journeys have been made to Shoa, his object being to open commercial intercourse between that kingdom and France.

Herr R. Flegel, formerly a purser on board one of the Liverpool Company's steamers on the Niger, but latterly a not undistinguished explorer of parts of tropical Africa, must be added to the list of those who have died in the attempt to open up the Dark Continent to civilisation.

Dr. Maywald, for many years one of the "calculators" of the "Berliner Astronomisches Jahrbuch," devoting his time more particularly to the orbits of the small planets, died recently in Berlin at the age of 70 years.

The income of the British Association for the past year amounted to £3,805, out of which £1,300 has been awarded for various purposes, e.g., in mathematics and physics, £280; in chemistry, £115; in geology, £210; in biology, £535; in geography £30; in economic science and statistics, £10; and in anthropology, £120. The sum devoted to Biology is mainly given to the "Zoological Record" and the Naples Zoological Station (£100 each), while the stations at Granton and Plymouth receive £75 and £50 respectively, and two sums of £75 are devoted to the Flora of China and the Flora and Fauna of the Cameroons. Ben Nevis observatory is awarded £75.

The American Association had no fewer than 252 papers before it; but, strange to say, separated without appointing the next place of meeting—a significant fact being that no invitation was received from any quarter. Prof. S. P. Langley was appointed president for next year. Amongst the papers read was one on the "Soaring Bird," by Mr. I. Lancaster, who had a number of diagrams to explain his paper, and was understood to have a model, which, however, was not forthcoming. The president of the association, Prof. Morse, attacked the principles and facts set out in the paper, moving a suspension of business that all might go out on the square and try a model. Great interest was excited, and many were willing to be spectators of the remarkable performance. But Prof. Lancaster finally disclaimed a knowledge of mechanics, saying that he had made his models fly in Florida, and that his theory was demonstrated. Some indignation was expressed by the audience, and 1,000 dollars was offered by members for a model that "would work."

Prof. T. C. Mendenhall read a paper on "Characteristic Curves of Composition," in which he described a method of analysis of authors by counting the number of words of different lengths employed by them. He finds that different writers employ a style of remarkable uniformity in the general average of words of different lengths used by them. By counting and tabulating the number of letters in 1,000 or 10,000 words in Dickens, Thackeray, and John Stuart Mill, he finds that the results may be graphically represented so as to give a characteristic curve for each author, differing from that for all others. The practical application of these researches might be in deciding the question of the authorship of Shakespeare, which Prof. Mendenhall thinks feasible at an expense of 1,000dols. or 2,000dols. In response to a query, he expressed the opinion that prose and poetry of the same author would contain words of the same average length.

The report of the Comptroller-General of Patents for 1885 states that the number of applications was 16,101. The number of applications communicated from abroad in 1884 amounted to 2,607, and in 1885 to 2,336. The largest number of applications on any one day in 1884 was 266 on the 1st of January, and the smallest 25, on the 26th of September in the same year. The corresponding numbers in 1885 were 109 on the 7th of April, and 24 on the 17th August. The total number of applications, including communications from abroad—viz., 12,461 in 1884 and 11,695 in 1885, made through agents, amounted to about 73 per cent. in both years, the remainder, or 27 per cent., being made directly to the Patent Office by applicants themselves. During the year 4,383 notices of similarity of inventions applied for were given in respect of 2,531 applications, and 49 applications previously included in prior applications were reported.

The new electrical launch *Volta* made a successful voyage to Calais from Dover last Monday. She is built of steel, is 37ft. long by nearly 7ft. broad, and is fitted with two Reckenzaun electro-motors, supplied with energy from 61 accumulators, some or all of which can be employed at will by means of switches. The power of the motor ranges from 4 to 12 horses, the motor shaft making from 600 to 1,000 revolutions per minute. The trip to Calais occupied 3 hours 51 minutes, the return trip 4 hours 15 minutes; but the trial was not one for speed, although, according to one account, during the last half-hour of the return trip a speed of "fourteen miles an hour" was reached. The quiet movement of the boat was well shown by the fact that a sleepy gull was caught by the hand and brought into Dover. That indicates the special value of the electrical utilisation of energy.

The salt industry at Port Clarence and Haverton Hill is progressing apace, and with cheap coal on the spot promises to become a formidable rival of the Cheshire trade. Altogether there are sixteen bore-holes down, and more are being made. The salt beds are in the form of a basin, the dip being apparently to the south and east, as the brine is reached nearest the surface at Haverton Hill, and at Eston Junction is found some 600ft. lower. It is stated that the product of salt will this year reach 200,000 tons. In connection with this matter we hear of a new boring apparatus which is said to be capable of sinking a 5in. borehole 800ft. in a fortnight. It is an American device, which has been often employed in making prospecting boreholes in the oil-regions of Pennsylvania.

The programme for the autumn meeting of the Iron and Steel Institute, which is to be held in London on the 6th, 7th, and 8th of October next, has been issued. The council of the Institute has arranged to hold the meeting in London this year, for the second time in the history of the society, with a view to affording members the opportunity of studying the mineral resources, &c., of the Colonies as illustrated by what is shown at the Exhibition, and of coming into contact with colonists and Indians who are interested in mineralogical operations. Perhaps the most interesting paper in the list is one on the ironmaking resources of our Colonies, prepared by Mr. Gilchrist (whose name is associated with the well-known basic process) and Mr. Edward Riley. Among other papers to be read there is one on the chemical composition and mechanical properties of chrome steel, by M. Brustlein; another on combustion, with special reference to its application in the arts, by Mr. F. Siemens; another on the treatment of high-class tool steel, by Mr. A. Jacobs, of Sheffield; and one on modifications of Bessemer converters for several charges, by Mr. John Hardisty, of Derby.

The master of the steamer *Thessaly*, belonging to the Houston Line, writing to the owners of that vessel, notes a strange experience on his last voyage from Liverpool to Montevideo. On Thursday, July 1, at 11.35 p.m., the ship, which at the time was in lat. 0 55 N., long. 29 34 W., was suddenly and violently shaken and bumped, the shaking being accompanied by a loud, rumbling, metallic kind of noise. The first impression was that the ship was tearing the bottom out over hard rock, but knowing there was nothing in the neighbourhood she could touch, save St. Paul's rocks, and as they could not see land, the captain concluded the machinery was going to pieces. About eight minutes after the first shock, a second, not quite so severe, stopped the ship, which in the meantime had been going slowly. Subsequently they experienced a third shock—a slight one. The lead indicated 60 fathoms with no bottom. Being now satisfied that the shocks were caused by some submarine disturbance, the captain proceeded on his course. After steaming about fifteen minutes, he experienced a fourth shock, only inferior to the first in severity and duration. After this all was quiet. During the shocks the compass cards were much agitated.

Prince Albert of Monaco has been on a voyage of scientific investigation in his yacht *Hirondelle*, his object being to study the influence of the Gulf Stream on the French coasts. Altogether 179 floats were thrown out at various spots north-west of the Azores, forming a line about 170 miles in length, and the conclusion arrived is that as far as 300 miles to the N.N.W. of the Azores the Gulf Stream shows no tendency to flow N.E., and even its tendency E. is not definite.

Prof. A. A. Church will deliver in November and December, at the Royal Academy of Arts, Burlington House, a course of lectures on the chemistry of paints, of painting methods, and of pictures.

Before the Royal Scottish Society of Arts, Mr. G. R. Primrose read last Monday a paper describing his Electric Meteorological Scale Reader, an instrument which transmits by one wire readings of a distant barometer, &c. It is intended for use between mountain tops and captive balloons.

M. Camille Koechlin has recently brought before the Academy of Sciences a paper "On the Purple of the Solar Spectrum." He contends that the solar spectrum yields only two simple colours, blue and yellow. It is not easy to describe within a limited space M. Koechlin's views; they must be carefully studied to be properly understood. He contends that the spectrum contains the elements of all shades, by mixture, or by diluting with white, or extinction with black. In the last case the colours containing blue preserve their tint, while those on the opposite side of the yellow become changed in character. The whole question of colour radiations is opened anew by these statements, and it demands a most thorough and exhaustive examination from M. Koechlin's point of view.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects; For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

NOTES ON TELESCOPIC DEFINITION AS AFFECTED BY THE DIRECTION OF THE WIND.

[26247.]—IT has long been a subject for remark with astronomers that the east wind exerts some curious influence upon the definition of their telescopes. Almost every practical observer, from the time of Sir W. Herschel to the present, has noticed —in this country, at least—the tendency that star discs have to assume a more or less triangular appearance under such atmospheric condition. Some time ago I had occasion to mention this peculiarity before the Liverpool Astronomical Society (*cf* "Abstracts of Proceedings," Vol. I., p. 37; Vol. II., pp. 7, 10), where it provoked a little discussion. With a view to obtain further information on the point, I sent a request to observers through the ENGLISH MECHANIC (Vol. XXXVII., p. 336). By way of reply, I received copious notes from Mr. A. S. Williams, of Brighton, and from the late Prebendary Webb, at Hardwick. Want of leisure has hitherto prevented me from making use of their results; but, now that the lamented author of "Celestial Objects" has passed away, it seems scarcely fair to withhold them longer, so I send a brief abstract, in the hope that it may interest your readers. Mr. Webb's notes relate to lunar, planetary, and stellar objects; Mr. Williams's to lunar and stellar—the *stellar* records only being here quoted. In the earlier observations by Mr. Webb a $3\frac{7}{10}$in. achr. telescope was used: a $5\frac{1}{2}$in. Alvan Clark achr. from 1861: and a $9\frac{1}{3}$in. With reflector, from 1869. The instrument used by Mr. Williams was a $5\frac{1}{4}$in. Calver reflector. The precise dates are omitted from the abstract, for the sake of brevity; but they can be furnished to anyone who cares to investigate the subject further.

NOTES ON DEFINITION AS AFFECTED BY WIND, &C.

By Rev. T. W. WEBB.

1850—Very fine, warm, haze, strong N.E.; very fine, occasionally blotty, warm N.; fine, very cold N.E.; very beautiful, after falling of cold N.E.; good, strong cold N.E.; splendid, S.W.

1851—Excellent, N.E.; in part very fine, high and cold N.E.; remarkably fine, N (4 dates).

1855—Very nice, severe frost, cold N.E.; very pleasant, mild, transparent, calm below, W. above, but "villainous D."

1856—Above average, severe frost, piercing E.N.E. or N.E.; good, not superior, N.E.; fine, N.E. (2 dates); not quite so good, S. or S.E.

1861—Sometimes sharp, at others flaring or distorted, severe frost, N.E. or E.

1862—Strong flare, cold N.E.; exceedingly high and cold W.S.W., "all kinds of definition"; very fine, strong cool W.

1863—Fine, a little flutter, W.N.W.; discs small, much rippled, focus very changeable, haze, E.; worse, clearer, E.; bad, perfectly clear, N.E.; fine, thick haze, warm N.E.

1864—Really fine, N.E., causing very chilly, ungenial weather; very fine, though frequently blotted, much haze, cool E.

1865—Extraordinary weather, warm, not hot, nearly cloudless after morning fog, very gentle, warm S., beautiful D. (5 dates); brilliant sky, very gentle N., D. fluttering with high powers.

1869—Very severe frost, snow on ground, N., D. especially bad, disturbance plane very near earth; sharp frost, N.E. changed to N.W., disturbance region lowered, D. not good.

1870—Unusually good, severe frost, calm, N.E.; before sunrise, therm. 16°, D. almost perfect, N.E.; a good deal of haze and flutter, severe frost, N.E.; good, but flaring and very unsteady, N.E.

1871—Quite calm below, rapid upper current, W., D. very blotty; bad, small discs, much false light, chilly, N.E.; good, stars dull, haze, N.E.; moderate, therm. 26°, N.E.

1873—Marvellously bad, wind, if any, E (2 dates).

1877—Fine, strong W.

1878—Exceptionally fine, N.E., not cold.

1881—Bad, a little white haze, cold N.E.

1883—Blotty, high and miserably cold S.W.

(The immediate proximity of the Welsh hills might give rise to some peculiarities in the atmospheric conditions noted by Mr. Webb, as this was a point frequently alluded to in private letters from him.)

NOTES BY A. S. WILLIAMS, BRIGHTON.

1st Series (from double star obs.)

1880—Bad, strong N.E.; moderately fine, slight N.E.; decreasing from pretty good to bad, E.; ditto, N.W.; moderate, strong N.; bad to moderate, N.E.; bad, very misty, N; moderate, pretty fresh N. to N.W.; moderate, E.; good, light N.E.; indifferent, strong N; ditto, strong W.N.W.; bad, half gale from N.E.; moderate, misty, strong N.E.; very indifferent, half gale from S.W.

1881—Indifferent, misty, E. (two dates); very indifferent, fresh N.E.; very poor, fresh N.E.; moderate, E.—better later on, when wind veered to N.W.; moderate to good, N.E., light generally; bad, very strong N.E; indifferent, misty, much dew, slight E.; fair to indifferent, fresh N. to light N.W.; indifferent to fair, light N.; bad, very strong N.; fair, rather misty, strong N.E.; very good, strong S.; good, fresh W.; bad, strong N.; fairly good, strong S.E.

2nd Series (from double star measures).

1880—Not good, unsteady, strong N.E.; moderate, N.E.; fair, N.W.; moderate, E.; not first rate, light N.; moderate, fresh N.; moderate, calm to N.E.; moderate to indifferent, light W.

1881—Moderate, heavy dew, light E.; pretty good but a little unsteady, N.W. to light W.; very indifferent, fresh W.; moderate to indifferent, N.E.; good, hazy, calm to light N.; good, light S.E.; indifferent, occasional puffs from N.W.; moderate to indifferent, heavy dew, N.W. light to fresh; not good, rather misty, light N.E.; fair, fresh N.E. (two dates).

In the lunar observations, Mr. Williams uses numerals to denote the quality of definition, according to the following scale:—

0 = the worst possible state of atmosphere.
1 = a very disturbed atmosphere.
2 = fluttering and unsteady definition.
3 = fair definition.
4 = good definition.
5 = finest possible definition.

Mr. J. E. Gore, of Ballisodare, in a private letter, dated June 17, 1883, says:—"In the Punjab summer, when the air is *extremely* dry and hot (sometimes over 100° F. several hours after sunset), it is generally so laden with dust that telescopic observation is out of the question—stars below 4 mag. being invisible to naked eye. This state of things is at its worst with a west wind." (The wind from this quarter would traverse the arid countries of Arabia, Persia, and Afghanistan —the western desert region of Asia.) Whatever may be the peculiar characteristic of the east wind in the British Isles, which causes this phenomenon of a triangular star disc, it is a matter that deserves rigid investigation.

That such winds have an effect upon the human economy is a fact with which many persons are only too well acquainted; and it does not seem strange, therefore, that the same winds should exhibit anomalous optical effects. Of course, local conditions may undoubtedly modify the peculiarity already mentioned; but I think it will be found that the consensus of opinion will corroborate it. At any rate, most observers that I have met with in this country have expressed themselves in accord with my own opinion. I shall be very glad to learn what others have to say in regard to this curious point. **W. S. Franks.**

METEORIC.

[26248.]—FURTHER particulars respecting the fire-ball of August 4th are as follows:—As seen at Bristol, Mr. Denning writes me, saying, "The path was R.A. 129°, Dec. 60° N., to R.A. 83° Dec. 40° N. . . . Estimated brightness equal to or brighter than Jupiter." The meteor was also observed by a correspondent of *Nature*. Writing from Ramsey, Isle of Man, he says the path was a little E. of η Aquarii, and seemed to be in the direction of a line joining η and δ Aquarii. The path seen at Leeds, put into R.A. and Dec., at the request of Mr. Denning, three weeks after the meteor was seen, reads from $\pm$ R.A. 265°, Dec. 25° N. to R.A. 287° $\pm$ Dec. 0°. I took my magnitude from a cottage chimney over which the meteor passed, as seen here; the chimney just eclipses the full moon. A Mr. W. Gaunt, of Leeds (three miles W. of centre), says: "It lit up the country like the full moon." Is Mr. Davenport sure the meteor appeared to take the path indicated by him in letter 26142? —namely, "parallel with α and β Ophiuchi."

D. Booth.

5, Rownsley-street, Leeds.

ORIGINAL ELECTRICAL EXPERIMENTS.—No. VIII.

[26249.]—I WILL now take what I conceive to be a new departure in Electrics, and will describe an experiment or two with a Wimshurst machine, in order to give those interested some brain friction during the fast approaching winter evenings. We will take this machine with 24in. discs, and, say, any equal number by preference, of sectors upon each, from, say, 16 up to 128, have I tried, and have introduced odd numbers without any noticeable difference, and for the Bunsen's I substitute, say, 2in. of the wired bass string of a violin, unwinding, say, an inch of the wire as required at the end, which, if bent into a small ring, will not damage the tinfoil sectors for a considerable time; the other end is pegged into the short piece of tube on ends of what are termed the neutralising rods. It will now be found that although the machine will not start in all weathers, that, on being started, it will continue to work with only three brushes, or, as I prefer to term these, three electric conductors, because a careful investigation will reveal the fact that electricity is going "on" to the discs at "all" times, whether three or four are used. Next, I remove these brushes or conductors, and set up each one upon a separate stand, and the machine will work just as well as in the original arrangement, it being understood that there are merely in operation the discs and brushes. I now arrange four Leyden jars, easily prepared by filling champagne bottles with the numerous scraps of waste foil resulting from varied experiments, coating outside up to spring of neck, then a length of $\frac{1}{8}$in. brass wire passed through a cork, the top end bent to a rounded right-angle, a small hole drilled therein, and a piece of aforesaid wire pegged in same; each jar has a piece of foil pasted on it reaching from the rod down the neck until it is, say, $\frac{1}{8}$in. from the outside foil. Now we can substitute these four jars for the four brushes, by having the rods of suitable lengths to touch the sectors at the proper places upon the opposite diameters of the discs, thus we can have a succession of shocks as long as the machine is kept going. We can also take a large jar with a jumping place of, say, $1\frac{1}{2}$in.; arrange a fork with two pieces of the fine wire, as explained, so that the jar being placed opposite to the circumference of the discs, these wires all but touch the sectors; it will give in favourable states of the atmosphere tremendous shocks, and it will be found that the action is as though the sectors were pumping from the inside foil of said jar, and the discharge can be plainly seen to take place "from" the earth "to" the inside foil. Now, during all these experiments, it may be proved that "all" the electricity is coming on to the discs, and also, if the knuckles be brought near, it is undoubtedly clear that, although a careless observer might imagine otherwise, that these sparks are "from" the knuckles "to" the discs. Thus we find that all the electricity visible is going on and none whatever coming off, and if further proof be desired I will take a jar, arrange a jumping place of, say, $\frac{1}{8}$in. or so, place said jar upon a sheet of thick glass. Now, if the knuckles be approached to the outside foil when the machine is set in motion, the sensation will be found to be very powerful and painful. It will also be observed that the outside foil takes a charge in proportion to the jumping distance, and when sufficient has accumulated upon its surface there will be the jump. If, instead of the knuckles, we arrange a chain lying along the table, and within, say, $\frac{1}{4}$in. from the outside foil, on approaching a knuckle to any part of said chain we will experience a sensation similar to a very powerful electro-magnetic machine.

In these experiments it will be found that the electricity is in a state of great tension, as, if any connections from the rod to the jumping place be made by pasting tinfoil around said rod, across the varnished mahogany or other cover, and down the side of the glass, or of one piece of foil to another, it will be observed that each spark punches a small hole in said foils through the resistance of the damp paste.

Thus, it would seem as though the Wimshurst machine is virtually an electric pump, as thus arranged, of tensional electricity; but also one differing from all other pumps in the fact that, as thus arranged, it swallows in its insatiable maw all that undefinable "something" that it produces.

We can also obtain a continuous current from the machine by arranging the rod leading into any Leyden jar, so that it does not touch the inside foil, and shortening the jump to a suitable distance proportionate to the power of the apparatus; thus for this size machine I use a jar of, say, 9in. by 4in. Thus it would appear, as a result of these experiments, that when + electricity is produced by any means upon any substance capable of partly retaining it, that said substance becomes possessed of the property of attraction for all bodies and — flows on to the opposite side (not to the opposite diameter) of, say, in this case the discs, from both

the air and the earth, just in proportion to the quantity of + developed, and thus the circuit is complete when the one joins the other; in proof of which I am ready to take the largest Leyden jar in my hands whilst another discharges it, so long as I am not included in the circuit, as the instant the shock takes place there is an end of the matter, such as a return to air or earth of the combined forces. It thus appears possible to me that the electric theory may be formulated thus. This earth is a magnet, and everything upon it is saturated with electricity of the quality termed, which, by the way, is a misnomer, because it is so subtle that nothing is able to retain it save in comparatively small quantity; and I hazard the opinion that all attraction is due to it, because when developed upon any substance capable of retaining even a small quantity of it, that body exhibits strong attractive properties. Therefore, it seems evident that the true action of all electric machines consists in the removal of some of this—what shall I term it?—say, form of energy, from its usual habitation, thus reducing its tension or force, and causing an instantaneous rush from surrounding matter in order to restore its balance. In proof thereof, any person possessing a Wimshurst machine will find that if he places a light balanced wire at the base of insulated conductors, say, as I have, of glass tube 2ft. long, then the instant that the machine shows any electricity the said needle will be attracted to the glass, and experiment will show that it is – which is ascending, not any kind coming down. A., Liverpool.

THE LARGEST DYNAMO IN THE WORLD.

[26250.]—YOU have already mentioned that the Brush Co., of Cleveland, Ohio, were building for the Cowles Electrical Furnace Company the largest dynamo in the world, and your readers may possibly be interested in the following, which I extract from an article in the *Scientific American* by a Mr. H. C. Hovey: it is remarkable in more ways than one:—" It is related (says Mr. Hovey) that about nine years ago Mr. Charles F. Brush, then a professional chemist in the city of Cleveland, intimated to his friend, G. W. Stockley, at that time President of the Telegraph Supply Company in the same city, his purpose to make a dynamo that should excel the French and German machines. Without further ado, Mr. Brush completed his dynamo in about two months, brought it to the factory, set it to work, and found it to work successfully on the very first trial. It was purchased by other parties, and has been running constantly ever since without needing repairs. This illustrates the quietness and thoroughness with which this distinguished inventor works. A peculiarity of his method is that he wholly discards empirical experiments; but when he sees that some new machine is demanded, he proceeds to meet the demand. In this he is greatly aided by his remarkable powers of vision. He will draw his original designs, send them to the pattern-maker, and when the model is returned will, by his unassisted eye, detect any deviation to within the sixty-fifth part of an inch. He can also, it is said, subdivide an inch into hundredths, using only a common pocket-ruler, and do it so accurately that on testing his work by the vernier it shall be found correct to within two one-thousandths of an inch. Last spring Mr. Brush contracted with the Cowles Electric Smelting Company (then of Cleveland, but now removed to Lockport, N.Y.) to build and deliver a 500 horse-power dynamo within three months, under forfeit. He made no model nor experimental machinery, although the mechanical design was new, and the electrical proportions had to be worked out entirely *de novo*. He simply made his working drawings and placed them in the hands of Mr. Possons, the company's superintendent. The patterns, of course, had all to be made new. The machine was built exactly according to the original drawing: its parts were duly assembled; it was set in place and tested for ten days with a 500 horse-power engine under all varying conditions of load, and it was found to realise all expectations, not only in the output of current, but in all mechanical and electrical details. The problem of the commutating arrangement for currents of 3,800 ampères at 100 volts would alone have been enough to discourage ordinary electricians. The commutator of Brush's 'Colossus' performed its functions perfectly on the first trial, and no difficulty whatever was experienced in this respect. In order to avoid attacking this very problem, Mr. Gordon, in making his great dynamo, was obliged to make the field-magnets revolve, the armature remaining stationary. Gordon's dynamo, built several years ago in England, was the bulkiest machine of the kind ever constructed, being two or three times as heavy as Brush's 'Colossus.' It had nearly as great electrical capacity, but did not work for any great length of time, when, as we understand, it went all to pieces on account of mechanical imperfections. The 'Colossus' represents the latest advance in dynamo building, having the greatest electrical capacity of any machine ever hitherto made—having, perhaps, five times the capacity of Edison's famous 'Jumbo.' Indeed, the Brush Company itself, a few years ago, would have had to build a dynamo of double the size to get the same capacity. But this dynamo embodies all Mr. Brush's latest improvements, and may safely be pronounced the foremost achievement of its kind. The work to be required of it at the Cowles Smelting Works will be the reduction of refractory ores. This company has for some time past been using a Brush dynamo of 125 H.P., and the results attained have been so remarkable as to justify the expectation of still more wonderful triumphs by the means now placed at their command. Precisely what these may be, however, is as yet a matter of conjecture. Those already familiar with the dimensions and powers of other dynamos will be specially interested in the following data, given by Mr. Brush, concerning the 'Colossus': The whole machine is 14ft. long, 5ft. 2in. high, 4ft. 2in. wide, and weighs in all 22,000lb. The weight of the copper wire used on the machine is 6,250lb. The diameter of the pulley is 40in., and of its face 45in. The normal speed of the dynamo 430 revolutions per minute. The electrical capacity is 300,000 watts, or the equivalent of 5,000 incandescent lamps of 16c.p. each."

There is no doubt about Mr. Brush's dynamo being a monster, but it is simply nonsense to suggest that because Mr. Brush can divide an inch into hundredths by means of a pocket ruler that he can also build the best dynamo per saltum. If Mr. Hovey's knowledge of the "Colossus" is to be gauged by his acquaintance with the history of the Gordon dynamo we shall know what to think; but at present one may hope that he knows more about Brush's machine than he does about Gordon's, which is running very well indeed at Paddington station. **Nun. Dor.**

LIGHT — THE COLOUR DISPERSION. —III.

[26251.]—IN attempting to explain this matter, which has always caused perplexity, it will be necessary to introduce the undulatory theory. Now, in explaining refraction generally, we have to take into account the fact that light is not propagated instantaneously, but takes time to advance; so also in explaining dispersion, which is nothing else than the unequal refraction, we must also suppose that this, too, depends, therefore, upon time; and the only question is, How does time enter into the calculation? It must be thus:—

The fact of there being refraction shows that the velocity is not the same in one medium as in another, and we shall try to show that the entire change is not instantaneous, but goes on all the time that the wave is passing from one medium to another, and this depends upon the length of the wave. Let us see how this happens.

As long as a wave is moving in a homogeneous medium, the action of the forces which act upon the particles is such as to maintain an equal and uniform speed of both ends; but while the wave is in passage, this can no longer be the case, for it becomes a *composite* wave, with a different force acting in one part to what acts in the other, and having a tendency, therefore, to produce a different velocity in the advancing end to what it would have had if either of the forces had acted singly, so that we must regard the force in the following part as a *disturbing* force, which disturbs the uniformity which the motion of the advancing front would otherwise have had, so that the motion is no longer uniform, but keeps increasing or diminishing; that is, the velocity of the front having been interrupted by entrance, the initial velocity in the second medium is not maintained uniform; but continually increases or diminishes, and does not attain its final value till the wave has completely entered, after which there will no longer be any difference between the forces in one part to those in another. And this is what we proposed to show—that the change of velocity was not complete till the whole wave had passed. Now, the tendency of the force in the advancing end being always to assimilate the velocity of the advancing end to that of the following, the assimilation becomes more complete, the longer the process is going on—that is, the longer the wave is; or, in other words, $\frac{v}{v_1}$, upon which refraction depends, is always nearer to unity for long waves than for short ones, which quite agrees with observation.

It may be objected that we ought not to have treated it as a case of force, but as a case of the conservation of momentum. But if forces *are* really acting, as they certainly are—to wit, the force of elasticity, it seems, to begin with, to be simply a contradiction to say that forces are acting, yet it is not a case of force. However, let us see what would follow from looking upon it as a case of momentum. Let m be the mass of the particles in a given portion of the wave which has not entered, v the velocity, m_1 and v_1 corresponding quantities for the other part. It would then follow that $\frac{v}{v_1} = \frac{m_1}{m}$; but this is utterly untenable, for suppose the wave to be moving from vacuum, or from ether, into glass. To institute any comparison between the mass of ether and that of glass cannot be; moreover, if it could, since $\frac{v}{v_1} = \frac{m_1}{m} = \mu = \frac{3}{2}$, it would make out that the mass of a wave of ether would be two-thirds that of one of glass.

And this confirms, or even may be said to demonstrate, the truth of the supposition that the undulation going on in glass is not an undulation of the particles of the glass itself, but of the same ether which is outside, only having its density and elasticity, one or both, modified by being in the glass; or, at least, we may suppose the effect of the glass upon it to be the making of the vibrations the same as those of ether thus modified. This being so, since it is not the glass itself, but the ether, which undulates, we might, if convenient, omit all further reference to the glass, and might simply treat the medium as ether in its altered state.

If, then, we avail ourselves of this, our liberty, the whole question becomes much simplified. For, according to Newton (Lib. 2, Prop. 48), the velocity of a wave in an elastic medium varies as $\frac{e}{d}$ the elasticity and density, but is independent of the length of the wave; so that $\frac{v}{v_1}$ would be the same for all waves had no change in v_1 been made by the passage from one medium to the other. But the fact of there being dispersion shows that the ratio is not constant for all waves when there has been a passage, so that the alteration can only have taken place during the passage. The manner of its doing so has been indicated above, and it has been brought about by the difference of the elastic forces in the two media.

We might illustrate the case by comparing the effect which the length of a wave has with that of the length of a gunbarrel upon the velocity of the projectile.

Two things following from this may be mentioned, first, that $\mu = \frac{v}{v_1}$, will be only an approximate value; its more correct is $\frac{\lambda}{\lambda_1}$. These values would be identical if v_1 were constant during the passage; however, as v and λ both increase together, we were correct in saying above that μ depended upon $\frac{v}{v_1}$ and increases or diminishes with it.

Another consequence, and a very curious one, of v_1 not being constant during the passage, is this: it may easily be shown that the waves, after passing from a rarer to a denser medium, become detached, and proceed singly, and that they are somewhat jammed together when they move from a denser to a rarer. This may seem a great objection; but it is one which appeals to imagination rather than to reason, for a wave which has been once set in motion, goes on quite independently of any that may follow it; moreover, after being refracted again through the second face of the prism, they will be reunited as before.

On account of the importance of the subject, I shall ask leave to give in another letter a summary of what Newton says on the subject, with some remarks as to how it bears upon the theory of light generally. **W. G. Penny.**

(*To be continued.*)

IS VIOLET A PRIMARY COLOUR?

[26252.]—BEFORE proceeding to reply to Mr. Hardie's criticisms (letter 26121) on my first letter under this heading, I must point out an error in his explanation of the fact that blue and red mixed make violet. He writes: "The red simply neutralises the green constituent of the blue, and leaves its violet outstanding." Red, however, does not neutralise green, since they are not complementary colours; so a portion of the violet constituent of the blue would also be required in order to effect that result. Moreover, since the proportion of red required to be mixed with blue to form violet is so small, it is not clear even then that all the green would be neutralised. Mr. Hardie is right in saying that "if the red and blue are at all bright, the result is rather lilac than violet." But it should be borne in mind that violet is the least luminous of all colours; and it is unreasonable to expect to obtain a colour of such low intensity as violet from blues and reds of a high degree of luminosity. It would be scarcely more unreasonable to expect to obtain dark blue by mixing two light blues. Nevertheless, the violet of the spectrum can be perfectly imitated if a deep, rich blue be used and not too much red.

The next paragraph of Mr. Hardie's letter shows that he does not understand the nature of the coloured spectral images which are seen after staring at coloured objects—a fact illustrated by

the well-known advertisement of Pears' soap. Mr. Hardie regards the effect as existing in the eye independently of any light which it (the eye) may receive from without; and asserts, as proof of his statements, that the spectral image may be seen projected upon a black surface. To determine that point I laid a sheet of white paper on black velvet, and then proceeded to gaze attentively at a small piece of coloured paper placed on the white. When this coloured paper was removed I saw in its place a faint image of it, having a colour complementary to that which I had been staring at. But when this spectral image was caused by a movement of the eye to overstep the limits of the white paper, it disappeared, and reappeared when the eye returned to the white ground. The following is Helmholtz's explanation of the phenomenon. Suppose the eye to have been gazing intently at a small piece of green paper placed on a white ground. Then if the green paper be suddenly jerked or blown away, the light which enters the eye will be white; but since the nerves of the eye—which are sensitive to green light—have been fatigued by staring at the green paper, they act but feebly, whereas the two other sets of colour nerves, having retained their freshness, act with their usual vigour. Consequently, the colour due to the combined action of these latter nerves predominates, and so a faint rose-coloured image is formed, that being the colour due to simultaneous action of the red and blue (or violet) nerves. In effect it is the same as if one of the seven colours composing white light were to be partially withdrawn, in which case the combined action of the remaining six would produce that colour which is complementary to the one withdrawn. In the case we have just considered the green nerves do, of course, act to some extent, and so produce white light, rendering the rose-coloured spectral image paler than it would otherwise be. If the green paper be now placed on a yellow instead of a white ground, then it is clear that after it has been removed certain of the rays of light necessary to form the rose-coloured spectral image will be wanting. Since the light which in this case enters the eye is yellow, it stimulates chiefly the green and red nerves; and since the former have been fatiged by staring at the green paper, the effect of the latter predominates, and so we see an orange-coloured ghost where the green paper lay. For a similar reason, if red paper be used instead of the green, the spectral image is a greener yellow than the ground. Applying these explanations to the fact that red paper on a violet ground produces a blue ghost, I draw the natural inference that violet contains red light, the blue spectral image being due to the temporary withdrawal of the red constituent of the violet owing to the fatigued state of the red nerves. Mr. Hardie's explanation clearly cannot be right, for chiefly violet light enters the eye, and this would be incapable of producing a green spectral image (green-blue he should have said) to combine with the violet in forming blue. To believe that the feeble spectral yellow resulting from exposure of the eye to pure blue light could so modify violet as to cause it to appear more red, requires an undue stretch of imagination. According to the theory which Mr. Hardie is advocating, its green and red constituents should mostly combine with the violet to form white.

Mr. Hardie only objects to my explanation of the fact that violet and green make a pale blue on the ground that it assumes the existence of blue and red in violet. I may, with equal reason, object to his explanation that blue and red make violet, because it assumes the existence of green and violet in blue, the proofs of which are far from convincing.

I will now endeavour to make clearer the objection which Mr. Hardie found incomprehensible, but may remark in passing that since, on his own confession, he failed to understand it, it was at least premature to pronounce it irrelevant. The difficulty briefly stated is this: to account for the fact that blue, a colour by hypothesis containing green, still remains blue when much more green is mixed with it; in other words, to explain why blue and green mixed in certain proportions (nearly equal) produce a beautiful light blue in which no trace of green can be detected by the unaided eye. If we mix red and green we obtain yellow, and if we mix red and yellow we get orange, because we are then mixing two parts of red to one of green. Therefore, analogy would lead us to expect a very green blue to result from a mixture of blue with only a moderate amount of green. When we further reflect that the blue thus produced is equally pure and brilliant in appearance, if not superior (which I think it is) to the blue obtained by mixing green and violet, the fact is calculated to shake one's faith in the hypothesis that blue is a secondary colour containing green.

I certainly do not insist that white light must contain equal proportions of the primary colours; but failing positive information on the point, it seems a safer assumption than the contrary. Therefore, I think that a theory which is apparently consistent with such a supposition is more probable than one which compels us, as I have pointed out, to assume inequality of proportions in order to reconcile it with facts relating to the complementary colours. Until it is agreed which are the primary colours the question cannot be settled; and in any case must be very difficult to decide. However, it is not quite so obvious as Mr. Hardie seems to think that "white light contains a far larger amount of green than of the other constituents, as anyone who looks at the spectrum may see at a glance." Obviously, green occupies a larger space than red; but Mr. Hardie takes no account of the relative intensities of the colours. I have by me two diagrams by Clerk-Maxwell which represent by curved lines the relative intensities of his three primary colours, red, green, and blue, in different parts of the spectrum. The diagrams were obtained from observations on two different persons, the intensities differing slightly for different eyes. In one the maximum intensity of the red is shown to be one-third greater than that of the green, and in the other one half greater. Therefore, it is clear that if the proportions of red and green in the spectrum were equal, the red would occupy considerably less space. Moreover, according to Maxwell's theory, there is red at the violet end of the spectrum, which must be taken into account if we accept that theory.

Mr. Hardie treats with scorn the last objection I advanced, which was virtually an appeal to our sense of colour; but his criticism is hardly fair. On the contrary, to class together as of the same kind the popular beliefs that violet contains blue and red, and that green is composed of blue and yellow, is manifestly unfair. The former is based on the evidence of our colour sense, the latter solely upon the fact that blue and yellow pigments make green. The most ardent supporter of the latter would not seriously maintain that he can perceive both blue and yellow in green. But if it be admitted that the unaided sense can discern the presence of both yellow and red in orange, or of blue and green in certain mixtures of those two colours, then it must also be admitted that the evidence of the same sense is not wholly devoid of weight when it pronounces violet to be merely a reddish blue.

Before closing this letter, I must state that I have observed a green ghost on a blue ground after gazing at violet, which I accept as conclusive evidence that the blue paper which I used reflects green rays, but not necessarily as evidence against blue being a primary colour. This particular blue I examined with a spectroscope, and found it to reflect an abundance of green. My belief that this is the cause of the green ghost above mentioned is confirmed by the fact that I failed to obtain a violet ghost after gazing at green unless I used a pale blue; on a medium blue the ghost appeared merely as a darker blue. The violet ghost on pale blue may be due to the presence of white light, from which a rose-coloured spectral image would be formed after staring at green. However, since pigment colours are never pure, experiments of this kind made upon them are not conclusive, and it is to the colours of the spectrum themselves we must appeal for more positive evidence. I detailed at length in my first letter how the violet of the spectrum could be made to assume a bluer or redder tint by exposing one eye to red or blue light; but numerous attempts to modify the appearance of blue either towards green or violet have failed. No length of exposure of the eye to violet light (I used a combination of green and violet-blue glass, which, it so happens, cuts off all colours of the spectrum except violet) sufficed to produce the slightest appearance of green in the blue of the spectrum; nor was exposure to green light any more successful in developing a violet tint. I leave these facts without further comment to the consideration of your readers, hoping they will try the experiments for themselves.

F. W. Reynolds, B.A.

RAILWAY SIGNALS.

[26253.]—BEING very much interested in the correspondence on signalling in your valuable paper, I venture to offer a few remarks which I think will be of service to your readers and the public as coming from a driver of thirty years' standing, who is well known to you, but who is in the position of one of Mr. G. L. Watkinson's (p. 555) "up jumps" for the first time on this question. Who he is I do not know, nor do I care very much; the logic he lays down is not very much. I say that were I to sign my name, my situation would not be worth this paper that I am writing on. Now, as to Mr. Watkinson's remarks, it is very well known among railway servants that Mr. Stretton's name is a great bugbear to railway officials, and whatever he says is poo-poohed by them if they possibly can do it; some of them have coossed swords with Mr. Stretton on railway matters, but they have always come off second best, and it would be the very essence of ingratitude on the part of railwaymen were they not to defend their disinterested champion when they know that he is in the right. Such champions as Mr. Stretton is on behalf of all classes of railway servants are very scarce. Mr. Watkinson says that signals are not fixed at random. I say that they are not fixed by thorough practical men on all lines, and the London and North-Western is one of them, or why should new signals have to be so repeatedly altered after they have been fixed? No one acquainted with signalling will say that the London and North-Western does not pay any attention to the signalling of its own line, but it is the way it is done, and the men they employ to do it, who do not know their business and won't be told, or who will not do it properly—I do not know which; but the fact is, they do not do it properly. There are a number of cases on this line, as I believe there are on others, where what is a signal at one place for one line, on a similar post is a signal at other places for another line. A fortnight ago a Leeds driver was discharged for mistaking one for the other at Huddersfield, and he had not twenty yards' sight at the time of the signal. A collision occurred through the mistake, the man was not allowed to be heard, although his regular work was over a district where the signals are for the other line at other places. There are scores of places where signals are fixed where there is not fifty yards' sight of them. Are they fixed up by practical men? Where the line is as level as a billiard table and as straight as a pikestaff, distant, home, and starting signals are fixed on the right-hand side of the line. What does Mr. Watkinson think of such practical work as that? Mr. Watkinson's remarks about drivers asking for signals to be shifted to the right side of the line may be quite true; but in such cases as these there ought to be a repeating signal placed on the other side of the line (or "proper" side, *vide* Mr. Stretton), so that a driver would have a more extended view, and when he came to the repeater he could make no mistake. There is not a driver on any line in the world who would object to that, because it would meet Mr. Stretton's and all drivers' ideas of proper signalling, to suit all weathers, and foggy weather most of all. That is why Mr. Stretton and drivers wish all signals to be placed on the left-hand side of the line. There are repeaters fixed on some parts of the line now where there are bad places. What is good for one place surely ought to be good for other places. Mr. Watkinson says that when drivers make a complaint that signals are not in a proper position to be seen it is inquired into and remedied if possible. I flatly deny this statement, and say it is not so in all cases, and should any one driver report a few cases a way will soon be found to make him understand that he is making himself too officious. Nothing short of some practical drivers being appointed by Government as signal inspectors will ever make signalling safe and easily understood by all in the service;—that such wanted there cannot be any doubt, more especially is now than ever; what with the speed they have to run, and the weight of the trains, and the engine they have to do it with, it has become a very harassing life; they are buffeted about from pillar to post by everybody, both men and boys, who do not know their duty, but whom they have to obey, right or wrong; and should anything go wrong the drivers are told that they ought to have known better.

A Lancashire Driver.

HIGH-PRESSURE v. COMPOUND-CONDENSING ENGINES.

[26254.]—I APOLOGISE to "Engineering, Manchester," if I have fallen into error; but I construed the meaning of the letter to infer that the engines with the 7in. cylinder were converted into surface-condensing engines, although such is not directly mentioned in his letter (26042, July 30th). I will not dispute the fact that the simple high-pressure engine will always find favour in small launches, where the question of cost is the first consideration and it is a secondary consideration the cost of coal. I quite agree with G. D. Seaton on that question, but I was led by the wording of "Engineering's" letter to think that in using the term yacht he was referring to sea-going vessels. Now in respect to compound non-condensing engines, I do not see how such great economy can be claimed for them, because we have the back-pressure, radiation, and extra friction to contend with without the benefit of a vacuum, which would give at least 14lb. on the square inch more pressure on the large cylinder. This is the text of "Tube Plate's" communication in the Query column of Sept. 3rd, No. 60310.

Now, it is a well-known fact that where steam is used expansively great economy is the result, and I can only reason the matter thus. When the steam is cut off early, say at $\frac{1}{4}$ stroke, the crank is approaching its most favourable position for receiving the full sweep of the pressure, and when at $\frac{1}{2}$ stroke the maximum position, at which the crank develops the greatest effect, is reached. To apply the full pressure after reaching this point can only result in loss. When using steam in stationary

engines working expansively a flywheel is used, which is inadmissible in a yacht. No benefit can result from expanding in two cylinders placed tandem fashion, because the expansion could be carried out equally as well in one cylinder; but in the case of applying the power to another crank placed at right angles to the high-pressure cylinder crank the case is different, because the pressure is applied on a crank in a more favourable position to receive the power, thus giving greater regularity of motion, and this is even more marked in using three cylinders.

Pressure of business compels me to defer writing more on this subject at present, but in the course of a week or so I hope to place my ideas on this subject more clearly before the readers of this paper.

London, Sept. 6th. **Ingeniero.**

NOTES ON THE CHAMBER ORGAN.

[26255.]—I HAVE very great pleasure in submitting to Mr. Audsley the information he asked for with regard to the dimensions of the organ I gave a specification of, as also of the room in which it is erected:—

Room.—Length, 39ft.; width, 14ft. 6in.; height, 11ft. 6in. Organ.—Depth, 10ft.; width, 14ft. 6in.; height, 11ft. 6in. Each manual has a separate reservoir supplied with wind by a large main bellows placed in a kitchen below, and worked by a hydraulic motor. The console stands a few feet in front of the instrument.

I now append the specification of another chamber organ constructed by Mr. Gern on a new principle, as shown by him at the Inventions Exhibition, and for which he obtained a medal. The great advantage of this system is that any stop can be transferred from one manual to all of the others, and made to sound separately on either manual or on all at the same time; thus a choir or solo organ may be obtained without the use of any additional pipes.

GREAT ORGAN CC TO C. 61 NOTES.

(Inclosed in a Swell Box.)

1. Lieblich Bourdon ...	16ft. tone	61	pipes
2. Open diapason	8	61	"
3. Dulciana	8	61	"
4. Stopped diapason ...	8ft. tone	61	"
5. Harmonic flute	4	61	"
6. Principal	4	61	"
7. Flautina	2	61	"
8. Clarionet (Ten. C)	8	49	"

Three combination pistons to great, acting on pedal stops as well.

SWELL ORGAN. CC TO C. 61 NOTES.

1. Open Diapason	8ft.	61	pipes.
2. Hohl Flute	8	61	"
3. Viole de Gambe	8	61	"
4. Voix Celestes (Ten. C).	8	49	"
5. Flanto traverso	4	61	"
6. Gemshorn	4	61	"
7. Oboe	8	61	"

Three combination pistons to Swell Organ.

CHOIR ORGAN CC TO C. 61 NOTES.

Borrowed from the Great, but acting independently as separate ranks of pipes.

1. Dulciana.
2. Stopped Diapason.
3. Harmonic Flute.
4. Clarionet.

Two combination pistons to Choir Organ.

PEDAL ORGAN. CCC TO F. 30 NOTES.

1. Bourdon .... 16ft. tone 30 pipes.
2. Sub-bass, composed of Quint 10⅔ft., borrowed from Bourdon, with the extra 8 pipes in the upper part, which, when drawn, speaks with the Bourdon, thus forming an acoustic Sub-bass of 32ft. tone.
3. Violoncello .... 8ft. 30 pipes.

COUPLERS.

1. Swell to Great.
2. Swell Octave.
3. Great to Pedals.
4. Swell to Pedals.
5. Tremulant.

A self-recovering pedal to take "Great to Pedals" in and out. A self-recovering pedal to take Tremulant in and out.

It will be seen from the above specification that the builder has studied his work well, for while he has only a limited space to contain the organ, he has so arranged it that it is full of variety and pleasing combinations.

The whole is inclosed in a handsome oak case, beautifully carved in Gothic design, with burnished tin front pipes. **Organist.**

EXTEMPORISING A STRAIGHT-EDGE.

[26256.]—IT is often necessary in the workshop, or when engaged at a distance from the tool-room, to extemporise a straight-edge, and the following method, though doubtless well known to many of your readers, may still be news to many others. A straight edge, then, may be extemporised by jointing one edge of a board, then marking in centre of board a line parallel with the jointed edge. Get out a strip of board and nail or screw to the straight edge in such a manner that the upper edge of the strip coincides with the mark before mentioned. The level may be placed upon this nailed-on strip, and the levelling job finished long before a straight-edge could have been finished. In fact, quite a long distance may be accurately levelled with any board or plank that may chance to come to hand, no matter whether it be straight, crooked, or taper. The only points are to place the level on top of the board in exactly the same place every time the level board is used, and the board must also be turned "end for end" also, and the last levelling must be made with the board turned in an opposite direction from what it was when the first length was levelled. **E. A. M.**

HAS ENGLAND GONE UP-HILL OR DOWN DURING THE LAST FIFTY YEARS?

[26257.]—THE population of England, Ireland, Scotland, and Wales was, in 1831, 24 millions; 1871, 31½ millions; 1881, 35¾ millions. The poor's-rates in England and Wales in 1832, £9,683,420; in 1869, £9,100,244; in 1884, £8,432,409. The paupers in 1869, 995,346; in 1884, 779,038. The number of convictions in England and Wales in 1837, 17,000; 1858, 13,236; 1883, 11,347; 1884, 11,134; ditto in Ireland, 1838, 11,036; 1858, 3,350; 1874, 2,567; 1883, 1,740; 1884, 1,546. The pig-iron produced in 1850, 2¼ million tons; in 1870, 6 million tons. The clearing-house passed in 1869 £3,626,000,000; in 1883, £5,929,000,000. Coal raised in 1850, £40,000,000; in 1871, £115,000,000. Cotton and other fabrics enormously increased. The whole country has been covered with railways and telegraphs. London and all large towns have very superior hotels and public institutions. Buildings of every description are better lighted—gas *versus* candles. Places of amusement more than ever supported. Ten times more people have pianofortes, watches, and jewellery. Such tradesmen as used to live over their shops now have suburban residences. Four times more people take long summer holidays. More employment for females. All classes have better houses, better clothing, better food, and more ornamental articles. All classes are better educated, better paid for labour, and work shorter hours. Nearly all provisions are much cheaper. Domestic servants are very scarce, at double the former wages. Shipping has increased more than in any other country. Manufactories all over the country increased enormously. Books, newspapers, postage, and travelling are much cheaper. Tenfold more subscriptions to churches and charities of all kinds, the deposits in the savings and all other banks very much increased. One penny Income tax produces nearly double what it did at first. The imports in 1839, £61,250,000; in 1883, £426,750,000. The exports in 1839, £105 millions; in 1883, £305,000,000. It is easier now to raise four million pounds for public works than one million in 1840. Consols and all other Government securities are much higher, showing a bountiful supply of capital—in fact, millionaires, which were very scarce articles, are now almost as plentiful as blackberries. **B. R.**

A WAVE OF HEAT.

[26258.]—THE following is an abstract from a letter recently received from Manitoba, Canada:—One Sunday night, early in July last, a hot atmospheric wave swept over the town of Portage la Prairie. The sudden increase of temperature was so great that the inhabitants left their beds and rushed into the street, expecting to find that the town was on fire. During the hot blast, thermometers in some of the houses indicated the temperature of 95° Fahr. The summer has been unusually dry, and the farmers were loudly complaining of want of rain. The letter does not contain information as to the direction from whence the hot wind came, or the length of its duration. I have reasons for believing that the phenomenon occurred on Sunday night, the 4th of July last; probably an account of it may have appeared in some of the Canadian newspapers at the time.

Greenheys, Manchester. **J. B. Dancer.**

MIXED TRAINS.—ENGINE COUPLINGS.

[26259.]—"ANTI-VAC" (26237) gives a curious reason for placing the passengers at the end of the train. But suppose another train ran into the mixed train, or the passenger carriages became disconnected, and then run into. How about the passengers then? Or some of the ancient rolling stock between the passenger coaches and the engine comes to grief? This latter is, I think, the usual cause of accidents to mixed trains.

The couplings, wheels, and axles of goods waggons do not seem to be so carefully looked after as those on the passenger carriages. Perhaps Mr. Stretton or others could give a few of the chief causes of accidents to mixed trains?

I believe that nearly all the railway companies attach the engine to the train with the screw coupling only. If I am wrong, perhaps someone will kindly correct me. This manner of attaching the engine with only one coupling seems to me to be a source of danger. Suppose the engine breaks away and nothing more serious happens—are spare couplings carried? And how is the train to be taken to its destination.

Wm. Rowland Hart.

THE "ADVANTAGES" OF STEAM DOMES AND DRUMS.

[26260.]—IF some of your readers, whose existence seems to be passed in timing trains and in making lists of locomotives with their stations, would but condescend to think over matters connected with the construction and working of those engines, they could, no doubt, enlighten the world, which, after all, is not much interested in the speeds of rival trains or in the performances of rival brakes. As a contribution to the subject of domes and drums, I send the following with the hope that some of your contributors will kindly criticise and let in a little light from their experience. Mr. Stirling on the Great Northern dispenses with domes, but the majority of locomotive superintendents seem to prefer them. Still, the storage capacity for steam which a dome adds to a steam boiler, sometimes adduced as an argument in favour of their use, is insignificant, and can be obtained many times cheaper by making the boiler shell slightly larger. For example, take a 48in. boiler with tubes 15ft. long, and provided with a dome 27in. in diameter and 27in. high. The dome would have a storage capacity of about 9 cubic feet, while the shell would have, with the water at its usual height, a steam-room of 52 cubic feet; 52 + 9 = 61, and retaining the same number and arrangement of tubes we can get the extra 9 cubic feet of steam-room by simply making the boiler shell 2in. larger in diameter. The cost of this extra two inches added to the shell of the boiler would be much less than that of adding a dome to the smaller boiler, while the extra surface presented to the air for the radiation of heat and consequent condensation of steam would be very much less. Steam-drums are a nuisance, pure and simple, in ninety-nine cases in a hundred where they are used. Why steam should be generated, conducted outside of the boilers, and stored up in a drum whose only possible function is to furnish cooling surface for the condensation of the steam, passes comprehension. Steam, the instant it passes out of the boiler, away from the influence of the furnace heat, begins to part with its heat; no matter how well the surfaces of the containing pipes or drums may be protected, there will always be some loss, which is continuous and irrevocable. This radiation of heat means condensation of steam, therefore it is evident that the steam should be retained in the boiler so far as it can be done until it is ready to be used. Do away as far as possible with storage domes and drums, and make the body of water in the boiler the reservoir of heat. The steam supply will be much steadier, and its quality will be better in this case than it will be if the conversion into steam has taken place and an attempt has been made to bottle it up outside of the boiler. These are points worthy of debate; but while writing I should like to ask "Kappa" (p. 41) what there is wonderful in a light engine running a mile in 40sec. that he should think there are beings conversant with railway work who would doubt it. It is quite possible for an engine to run at the rate of 100 miles an hour, but can any of your readers supply authentic records of a train having been taken 60 miles in one hour?

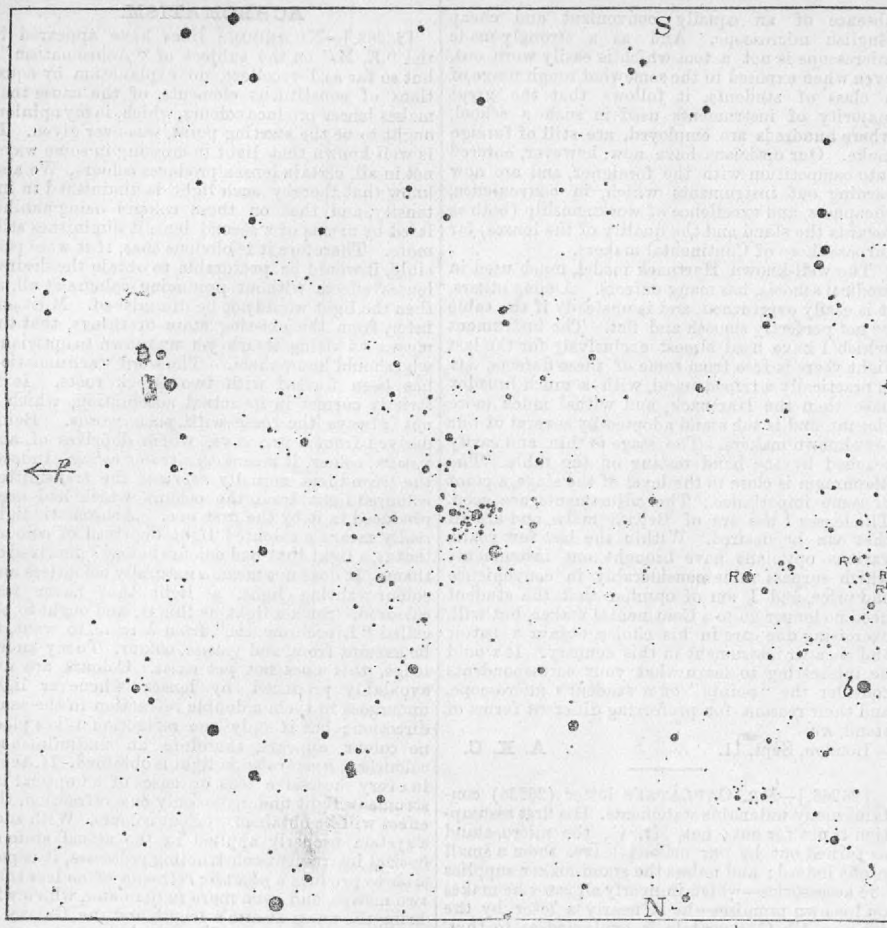
J. T. M.

CLEFTS WANTED.

[26261.]—FOR some time past I have been looking in vain for clefts where, it seems to me, we should find them so far not recorded; but my telescope is too small (3·5 o.g.) to show such delicate detail, and I appeal to the fortunate possessors of larger instruments to help me if they will.

The belief seems to be very general that clefts are really huge cracks or "crevasses" in the lunar surface, and that they are not the beds of old rivers, as at one time suggested. The way in which they hold their courses along plains, inclines, and right through mountain ranges, shows clearly enough that they are not due to erosion.

A study of their arrangement in relation to surrounding features seems to indicate that they are



CLUSTERS IN PERSEUS.

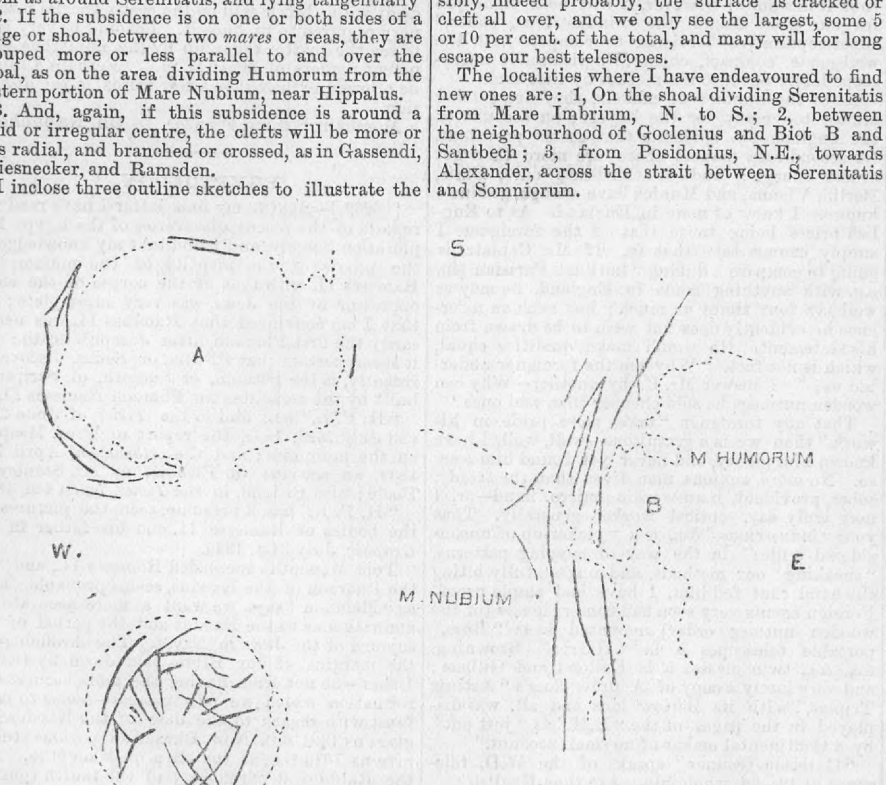
due to subsidence of an adjoining area, and that they can be, as it were, classified thus:—

1. If the area of subsidence is large, and surrounded by a presumably rigid margin, we see them as around Serenitatis, and lying tangentially

2. If the subsidence is on one or both sides of a ridge or shoal, between two *mares* or seas, they are grouped more or less parallel to and over the shoal, as on the area dividing Humorum from the eastern portion of Mare Nubium, near Hippalus.

3. And, again, if this subsidence is around a rigid or irregular centre, the clefts will be more or less radial, and branched or crossed, as in Gassendi, Triesnecker, and Ramsden.

I inclose three outline sketches to illustrate the



above: A of the tangential arrangement, as around Serenitatis; B of the parallel or linear, as over a shoal dividing two seas; C of the radial or crossed, as seen inside Gassendi.

At first sight it may seem that the great series of clefts, extending from Hyginus past Sabine to Magelhaens does not fall into the above groupings; but if all are plotted in red ink on the map in "Webb's Celestial Objects," their relation is at once seen as bordering a *series of mares*, i.e., Fecunditatis, Tranquilitatis, and Vaporum. Possibly, indeed probably, the surface is cracked or cleft all over, and we only see the largest, some 5 or 10 per cent. of the total, and many will for long escape our best telescopes.

The localities where I have endeavoured to find new ones are: 1, On the shoal dividing Serenitatis from Mare Imbrium, N. to S.; 2, between the neighbourhood of Goclenius and Biot B and Santbech; 3, from Posidonius, N.E., towards Alexander, across the strait between Serenitatis and Somniorum.

Where there is any decided and extensive fall in the surface we may look for clefts transversely, as on the S.W. boundary of Nectaris, from southern extremity of the Pyrenees to the west horn of Fracastorius, parallel to the Bohnenberger cleft. Or, again, where there seems to be a possibility of prolongation of a shoal, as from Agatharchides to the Riparian highlands, or under sea cliffs, as th eastern border of Crisium.

If the above relating to A B is correct, we find that lunar seas and terrestrial have one feature in common, i.e., permanent and slow subsidence of the floors—a singular feature, when we consider that they have absolutely less weight on them than land surfaces at similar depths.

If the *mares*—at one time seas of water—subsequently dried up and became semi-solid mud (see Neison's "Moon," p.50, lines 4 and 5), we should surely expect to find the parts solidified last, in the centre, full of clefts?

Instead of this, they are at such places conspicuously absent. There can hardly be a doubt that the *mares* solidified first around the edges, by zones; not only are the margins marked out by wide belts of a different and darker tint, but they are at a higher level, and often bordered by long, low ridges.

The central portion of Imbrium is well marked out by great ridges, and is closely spotted with small craterlets. Why these so-called *volcanoes* (?) should be specially grouped over the portion that was *last liquid* I leave advocates of igneous surfacing to explain. It seems the same kind of anomaly as that presented by volcanic cones in the centres of large walled plains allied to marine formations. Indeed, the crowding of small "craterlets," especially over that portion of the *mare* that was last liquid seems to me an argument of some weight as against their *volcanic* origin, and a really good one in favour of "surfacing by glaciation," where craterlets are simply rings of snow—i.e., condensed aqueous vapour—piled around small orifices in the ice crust at temperature of, say, minus 60° or 80° C., at which ice does not vaporise, even in vacuo. **S. E. Peal.**

Sibsagar, Asam, Aug. 4.

CLUSTERS IN PERSEUS.

[26262.]—DRAWINGS of star clusters in popular works on astronomy are, as a rule, not very satisfactory from a scientific point of view. Many of them are taken from Smyth, whose renderings of such objects are unsurpassed as purely imaginative sketches, but which leave something to be desired as representations of the actual objects as seen in the heavens. Take, for instance, the clusters in the sword hand of Perseus, "affording together," Smyth observes, "one of the most brilliant telescopic objects in the heavens." His drawing of the preceding of the two clusters, Ḩ vi. 33 = h 207 = G.C. 512, is, perhaps, less unlike the actual star-group than his sketch of M 11 Antinoi is, for example; but it is, nevertheless, wrongly orientated, and conveys but a very faint idea of the actual

appearance of the cluster as viewed with a telescope of moderate power. Most of the figures of this cluster in popular works are copied from Smyth's on page 58 of the second volume of the "Celestial Cycle," while professedly original ones—*e.g.*, the one in Nichol's "Architecture of the Heavens," last edition—are equally unlike the real object.

Nearly all the stars on the annexed diagram are traced from a photograph by MM. Henry, taken with a 6·3in. photographic telescope on October 10th, 1884. The exposure was fifty minutes, and over 500 stars down to the 13th magnitude are shown on the original negative. I have not traced all the photograph, and have omitted some of the faintest stars, as the visual and photographic magnitudes differed considerably in some cases. I have given the magnitudes for 43 of the chief stars of the preceding cluster assigned by Krueger in his measures with the Bonn heliometer ("Der Sternhaufen *h* Persei," Fennicæ Soc. Sci. Acta., Vol. VIII.), and for the magnitudes of the stars in the following cluster, which is Ḫ. vi. 34 = *h* 212 = G.C. 521, I have followed Vogel ("Der Sternhaufen χ Persei") while I have given the *Durchmusterung* magnitudes for the bright stars outside the clusters. Vogel shows 176 stars seen in Ḫ. vi. 34 with the 8½in. refractor at Leipzig. The stars marked A and B are P. II., 21, 22; OΣΣ 25. The magnitudes of this pair, according to Dembowski, are 6·1, 7·1., the angle being 204·2°, and the distance 102·91″. The pair has two small *comites* between the bright stars which have not been previously noted. Krueger gives the magnitude of A as 6.6 and B 7.1, both being white, according to De.; in the *Durchmusterung* A is 6·6 and B 7·0. The star marked *b* in the cluster G.C. 521 is 6·6 mag. according to Vogel, 6·7 Argelander, δ being 8·5 mag. Vogel, and 8·9 Argelander; the distance between them being 203·7″, and the angle 58·5°. The star lettered *c* is 7·7 mag. Vogel, 7·5 Argelander, and *x* is 8·0 mag. Vogel, 8·5 Argelander, its photographic magnitude being about 10.0. The position angle of these two stars is 138·3°, and the distance 218·0″, while ζ 9·2 mag. is 347·2″ from *c* in 105·7°. Anyone desirous of observing the cluster can construct a rough scale from these measures. The stars lettered R are those called red or orange by Vogel and at the Dunsink Observatory.

Sept. 9. **H. Sadler.**

FOREIGN MICRO-OBJECTIVES.

[26263.]—I AM not going to enter upon any controversy with "Prismatique"; but his condemnation of all except English optical work is too strong. I have used both English and foreign for many years, and can say, without hesitation, that Seibert's and Zeiss's lenses are equalled by few English, and if they are surpassed by any, I have yet to see them, while they cost less than half equal quality English. The brasswork is not of the stuff he describes. Indeed, he must be as innocent of knowledge on these points as he is loud in denunciation, and as he has often proved himself on other matters. I say nothing of the taste which allows such remarks under a *nom de plume* from an interested party. I shall not say a word more on this matter. **E. Holmes.**

ENGLISH VERSUS FOREIGN MICROSCOPES.—TO "PRISMATIQUE."

[26264.]—WHILE agreeing with many things adduced by our friend, I cannot endorse all he has written, for I *know* that objectives as good as English ones are made by Continental and American makers. I must, however, point out that I am not, as "Prismatique" seems to think, "interested in pushing foreign stuff." The only thing that interests me is the advancement of *truth*. As to the claptrap which passes current under the name of *patriotism*, if "Prismatique" wishes to have my opinion on it, I must beg him to peruse an article by my brother, which he will find at p. 19, of No. 3, Vol. XII. of the *Republican* for June, 1886, and which embodies *my* notions. **S. Bottone.**

ENGLISH v. FOREIGN MICROSCOPES.

[26265.]—AS one who has worked in one of the largest science schools in Britain, I have been much interested in the correspondence on the relative merits of English and foreign microscopes. Some ten or twelve years ago it was a matter of some difficulty to procure a really suitable "student's" microscope for histological work. Opticians were slow to discard the tall, imposing-looking stand, with its mechanical stage and other costly complications, and consequently the English-made instrument, though of undoubted excellence in workmanship, was placed beyond the reach of the average student, who was obliged to fall back upon the cheaper and smaller instruments of Continental make, which, after all, he found much more suited to the nature of his work. His teacher also, who had probably "gone to Germany" to complete his histological studies, introduced the Continental model into the laboratories, in the absence of an equally convenient and cheap English microscope. And as a strongly-made microscope is not a tool which is easily worn out, even when exposed to the somewhat rough usage of a class of students, it follows that the great majority of instruments used in such a school, where hundreds are employed, are still of foreign make. Our opticians have now, however, entered into competition with the foreigner, and are now turning out instruments which, in convenience, cheapness, and excellence of workmanship (both as regards the stand and the quality of the lenses) far surpass those of Continental makers.

The well-known Hartnack model, much used in medical schools, has many defects. Among others, it is easily overturned, and is unsteady if the table be not perfectly smooth and flat. The instrument which I have used almost exclusively for the last eight years is free from some of these defects. It is practically a tripod stand, with a much broader base than the Hartnack, and withal much more elegant, and is the stand adopted by several of our best-known makers. The stage is thin, and easily reached by the hand resting on the table. The diaphragm is close to the level of the stage, a point of some importance. The adjustments are good. The lenses I use are of British make, and are all that can be desired. Within the last few years, various opticians have brought out instruments which surpass mine considerably in convenience and price, and I am of opinion that the student need no longer go to a Continental maker, but will, exercising due care in his choice, obtain a better and cheaper instrument in this country. It would be interesting to learn what your correspondents consider the "points" of a student's microscope, and their reasons for preferring different forms of stand, &c.

London, Sept. 11. **A. K. C.**

[26266.]—MR. CAPLATZI'S letter (26234) contains many untenable statements. His first assumption is not far out; but, Mr. C., the micro.-stand as turned out by our makers leaves them a small profit indeed; and unless the stand-maker supplies the accessories—which in nearly all cases he makes on his own premises—he is nearly a loser by the job; so, Mr. C., your tale is explained as to that. "Could they (the English makers) supply one-fourth the demand?" Yes, one of our works, now in my mind, once busily engaged in micro. work, full of bustle, and turning out A1 work too, has almost lain idle for some years, and is capable of supplying ten times the number of microscopes that it has done; however, it will be a tight job for our good friend the "industrious, sober," super-superlative foreigner to compete with the well-made, compact, cheap, English-made microscope lately put into the market by that firm.

As to the number of makers, they are getting almost too many for the buyers; on account of the Anglophobia epidemic that seems prevalent. Of second-rate makers there are more than get orders enough; and of third-rate ones, Paris, Berlin, Vienna, and Munich have enough, goodness knows. I know of none in England. As to English prices being twice that of the foreigner, I simply cannot take that in. If Mr. Caplatzi is going to compare a duffing "button" Parisian ¼in. o.g. with anything made in England, he may as well say four times as much; but such an inference he evidently does not wish to be drawn from his statement. He would make qualities equal, which is not fact. "Why can the foreigner underbid us?" I answer Mr. C. by another—Why can wooden nutmegs be sold cheaper than real ones?

That any foreigner "takes *more* pride in his work" than we is a gratuitous—well, well, I have known him plenty, and never yet found him *more* so. No more anxious man lives than the steady, sober, provident, hard-working micro. hand—or, I may truly say, optical worker generally. That your "industrious," &c., is a "picker-up of unconsidered trifles" in the way of copying patterns, "sneaking" our methods, and ungratefully biting the hand that fed him, I have had ample proof. Foreign agents very soon had camera lenses (of the wooden nutmeg order) mounted à la "Ross," portable telescopes à la "Harris," Browning, &c., &c., twin glasses à la Dollond and Gilbert; and very lately a copy of Andrew Ross's "Actinic Triplet," with its Barlow lens and all, was displayed in the pages of the "E.M." as "just out" by a Continental maker of no small account.

"Garrison Gunner" speaks of the W.D. telescope at 19s. 6d. wholesale. Are they English?

Prismatique.

ATTRACTION.

[26267.]—WOULD you allow me two, or three lines to request any of your competent authorities if they can to furnish me with any demonstrable evidence that there is such a principle as attraction of any kind in all nature—solar, lunar, polar, or central? I would gladly pay for any information on the subject.

Balham, Surrey. **John Hampden.**

ACHROMATISM.

[26268.]—NUMEROUS lines have appeared in the "E. M." on the subject of "Achromatism"; but so far as I recollect, no explanation by equations of constituent elements, of the cause that makes lenses produce colours, which, in my opinion, ought to be the starting point, was ever given. It is well known that light in crossing in some ways, not in all, certain lenses, produces colours. We also know that thereby such light is diminished in intensity, and that on these colours being annihilated by means of a second lens, it diminishes still more. Therefore it is obvious that, if it were possible, it would be preferable to obtain the desired lenses' effects without producing colours at all, as then the light would not be diminished. Must one infer, from the existing state of things, that the means of doing it are yet unknown to opticians, who should know them. The word "achromatic" has been formed with two Greek roots. It is strictly correct in its actual acceptation, which is not always the case with such words. Being derived from a privative, which deprives of, and χρωμα, colour, it means *deprived of colour*. Indeed, the second lens actually *deprived* the transmitted coloured light from the colours which had been produced in it by the first one. Achromatic light really means a coloured light deprived of colour; that is, a light that had colours but was deprived of them. It does not mean a naturally colourless and colour-wanting light, a light that never was coloured. Such a light as this is, and ought to be, called "Lipochromatic," from λειπειν, to want, to be exempt from, and χρωμα, colour. To my knowledge, this does not yet exist. Colours are unavoidably produced by lenses whenever light undergoes in them a double refraction in the same direction; but if only one refraction takes place no colour appears, therefore an undiminished, colourless, *lipochromatic* light is obtained. If, then, in every successive lens or lenses of an optical instrument light undergoes only one refraction, the effect will be obtained without colours. With such a system properly applied in the actual state of optical instrument constructing processes, it is possible to produce a *gigantic refractor* of no less than two mètres, and even more in diameter, which will bring the moon at arm's length and the Galaxy in a neighbour's garden. Most likely such an instrument, which I have now been suggesting for more than fifteen years, will not be constructed in my country. I feel impressed that English, or rather American, opticians will realise it. The main difficulty is not the cost price of the instrument when made nowadays. Such matters are easily dealt with; but it will be the costly special machinery required to produce it. I should be very glad to see the matter taken up by the numerous competent readers of the "E. M." Perhaps I might be allowed to introduce a few words in the discussion.

Morchain, Somme, France. **Ch. Rabache.**

EGYPTOLOGY.

[26269.]—SINCE my first letter I have read the reports of the recent discoveries of the Egypt Exploration Society, and I find that my knowledge of the proofs of the identity of the mummy of Rameses II. with that of the corpse of the chief oppressor of the Jews, was very incomplete; not that I am convinced that Rameses II. was necessarily the first Pharaoh after Joseph's death; but it seems certain that Pi-tum, or Sekut, discovered recently, is the Pithom, or Succoth, of Scripture, built by the Israelites for Pharaoh Rameses II.

"H. F. L." will find in the *Times* of June 25th and July 23rd, 1885, the report of Prof. Maspero on the mummies; and the *Athenæum*, April 7th, 1883, an account of Pithom, by Mr. Stanley L. Poole; also Pithom, in the *Times*, April 4th, 1885.

"H. F. L." has, I presume, seen the pictures of the bodies of Rameses II. and his father in the *Graphic*, July 31st, 1886.

That Maneptha succeeded Rameses II., and was the Pharaoh of the Exodus, seems probable; and, as "Memnon" says, we want a more accurate examination as to the Exodus and the period of the sojourn of the Jews in Egypt. The chronology in the margins of our Bibles laid down by Bishop Usher—he not then having the more accurate information which we now possess—seems to be at fault with regard to the date of the Exodus; he gives us 1491 B.C. Now, Bunsen's laborious studies give us 1313 B.C. as the date of Maneptha. And the Rabbinical chronology of the fourth century, the result of learned comparison of the most ancient and trustworthy Hebrew texts then existing, curiously gives exactly the same date, 1313 B.C., as the date of the Exodus.

These are two authorities which we must respect, and in which we may have great confidence, and an examination of the tribes and generations, from Jacob's entry into Egypt down to the Exodus, results in further proof of the probable accuracy of this date—1313 B.C.—as that of the Exodus under Maneptha.

That Josephus is more correct with his 215 years

from Jacob's entry to the Exodus, than is the more generally accepted 430 years (exactly double) seems also to go along with the results of this study.

In Genesis xxxviii. 29, we have the birth of Pharez, the son of Judah, not long before the events leading to the arrival of Jacob in Egypt.

In Ruth iv. we have the generations from Pharez to Nahshon, four generations. In Numbers i. 7, we have the assertion that Nahshon was a prince of Judah just after the Exodus.

Is it probable that each of these four men handed down the stream of life from father to son, having each their first sons born to them at about the age of 107 years?—this would be necessitated by the supposition that 430 years elapsed during these four generations.

Is it not more probable that Josephus's 215 years, giving fifty-three years or so to each, is correct?

Further examination, allowing this lesser average to each generation, gives us for the six generations following Nahshon down to Solomon—a further 318 years. Solomon reigned 1,000 years B.C.; this is generally accepted as proved.

Adding this 318 from the Exodus to Solomon to the 1,000 B.C. of Solomon, we get 1318 B.C. as the date of the Exodus, not very far off the 1313 B.C. of Bunsen's calculation for Maneptha, and the same date of the Rabbinical chronology for the Exodus.

The request of "H. F. L." for me to give my impressions of the Pyramids, would lead me to cover too much space; but as I have seen, inside and out, the Great Pyramid, if "H. F. L." will kindly state what reported details he has seen reason to doubt, I will do my best to help him, from my own experience.

Gerard Smith, M.R.C.S.

Upper Clapton, E.

A PSYCHOLOGICAL PROBLEM.

[26270.]—"GARRISON GUNNER'S" very interesting letter (26230, p. 38), is merely an amplification of his former one. I would respectfully suggest to him that he has not met my particular arguments, which were offered from a metaphysical point of view.

Substantially, I am more in accord with him than would appear at first sight. What is rather incomprehensible to me is the way in which he seeks distinctively to separate the reason, the will, and the imagination. Will he kindly explain his use of the phrase "reasoning faculty"? I would have agreed with him had he simply said that the will is *potentially the ruling factor*.

The will seems to me to represent the only tangible element known to us. It is on account of this belief that I have insisted on the essential *unity* of the reason, the will, and the imagination. This position enables me to endorse in a large measure the ideas of "Garrison Gunner" in relation to religious truth.

He strangely asks—"Was any act of *true* heroism ever done to please the reason or the imagination?" The answer must be an affirmative one, if the will cannot come into operation without the alliance of the reason. "In "Garrison Gunner's" hypothetical case of the courageous soldier, the reason—more correctly, the judgment or comprehensive reason—has its proper share in determining the man's conduct. Not that the judgment is always right. It may err in company with the collective will. The whole issue, indeed, appears to me to rest on the question of ratio.

Two things are necessary for the true comprehension of the kaleidoscopic phenomena of dreaming.

There must be shown, in the first place, the precise external correlation existing between the reason, the will, and the imagination. Further, the origin of the function of sleep requires to be closely studied.

Surely very pregnant would be the answer to the question—What is sleep? **H. W.**

REMOVAL OF WARTS.

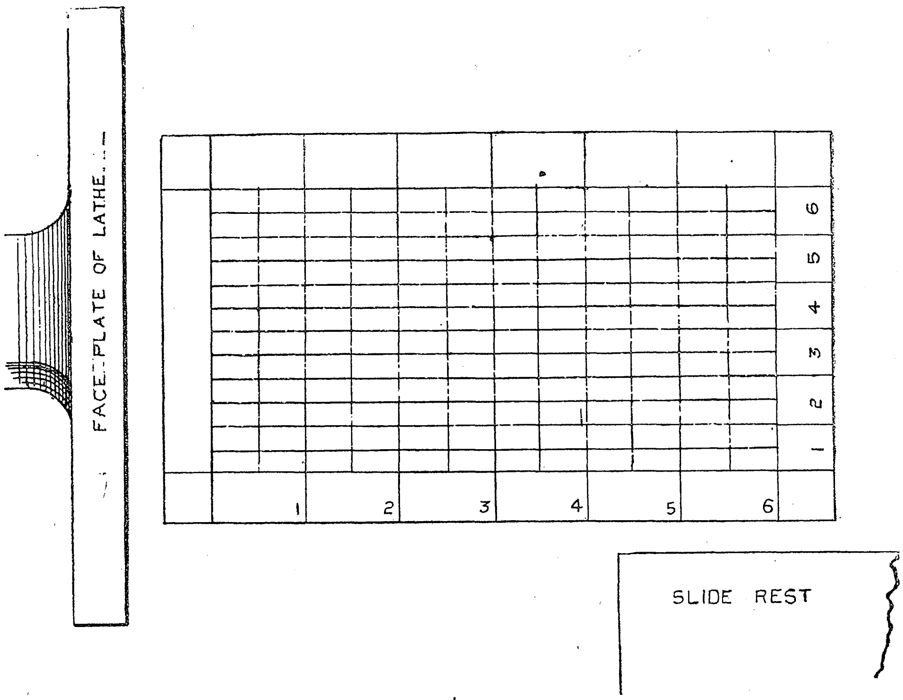
[26271.]—I RECENTLY observed in the "E.M." an article recommending the use of castor-oil for removing warts. A much simpler and more pleasant method is to rub the head of the wart frequently with a piece of common washing-soda, which should be carried in the pocket for that purpose. I have never had occasion to use it myself, but those to whom I recommended it have informed me that this treatment requires only to be continued for a week or ten days, as then the wart will have entirely disappeared.

James M'Cash Govan.

SETTING SLIDE-REST TAPER.

[26272.]—I HAVE seen several queries in "Ours" as to setting the slide-rest taper. I have invented a gauge which I am unable to patent, so I give it to the readers of the "E. M." The sketch is half-size. I have one myself which I use, and find it answers many purposes to my entire satisfaction. **W. Cooper.**

10, Harrow-street, London-road, Derby.



DRY-PLATE PHOTOGRAPHY.

[26273.]—THE appeal of "Punch," p. 580, is not in vain. I will do my best to give him his answers. I do not know how or in what form to apologise for my absence for a period from the pages of "Ours"; but it is simply through having too much, far too much, work to do—an increasing business, a seat in our Town Council, connection with some score of societies of all kinds—that I have been unable to spare a moment to write. But the visit of the British Association to Birmingham, and the shaking by the hand of so many, many readers of "Ours" who came to Birmingham, has made me snatch a few moments from rest, and I again will do my best towards helping the earnest mechanic in his endeavours to accomplish his desired work. Page 515 I cannot find. Will you please repeat queries 1 to 6 inclusive? (7) The focus is $10\frac{1}{2}$in. (8) The stops are F-12, F-16, F-24, F-30. (9) Make up two solutions—(*a*) bromide of potassium 40 grains, water $\frac{1}{2}$oz.; (*b*) ammonia $\frac{1}{2}$oz., water $\frac{1}{2}$oz—then mix them in ordinary proportions for developing—thus, 10 drops each *a* and *b* to each oz. of A solution. (10) Use a retouching pencil for small holes, and for large holes a little sepia. (11) You have not hurt the vignette glass. Simply wash it and use it for its ordinary work. (12) Don't trouble about any form of sensitometer, trust rather to experience. *Experientia docet*, and have method in your work. Make a note, both mental and pencil, of every photo you take, both as to light and amount of exposure, and in a very little time you will be astonished at your own success.

W. J. Lancaster.

STEERING OCEAN STEAMERS.

[26274.]—IT was only by the merest chance that I saw "Nun. Dor.'s" letter (26055) commenting upon my statement that "If an ordinary Transatlantic steamer were traversing the ocean at a speed of 20 knots per hour and an obstruction were suddenly sighted 500 yards ahead, she would inevitably collide with it, as there would not be time to alter her course in the time it would take her to reach it," and stating that if the rudder were put hard over in 10 seconds the 40 seconds remaining would be sufficient to clear the obstacle. When I made the calculation as to how long a vessel would require to clear an obstruction I certainly allowed more than 10 seconds from the time the man on the look-out saw the obstruction till the rudder was put over; but assuming that it was put over in 10 seconds, I could name more than one Atlantic "liner" that would not clear such an obstruction in 40 seconds, nor would they do so in the proportionally increased time which they would have, as they do not steam at the rate of 20 knots per hour.

When the s.s. *Oregon* was sunk, the captain stated that *after* the helm was put over she would steam 1,800ft. before her course was altered *one single point*, or, roughly speaking, nearly double the time I allowed. "Nun. Dor." speaks of the captain's statement as being absurd; but I really do not think that any captain placed in a similar position would make a statement which could so easily be disproved.

I know but too well that most collisions are caused by "sheer carelessness"; but I certainly do not understand what "Nun. Dor." means by saying, "It is not always that the truth is elicited before boards of inquiry when the counsel employed are incapable of seeing the absurdity of statements made by experts"; or, in other words, that Board of Trade inquiries are a mere farce. Moreover, "Nun. Dor." knows, or ought to know, that the "counsel" have nothing to do with the finding of the inquiry: they are employed by the officers and owners simply to look after their interests, and to see that their conduct is represented in as favourable a manner as possible. The inquiry rests in the hands of trained and competent men.

James M'Cash Govan.

MIDLAND EXPRESSES.

[26275.]—AS "P." still sticks to his statement that "the Midland trains are timed so fast that they cannot even now and then keep time," I will ask him how, if this be the case, he accounts for the fact that they *do* not only now and then, but frequently, keep time, as has been shown by various accounts of runs in previous numbers.

I see no more reason to doubt "Q.'s" run when he gained 25 minutes between Nottingham and St. Pancras, than "P.'s" own statement that "Avon" ran from Rugby to Willesden in 80 minutes, which is a performance more wonderful still, and which I can scarcely bring myself to credit. I have myself frequently gained time on the road with the Leeds expresses.

I should like "P." to note the arrival of the morning Scotchmen at Euston, and I think he would scarcely find them such a model of punctuality as the other trains on this line are according to him. There are many trains on the Midland (for instance, the up Leeds express due into St. Pancras at 5.50) which are delayed by connections with other lines.

I may inform "P." that I do not base my assertions on observations of the Midland main line traffic made at Rugby, which would be rather a difficult matter, to say the least of it; but upon the experience of myself and numerous friends who are in the habit of travelling by the Midland, and upon a series of observations made by myself during part of the past six weeks at Nottingham Station, through which, I believe, most of the Leeds expresses pass.

I find that the down trains are very punctual, and also certain of the up trains; but some up trains are late owing to constant delays, and though not timed as fast as the down trains, are not nearly so punctual.

I understand that the 1738 class of M.R. engines which work between London and Nottingham do not take water at Kettering. This looks as if they meant to run that distance without the stop at Kettering.

This ought to be productive of some grand running. I believe that the distance could comfortably be covered in 2 hours 20 minutes. I think also that, with a better arrangement of the traffic, they might quicken between Nottingham and Leeds. **E. A. Speed.**

RAILWAY SIGNALS.

[26276.]—DURING the recent correspondence on Signals "Libra" and others have told us what they *think* are the opinions of the *men*. There has been a very large and important meeting of signalmen at Leeds, and the report shows what the men do want:—

"RAILWAY SIGNALS AND SIGNALMEN.

"At a meeting of signalmen, held at Leeds recently, the question of signalmen and signals was discussed. The opinion of the meeting was that it is most essential that a uniform system of signal lights should be adopted—that red should be 'danger,' green 'all right,' and that white be a back light when the signals are at 'danger,' but when the signal is off it should show a blank. Shorter signal posts should be provided where possible. When tall signal posts are necessary, duplicate arms should be connected, so that the driver might have something to show him the position of the signal in foggy weather. All distant signals should be fitted with repeaters. All semaphores should lead distant signals—namely, the semaphore should be pulled off before the distant can be. All siding signals should be ground discs. All signals should be placed on the left-hand side of the road. Nor should signalmen be on duty more than eight hours, at busy junctions only six hours."

With regard to the question of *proper* side, you will note the resolution, that all signals should be on left-hand side of line. **Signalman.**

MIXED TRAINS.

[26277.]—"ANTI-VAC" says (26238, page 39), "Suppose the carriages are in front, and there is a collision?" Well, let us take a case with carriages in the rear—Suppose a following train runs into them; is not that surely as bad?

Railwayman.

ON A MODIFIED METHOD OF PRODUCING OZONE COMMERCIALLY.

[26278.]—SEEING in the queries, p. 23, an inquiry (60313) for a method of manufacturing ozone on a large and commercial scale, I give my experience in the matter of manufacturing it in large volume by a special process discovered jointly by the late Wm. Spottiswoode, P.R.S., and myself.

I will preface my description of the special apparatus by pointing out the necessary conditions for its successful production, whether on a large or on a small scale, and afterwards refer to the diagrams for explanation of the same. Nearly every one interested in science knows that ozone is oxygen in a peculiar state, produced by the packing, or grouping together, of the ultimate atoms of the gas, and this grouping occurs under two familiar conditions —i.e., when a disruptive electric discharge takes place in air, and in the decomposition of water by electricity, and by the oxidisation of crystalline phosphorus. It is necessary to employ dry air in its production, and, better still, *cold* dry air. Heat transforms *ozone* into ordinary oxygen. The silent or inductive electric discharged is the most preferable form in which to use the force for producing it.

Having, then, indicated the most favourable conditions for its production, I will go on to describe the apparatus. We will first consider the *ozone generator* which, though not new, may be unknown to many readers. Fig. 1: B is wooden box, 1ft. by 6in. by 2in. inside measurement. It has a tightly-fitting cover and a round hole about 1in. in diameter at each end, into which fit short lengths of ebonite tube about 2in. long for connecting it to the aspirator or pump for forcing the air through the box.

In the interior of the box, which is well varnished with shellac, and then paraffined, is a series of celluloid plates about $\frac{1}{16}$in. thick, P P P, and kept apart (by fillets of the same material) $\frac{1}{16}$in. thick. These sheets do not reach from end to end of the box, but are about 1in. short of each end. Each sheet has a piece of tinfoil attached to its upper surface, as shown at Fig. 2, S, with a small "lug" attached at one corner. The celluloid is now coated (tinfoil and all) with a *thin* coat of paraffin wax. This is to protect the foil from the chemical action of the ozone. It will be seen that if air is forced into one end of the box, it will go out at the other end, having to pass in thin "slices" between the tinfoil-armed sheets of celluloid.

Now every sheet of even number—i.e., 2, 4, 6, &c., has its "lug" of foil connected to a common binding screw P, and the "lugs" from the uneven numbers are all connected to binding screw N. Presuming that the box with its contents is air-tight, with the exception of the ingress I and the outlet O, we have our generator; but the only features I claim to be novel in such an apparatus are the use of *celluloid* plates, as being in every way superior to glass or ebonite, both for physical superiority and cheapness, and on the protection of the foil by paraffin wax.

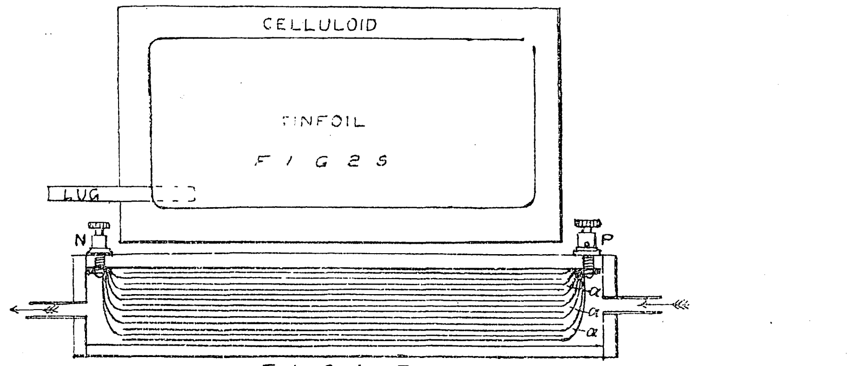


FIG. 1 B.

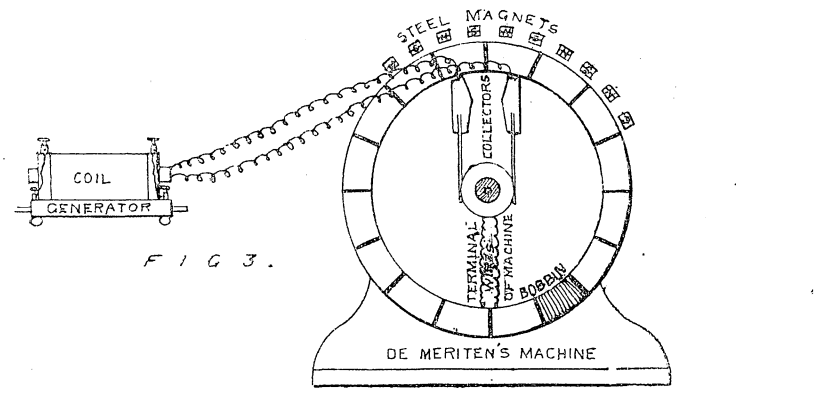


FIG. 3.

We now come to the feature for which I claim absolute novelty, simplicity, and cheapness. I allude to the apparatus for and means of generating the inductive silent discharge. It has hitherto been necessary to utilise a powerful induction coil with its complications of contact breaker, condensers, springs, switches, commutators, &c., and at best these sometimes fail, and it is only an experienced person who can "set" the contact-breaker to work evenly, and then he is not sure at what moment it is going to "stick," and thereby either burn up his primary or throw the belt off his dynamo.

Supposing none of these disagreeables happen, the operator can only get, at most, 4,000 currents per minute, and therefore he cannot drive his air through his generator beyond a certain limit of speed, in case he gets a "slice" through which has never been subjected to the inductive discharge from his secondary at all.

Our improvement consists in doing away with all complications of contact-breaker, condenser, &c., and employing a simple primary and secondary, and that is all, and delivering into the generator not 4,000 currents per minute, but 40,000 or more. This we effect by simply connecting up the primary of our inducing bobbin to the terminals of a De Meritens machine of single-ring type, absorbing about 2 H.P. when giving a current of 300 volts. and 5 ampères.

The current I ought to point out for the information of any who are not conversant with the De Meritens machine, is an alternating one; hence the fact of no condenser or contact-breaker being required. A reference to the accompanying diagram (Fig. 3) will show the simple disposition of the whole connections.

It will be seen at what an enormous speed air can be forced through the generator when we take into consideration that one discharge, for the contained air in the chamber, is sufficient to materially ozonise it. It means that, taking the air bulk to be $\frac{1}{3}$ the cubic contents of the box, we can drive through 48 cubic inches of air 40,000 times in one minute, or roughly speaking, 1,111 cubic feet in one minute; or supposing we gave the air four electrifications instead of only one, we should still get 277 cubic feet of well ozonised air per minute.

I have made gigantic experiments in this direction in the laboratories of the late Dr. Spottiswoode, and have had as much as 12,000 watts running through the primary of one of his large induction coils; but there is a limit to the use of ordinary big coils on account of the fact that the core, when it exceeds a certain mass, cannot follow the magnetising and demagnetising effects of the current sent through the primary at such vastly quick alternations.

Therefore it will be seen that by our methods *ozone* can be produced for any commercial purpose at very little trouble and at a moderate cost. I may mention that there is only one make of coil which will stand the enormous and continued strain put upon it—viz., the "Apps Inductorium."

57, Chancery-lane. **Paul Ward.**

USEFUL AND SCIENTIFIC NOTES.

University College, Bristol.—The session 1886-87 will begin on October 5th. Lectures and classes are held every day and evening throughout the session. In the chemical department, lectures and classes are given in all branches of theoretical chemistry, and instruction in practical chemistry is given daily in the chemical laboratory. Excursions to some of the mines, manufactories, and chemical works of the neighbourhood are occasionally made. The department of experimental physics includes various courses of lectures arranged progressively, and practical instruction is given in the physical and electrical laboratory. The department of engineering and the constructive professions is designed to afford a thorough scientific education to students intending to become engineers, or to enter any of the allied professions, and to supplement the ordinary professional training by systematic technical teaching. The engineering laboratory is provided with a powerful testing machine, and instruction in the use of tools is given in the workshop. Special courses in surveying are given, and excursions for field practice are frequently made. The department for geology, biology, and zoology includes various courses of lectures in all branches of those subjects, together with laboratory instruction. In the botanical department practical instruction is given by means of the botanical gardens, which contain upwards of 1,000 specimens. Several scolarships are tenable at the college.

City of London College.—The Engineering Department of this college is under the care of Mr. Henry Adams, M.Inst.C.E., whose list of successful students for 1885 must be gratifying to himself and the college. The instruction, which includes practical work, is given in evening classes in technical drawing with drawing-office practice, building construction, machine construction, carpentry and joinery, mechanical engineering, quantity surveying, and land surveying. The classes commence the first week in October.

Miniature Battery for Neuralgia, &c.—Mr. G. Lichtenfeld, court hair dresser and wig maker, of Regent-street, has devised a very small chloride of silver battery for fixing in the hat or a wig, which is intended as a remedy for neuralgia, irritation of the scalp, &c. The battery, which is inclosed in rubber and an envelope of silk ribbon, has two thin silver sheet terminals, which are passed through the hat band and made to press against the forehead or other parts of the head. A battery, weighing less than three drachms, which occupies very little room in the waistcoat pocket, will ring a bell or excite a coil quite as strongly as most people care about, and we understand that some are made which weigh no more than one drachm.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[59842.]—**Mathematical Probabilities.**—Reading hurriedly through "Alioth's" query (No. 1118 p. 582), I did not observe that the odds were to be "against" and not "for," and the rule I gave applies only when the required odds are "for." His query can be solved, however, by the same method as I gave on p. 444 of last volume. The equation becomes $\left(\frac{20}{21}\right)^x = \frac{10}{11}$, $x = \frac{\log. 1{\cdot}1}{\log. 21 - \log. 20}$ = 1·95, that is to say, the odds 20 to 1 are reduced to 10 to 1 in two throws. It is interesting to notice that if the odds be n to 1 in one throw, in r throws they are reduced to $(n \div r)$ to 1, if n be a large, and r a small number. Thus, if the odds be 20 to 1, in two throws they are 9·8 to 1, the theory requiring 20 ÷ 2 or 10 to 1. In three throws the theory gives 6·6 to 1 (6·3 to 1 calculated); in four throws 5 to 1 by theory (4·7 calculated); in five throws 4 to 1 by theory (3·7 calculated); which are pretty close approximations. I have just completed calculating the data for the table "Alioth" requires, and find that the following formula holds good for adverse odds:—Tabular No. $= \frac{\log. (n+1) - \log. n}{434{\cdot}3}$ where n is the odds required. The rule is the same as before—viz., Multiply the tabular No. for the odds required by the original odds, and the result is the number of throws necessary. The tabular number with odds "for" is $\frac{\log. (n+1)}{434{\cdot}3}$, which is very similar to the preceding. I give a solution of "Alioth's" last query (p. 41), by means of the table. The tabular number for odds 5 to 1 is ·184, which, multiplied by 100 (the original odds), gives 18·4, or in about nineteen throws the odds 100 to 1 are reduced to 5 to 1. Only one multiplication is needed, as "Alioth" stipulated for.—R. E. F.

[59842.]—**Space Filled with Spheres.**—On further examination, I do understand "E. L. G.'s" chess-board arrangement in a box; and he is right to this extent, that it does generally waste less space than alternate layers of n^2 and $(n-1)^2$ balls. But he is as wrong, as I said before, in applying it to an infinite mass, as he did in answer to "J. K. P.'s" question, which was limited thereto. An infinite mass can only be considered internally. Also, I had better inform experimenters that it is difficult, if not impossible, to lay the first layer in that way without the floor being grooved to hold the balls steady. And yet further, the floor of the box must not quite be divided chess-wise, but must have a margin, nearly a quarter of a square or a seventh of a ball wide, all round the chess-board divisions, the diameter of a ball being the diameter of one of the squares. It is a very small matter, but neither my observation nor other people's agrees with his appropriation of the square pyramid to cannon balls and the triangular one to oranges.—G.

[59842.]—**Effect of Time on Chances.**—The process by which "R. E. F." would have his table made (p. 17) is a very needlessly operose way of getting the natural or Napier's logarithms from common ones. Dividing each common tabular logarithm by ·434, or (what is much easier) multiplying by 2·3026, would give two or three figures of the Napier logarithm. He directs us, opposite each number n, to put this Nap. log. of $(n+1)$; and then, if it be asked in how many throws, each having the odds of m to 1 *against* an event, the odds will become n to 1 *for* that event, I gather him to say we shall roundly approximate this by multiplying the tabular figure opposite n by m. But this is not the kind of question that either "J. M. pro Alioth" put in p. 582, or "Alioth" puts in p. 41. The former supposed it "20 to 1 against a certain event," and asked "in how many throws will the odds be 10 to 1 against?" while the latter asks, "If the odds against success in one trial be 100 to 1, in how many trials will the odds be only 5 to 1 against?" Neither speaks, like "R. E. F.," of a reversal of odds, or change from improbability to probability. Whether "R. E. F.'s" table will tolerably approximate the solutions he speaks of, wherever the original odds are large—say, larger than 20 to 1—I cannot tell; but it certainly will not with smaller original odds. Thus, the top figure of middle column of my table, p. 12, it would make 1·4, whereas it is certainly over 1·71. "Alioth" would come nearer if, after multiplying by m, he added the fraction $\frac{1}{m+1}$.—E. L. G.

[59854.]—**Box Filled with Spheres.**—The arrangement of the interior of a mass of spheres of equal size is always the same, for these reasons: A ball cannot touch more than 12 others of its own diameter. It can touch 12 larger than itself, and therefore the 12 of its own size need not mutually touch. If they repelled each other and had none beyond them, the centre of each would be 63° 26′ from those of its five neighbours, and their 12 centres would form 20 equal triangles, with their planes in 10 directions. But the masses outside prevent this, and compel each to touch 4 of its fellows and form the junction of two triangles and two squares (so that there are but 8 triangles and 6 squares, all their 24 lines subtending but 60° from the middle), because the 14-faced solid thus formed is of less bulk than the icosahedron they would form if repelling each other. Now as only each opposite pair of faces can be parallel, "J. K. P." has here at once the 7 cleavage directions, whose consideration is, as he suspected, the key to the whole matter. (It is the same with crystals. They have but 7 cleavages, not 10, and the regular icosahedron is unknown among them, because their particles are held by attraction, not repulsion.) Thus there can be but 4 directions of honeycomb planes, and 3 of chequer planes. Now between any 2 of the former he finds the angle 70° 32′, and between any 2 unlike planes (viz., a honeycomb and a chequer one) 54° 44′. It follows that any planes to be perpendicular must have nothing to do with honeycomb ones. But any 2 of the 3 chequer planes are perpendicular, so that a box can always fit them all three. Not, however, if bordered with any close row, because he will find the meeting line of any 2 such planes is an open row, whose balls' centres (calling their diameter 1) are $\sqrt{2}$ apart. But as he considers only space, apart from any particular form, he may ask whether the cube wastes least or the octahedron (both having the same number of edges, and of faces and corners together). This may be settled by the cube's edges being the blunter; but, at any rate, by comparing the numbers of inclosed and outer balls. All those in a cube, we have seen, must be half of an even cube number, or half of an odd one + 1. An octahedron with root a contains $\frac{2a^3 + a}{3}$ balls. The smallest cube to have as many balls within as on the surface (and 12 more) he will find to have 500; but the smallest octahedron to have as many within as without (and only 18 more) has 670. So, then, 6-faced boxes excel any with less than 14 faces.—E. L. G.

[59995.]—**Excavations in the Hill of Tara.**—With reference to my former reply to this query (Vol. XLIII. p. 512), I have now heard from my friend in the Royal Irish Academy, and he informs me that the gentleman I alluded to has since died, and, he adds, "As far as I know, no excavations have been made at Tara up to the present time."—J. E. GORE.

[60050.]—**Space Filled with Spheres.**—Does "J. K. P." really know what he wants? The original question has been answered several times, and, indeed, he said afterwards that he had found the answer to it himself—viz., that the vacant space in an infinite mass of equal spheres close packed is ·269 the whole. He did not say which of the two modes of closest packing he had calculated on, nor did "E. L. G."; and then I told him that they both give the same result, though, probably, one would have guessed that the triangular plan was the closest, because all adjacent balls in every direction are in contact; while in the square pyramid no diagonally-adjacent balls in any horizontal plane touch. The note which he has several times referred to in Lord Grimthorpe's "Book on Building" said the same, though with a small error in the figure for the ratio of the sum of the balls to the volume of the whole mass—viz., ·707 for ·740, through a slip, of which I can guess the cause, though that is immaterial. The ·707 is practically right, within an insignificant fraction, either for a square or a triangular pyramid containing as a box, not an infinite, but a great, number of balls, such as 100 in each edge, the result varying somewhat with the number. ·707 is also quite right for the proportion of a mass so large that the margins may be neglected, of balls close packed in either way, to that of the same number set cubically all over. "J. K. P." now professes to wish to ascertain whether those who have given these results (evidently meaning me) are aware of the reason for them. So far as a reason for a mere geometrical fact means anything, I had told him the reason with the fact; and as he has not attended to it, he probably would not if I told him again. He has now discovered a genuine paradox of his own (to justify his persisting in speaking of the "shot paradox, I suppose") —viz., "by means of a drawing-board, that the arrangement of"—not the vacant space in—"the interior of a mass of spheres is the same in whichever of the two ways you commence laying them, and he is not sure that either 'G.' or 'E. L. G.' is aware of this." I am quite sure that I am not; but I do not presume to answer for "E. L. G.," whose games of chess I (like "J. K. P.") now understand less than ever. If "J. K. P." will drop his drawing-board and buy some marbles, and build up a triangular and a square pyramid with them, and observe their internal arrangement as he goes on, he will see that their interiors are different in every way. And if he will then put them into a box as wide both ways as any integral number of the marbles, he will appreciate "E. L. G.'s" last assertion that he was right about beginning with the alternate squares of a chessboard. For the box plainly holds n^2 balls in the first layer, and $(n-1)^2$ in the second; and so, with an odd number of layers you get one more n^2 layer than $(n-1)^2$; whereas, if you begin on the alternate chess-square plan you cannot get near so many. And when you go to infinity there is no initial layer at all, and you can only look at internal arrangement, of which there can be but one in rectangular close packing. "J. K. P." fancies we cannot be sure that either the triangular or rectangular pile is the closest without the differential calculus. Yes we can; for it is easy to prove that any other that can be invented is wider; and anyhow, the calculus could not invent one for us. It is not a question of degrees as in the honeycomb problem, as may be seen at once from the fact that the two modes give the same result; and also, because the balls absolutely fix the angles of the piles, which in honeycombs may be called discretionary.—G.

[60055.]—**House Boat.**—TO E. CONRY.—Thanks for your suggestions in No. 23 last volume. Accepting your measurements of 16ft. length and 18in. draught, will you kindly give me width of pontoon in widest part, and also how much of the 18in. I may expect to be submerged with the weight given? May I ask the reason why you suggest the principle of a boat cut in half rather than that of two distinct boats.—PONTOON.

[60076.]—**Frictional Electricity.**—One answer to this question is: Charge the ball with sparks from a machine; but I suppose that is not the answer desired. Still, I do not think it possible to charge the pots without a supply of the electricity. —W. A.

[60083.]—**Clematis.**—Cuttings of these plants are not readily struck without heat; but the plan most likely to insure success is to peg down shoots in August, just wounding them at a joint which is buried in the soil by cutting slightly into the surface, so as to raise a little tongue. As to pruning, you can do almost as you like; but they bloom all the better for being cut back severely. If you want to train them, cut out the summer growth, and shorten the main stems until you get it into shape. The Jackman only flowers on the new growth.—C. K.

[60087.]—**Leclanche Cell.**—"A special Leclanché" are the words used; but they cannot mean anything more than a large size and several cells of the agglomerate pattern.—W. A.

[60097.]—**Vacuum Brakes.**—This cannot be answered without examination. The sticking is only occasional.—S. W. R.

[60106.]—**Chamber Organ.**—"Young Amateur" should look up the back volumes for scales of pipes, unless he can wait for Mr. Audsley to reach that part of his subject, in which I presume he will give specifications and scales.—J. T.

[60121.]—**Prime Cost.**—"Prime cost" is the price to be paid for the work done; "cost price" is what is actually paid for the materials and labour.—SAML. RAY.

[60123.]—**Boiler for Yacht.**—An engine of the size mentioned would do; but a boiler of the locomotive type would be best at such a working pressure.—J. T.

[60128.]—**Photo Lenses.**—Wide angle lenses are most useful lenses when used for their special purpose. In confined situations, in churches, rooms, &c., where space to use an ordinary lens is unobtainable, then the wide angle lens is of great value. You can have lenses so wide in their angle as to enable you to stand in one corner of a drawing-room and obtain a photograph of almost the whole of the contents of the room. You may get a photograph of the whole of the front of a house in a narrow street; but you must make many experimental trials before being successful. You must master the swing back, rising and falling fronts, then you will be able to get straight lines, good proportions, and a photo worth all your trouble. S. Bottone's reply, p. 561, is ambiguous, and apt to be misleading. To get roughly the angle of the lens, you mnst have a camera so large (not of merely sufficient size only) that the lens gives a perfect circle on the ground glass; then you may measure to get roughly the angle of lens. Shall be pleased to give you any further information you may require.—W. J. LANCASTER.

[60185.]—**L. and S. W. Locos.**—Here is all the information I have at hand:—2 Tartar, 14 Mercury, 25 Reindeer (Mar. 1873), 27 Eagle (Dec. 1862), 39 Wizard (Feb. 1874), 71 Alaric—four-coupled passenger engines; cylinders outside; bearings inside, except to leading wheels; large dome on firebox, with valves on top; Gooch's safety-valve on boiler; designed, I believe, by Beattie. 149 (no name)—goods tank, six-coupled;

built by Beyer, Peacock, and Co., Manchester, in 1882. 348 (no name)—bogie four-coupled express; outside cylinders; designed by Beattie; built by Sharp, Stewart, and Co., Manchester in 1877 (No. 2657). Similar to Nos. 349—366. L. B. and S. C.—4 Mickleham—passenger tank; 1873. 85 Cannes, and 86 Geneva—goods tanks; 1883.—V. J. B.

[60190.]—**Leclanche for Quantity.**—For the information of "M.M.I.Sc.S." I have performed the desired experiment with a "quantity" galvanometer having a resistance of ·01 ohm. Upon connecting it to the cell, having an ordinary ⅜in. diameter zinc rod, the needle was deflected to the full extent of the scale. Instead of inserting a resistance, I put a shunt wire between the terminals until the needle stood at 25°; I then changed the zinc rod for a plate 6in. by 3½in., and another 9in. by 4in.; but the needle would not move, showing clearly increasing zinc surface is useless, as stated by me on page 585, Aug. 26, when I used a galvanometer having 126 ohms resistance. May I ask the attention of E. Conry to this?—for replying to query 60073 in to-day's issue, he states "that zinc plates give a larger current at any particular time than rods." How would he prove this in the face of these experiments? I shall be very glad to hear the opinions of others, for a "quantity" Leclanché is what I have been aiming at for years.—AN A.S.T.E., Sept. 10.

[60197.]—**"Take a Postage Stamp."**—At the railway stations in several of the large Scotch towns there is a mechanical apparatus for supplying travellers with stamps, &c.; these machines are divided into two parts, one of which supplies a postcard when a penny is dropped into a slit; the other, which requires two pennies, supplies a sheet of paper, envelope, and stamp. I cannot give a drawing, but suppose it would be of little use, as these appliances are the property of a private company, and are, I believe, patented. There are also several on many English piers for supplying cigarettes.—JAMES MCCASH GOVAN.

[60205.]—**Compound Engines.**—In reply to "H. R. W.," page 43, the diameter of l.p. cylinder —viz., 3¾in.—will be quite correct for steam at 80lb., which gives a ratio of 3½ to 1. If you intend placing the cylinders tandem, a receiver will not be required, as the exhaust may be taken direct to the l.p. valve box. The one eccentric works both valves; but in large engines it is better to have an expansion valve on the h.p. cylinder. Set the valves to cut off steam at about five-eighths of the stroke.—ENGINEERING, MANCHESTER.

[60241.]—**The Vanishing Lady.**—By simple reasoning, founded on observation, I have arrived at the following conclusion with regard to this trick, which, I believe, is certainly correct in the main, though possibly not so in some minor details. The carpet and newspaper placed on the stage conceal a trap door, the position of which is indicated to the conjurer by the folds of the newspaper. Upon this he places a specially constructed chair, having *no cross rails*, and, to give an idea of transparency, painted to resemble cane. The lady is now seated in this chair, and some moments before the *dénouement* (and after the audience have been repeatedly assured that she is still there) wire arms are brought into proper position for holding the covering cloth exactly as though a person were seated in the chair, the seat drops on its hinges, and the lady passes downward through the trap, of course concealed from view by the cloth. To accomplish this, squares must be cut out of the carpet and newspaper. The first is, no doubt, done beforehand; the latter presents more of difficulty; but, even if the paper is not also previously prepared (as it might well be), I assume that it could be cut by the lady herself. The trap is then restored to its original position, bringing the carpet and paper to their places, the seat of the chair slips up, and the conjurer is ready to throw off the covering cloth, and reveal the empty chair. When the cloth also disappears, it is doubtless carried behind the chair by the wire arms flying back to their concealments at the moment of *dénouement*. —W. A. COOPER.

[60243.]—**Electro-Magnetism.**—The question seems to be badly put. In point of fact, you would not have any trace of magnetism in the dry pile you refer to. You could, and would, obtain a slight electrical effect from simply building the foils as directed, and you could increase this somewhat by sending a current through the whole; but the effect would be very small indeed, as from your query it is evident you would have metallic contact from end to end of the pile. No doubt the original question has been somewhat modified, or was intended as a catch question.—W. J. LANCASTER.

[60246.]—**Heating Small Conservatory.**—I have used, with a fair degree of success, a gas-stove to heat a fernery throughout the past winter, and as this fernery faces north-east, it received more than its share of last winter's chill. I have been unable to trace any deaths of ferns, of which I have a large number of varieties. The stove is Ritchie's Patent "Lux Calor Hygienic Condensing Gas Stove." There is a very large condensation, the water falling in a tray beneath the stove, and I place in a metal dish on the top of the stove sufficient water, which, as it evaporates, compensates for any loss, and really keeps plenty of watery vapour in the fernery. I have tried the makeshift petroleum lamp and T-tubes, &c., but with me they have all been failures.—W. J. LANCASTER.

[60252.]—**Gravity.**—If the earth were homogeneous, and a well were dug at one pole through the centre of the earth, a stone falling down the well would be always attracted by a force proportional to its distance from the centre, because the attraction of that part of the body of the earth outside the stone, or the whole outer shell whose thickness had been traversed by the stone, would cancel its own attraction on the stone, according to a well-known principle. The stone would reach the centre in 21 minutes of time, with a velocity of five miles per second. The earth, however, is not homogeneous, but increases in density downwards. In consequence of this the actual time of falling to the centre would be less than that mentioned, and the velocity greater.—DUBLINIENSIS.

[60252.]—**Gravity.**—When a body has fallen lower than the level of the ground the matter behind certainly does retard it, in the sense of making its weight less, and its velocity no longer increases by the same law as while it was above ground, but slower and slower, though still so increasing that its maximum would only be reached at the centre. It is true the earth acts on all bodies outside her as if her mass were all concentrated, but not so on anything within her. If her density were uniform up to the surface, gravity would here be at its maximum, and a pound taken a mile down would be a 3,960th lighter, or 1,980 miles down only half a pound; but, owing to the lightness of all the surface material compared to the mean density, the level where gravity is greatest, though not many miles down, is lower than probably experiment will ever reach.—E. L. G.

[60252.]—**Gravity.**—"Angulus's" query is one of the most serious that ever was inserted in the "E.M.," as it involves the famous principle of attraction. A proper answer would require a large space, and the arguments—cosmogonal laws —to be set forth would have no chance of being admitted by the Editor, as being absolutely opposed to the hypotheses now admitted as truth by all scientists, although false. But, even in admitting the hypothetical principle, the so-called force (?) which increases until the falling body reaches the surface, decreases to zero from the surface to the centre, so that there is none there, and that inertia —which is a nonentity—is the consequence. A centre is a point where there is, where there can be, nothing; therefore, attraction to or by a centre is attraction to or by nothing, which is absurd. The reverse can be said of centrifugal force (?) which, by the bye, is not centrifugal, but axifugal, which, should it exist there, continually flying away, but constantly remaining in place, as asserted by scientists, would repel all bodies and prevent their fall, since that force is said to have been sufficient to enlarge the earth at the equator. If "Angulus" writes to me, I will give him some information.—CH. RABACHE, Morchain, Somme, France.

[60254.]—**Tricycle Driving Gear.**—I am afraid gut-bands will prove most unsuitable for the purpose you wish to use them. Now I have long had an idea, but have never found the time to work the idea into practical shape, and as my time is more limited than ever, and every moment is of value, I will give the idea to you to do what you like with it. It is this: Having years ago done my share in tricycle riding, having treadled to Land's End and treadled back again, I have over and over again wished for something to take the place of the chain gear, and to neutralise the two dead points in every revolution of the wheel, and my idea is this: Instead of the two wheels and chains, I should use cranks and treadles; but in place of steel rods connecting crank to treadle, I should use thick indiarubber rod or spiral steel wire. A stretch of 1in. or 1½in. would be ample. With such an arrangement you could have no dead point, no jarring or jerking caused by a loose chain, and I believe a machine built upon this plan would be one of the best goers ever made, and for hill climbing it would be excellent; by means of an adjustable lever the length of stroke could be altered in an instant, and so either low or high gearing could be used at will. I shall be interested in hearing that you have made the machine, and that it does more than I have given it credit to perform.—W. J. LANCASTER.

[60255.] — **Hydrostatic Pressure.** — To "ALIOTH."—Very sorry, I am sure, to have hurt your feelings, but your present addition to your query makes it more clear to me, however clear it may have been to your own mind before. The moment formed by the weight of the rod by its distance from the point of support is exactly balanced by the weight of water displaced by the distance of its c.g. from same point, the latter being upward and the other downward. The downward pressure on supporting point is the difference of the two weights. All this you probably know, and you also probably know that it is a very pretty little problem to work out—volume displaced, and its centre of gravity, and so on—which I, for one, have neither the time, and perhaps not the knowledge, to work out for you; as I believe you will find it requires the calculus. Try and get "M.I.C.E." to help you out, if no one else does.—T. C., Bristol.

[60259.]—**Electro-magnet.**—The pole-piece, or so-called keeper, should bear some relation to the size of core. About half the volume in cross section I have found to work best; thus with your magnet a bar 1in. by ½in. would answer every purpose, using, of course, the softest iron you can get.—W. J. LANCASTER.

[60260.]—**The Aneroid.**—With reference to reply contained in your last number respecting the aneroid as an instrument for measuring elevations, I may say that I thought the lines ruled on the dial were all spaced at equal distances apart. As, or if, this is not the case, what is the use of the vernier? I fancied its purpose was to subdivide the fiftieths into tenths. Within the limits of, say, 30·269 and 29·610, would it be correct to reckon the movement of the index across each fiftieth as the measure of a rise of 19ft.? And if when I have reached the top of a hill I find that the index has moved from 30·110 to 30·073, then to what height have I climbed? What I ask for is information respecting the aneroid and vernier, or reference to some book explaining those things.—X.

[60260.]—**Aneroid Barometer.**—Are you quite sure you have a vernier on your aneroid? I have never seen one fitted to an aneroid. I have, of course, seen thousands with an altitude scale, and I have an idea yours must have this, from the fact that the inch of the aneroid should show 100 parts, while that of the vernier (?) should show 930 for the inch between 30in. and 29in. That is, let the barometric inch 30in. to 29in. be divided into 1,000 parts; then the elevation scale in same space should read 930ft. Of course 930 is not the mean from bottom to top of atmosphere, but is really the lowest number of feet per inch; thus, between 29in. and 28in. you would have 960ft. This is, of course, at a definite temperature—about 56° F.; but there are so many circumstances to be taken into account that your best plan will be to spend 6d. in purchasing "The Aneroid Barometer: How to Buy and how to Use It," by a F.M.S. You will have all your necessary tables in this.—W. J. LANCASTER.

[60262.]—**Photo. Enlarging Lantern.**—The lens you have would make an excellent front objective for an enlarging lantern. You would require a pair of 5in. or 6in. condensers, a triple-wick paraffin lamp, and then you would have to make a chamber to hold lamp and condenser, &c. If you are a mechanic and can make the apparatus, I shall be pleased to tell you how to do it. You could get an enlargement up to 36 by 30, and a lantern disc probably 10ft. in diameter. I am assuming that your lens is a good one.—W. J. LANCASTER.

[60266.]—**Sun Dial.**—The simplest form of apparatus you can construct is a large hoop, say 2ft. in diameter, and 4in. or 6in. broad; in one side of this cut out a hole, into which fit a double convex lens, exactly 2ft. solar focus; the ring must be suspended in trunnions, so that it may be moved from or to the zenith. The inside of the ring opposite to the lens should have a piece of silvered metal, or pieces of white paper with a metal back, to conduct away heat, will answer. Exactly opposite the centre of the lens a line must be marked perpendicular to the ring; this line is the meridian line, and your difficulty will be to set the ring exactly in the meridian. When so set the image of the sun must be watched as it nears the line, and when the sun is bisected by the line then table your time; of course, you must have tables as to sun fast, sun slow, &c., and with care in making and setting you will have a fairly reliable time-teller. This is useless for any other time but when the sun crosses the meridian—that is, at or about 12 o'clock.—W. J. LANCASTER.

[60267.]—**Thermometer Tube.**— Your query contains its own answer; by working slowly, you admit that you get on quickly. Now glass will not allow you to heat it rapidly without some sign of temper, generally hard and ill-temper; this goes from the glass to the hasty blower. Better make one good tube in ten minutes than spoil half a dozen in twenty minutes. Co-efficients of expansion have a most unaccountable way of suiting themselves to a particular substance, and if two substances having different co-efficients are blended together it is then necessary to use every caution

when using them; but you can easily arrange a model furnace, into which you can place ten or a dozen tubes, and get them heated, say, to 600° or 700° Fahr.; then take them out as you want them, and you will save a lot of time.—W. J. LANCASTER.

[60268.]—**C.G.S. Units.**—If the gentleman who gratuitously advertises himself as "Mr. Wm. John Grey, F.C.S., Analytical Chemist, Newcastle-on-Tyne," will be good enough to look up the subject of C.G.S. units in any textbook, it may dawn upon his gigantic intellect that there are often more ways of stating a case than one. His correction simply amounts to this: "It is absolutely incorrect to say that two things added to four things make half-a-dozen things: they make six things!" It is a pity this gentleman does not utilise some of the energy he expends in rude and incorrect contradictions in answering the constant queries that go unanswered in "Ours," simply because many of our contributors are in the same position as myself, and have not the time to hunt up information on the various subjects, if they do not happen to have it by them.—E. CONRY.

[60274.]—**Mushrooms and Salt.**—Being interested in an article on salting meadow land, and the growth of mushrooms, and the answer to query, does it not appear the salt sown in spring would during the summer months penetrate the soil by autumn, creating and maintaining agreeable moisture, favourable to the growth of mushrooms, of course attracting the dew to the soil earlier and before the summer heat is spent. The mushroom seems to revel between drought and humidity. Although salt may be somewhat unfavourable in any great quantity, neither contained in its composition, it seems reasonable to believe, the moisture created thereby is beneficial to the ramification of the spawn in the soil. Should this, as it appears, be reasonable inference, it would be highly interesting to experiment on some fairly-drained fertile old sheep pasture. Other experiment is hereby suggested, too long to be now entertained. The mushroom seems to revel between drought and humidity—*any* meadow taken indiscriminately would likely prove futile.—W. F. DARK, Gardener.

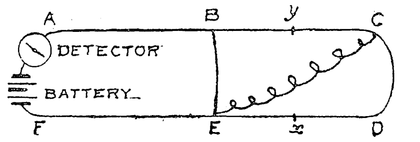
[60283.]—**Eyepieces.**—I should advise you to make two lower power eyepieces than you suggest, and you should use for the lower power $\frac{1}{2}$in. and $1\frac{1}{2}$in. lenses, these will give you a power of 40; then for the present high power use $\frac{1}{4}$in. and $\frac{3}{8}$in. lenses, power 80. The first pair must be mounted 1in. apart, and the last pair $\frac{1}{2}$in. apart, all plane surfaces to be mounted towards the eye. The dark head is a sun-cap to go over each eyepiece.—W. J. LANCASTER.

[60284.]—**Portrait Lens.**—You have nothing as yet towards a half-plate portrait lens, and I am afraid the making of such a lens would be an impossibility. Still, this is only an assumption on my part, as I do not know what you can do. Let me have this information. What have you done in optical glass grinding? Tell me what tools you have, then I will give you the information you require. Reading glasses are generally made of crown glass.—W. J. LANCASTER.

[60285.]—**Polarised Light.**—The arrangement as described on p. 550 appears primitive, and does not at all seem calculated to produce a good image. I should prefer two ordinary A eyepieces, with a cap fitting over eye lens carrying an achromatic plane of $\frac{3}{8}$in. focus. The opposite eyepiece I should make up in a precisely similar manner. The arrangement of Nicol does very well mounted as in drawing. For polariser, a single piece of $\frac{1}{8}$in. plate, roughened or smoothed on the back and blackened, answers almost as well as the bundle of plates, and is much more easily made. I do not just at the moment remember any experiments in circular polarisation with the microscope; but I see no reason why a quarter more plates might not be used with your Nicols to obtain circular polarisation.—W. J. LANCASTER.

[60186.]—**Mathematical.**—Thanks to "T. C.," "Toodles," and "E. L. G." for taking notice of my question. They had evidently overlooked the question of placing the three balls into a box "cube in shape." "T. C." and "E. L. G." give the side of the cube as $10\frac{1}{4}$in. (about) arranged diagonally in the box. Are they quite certain that by arranging them as a triangle in this way will give the size of the smallest cube. Will they kindly show the calculations for it?—ADAM.

[60297.]—**Testing for Faults.**—The question is one which can hardly be fully answered within the limits of a reply to a query, but the following may be of service. If you cannot get a current through A C D F, join the lines about midway, as Fig. 1, B E. This joint need only be temporary, as by scraping or cutting the insulation off both lines, and twisting a bit of wire round each; if, then, you get a deflection of the galvanometer needle (showing there is a current passing round A B E F) you will know the break of one or both lines is between B and C, or E and D. If you have a loose coil of wire of sufficient length handy, you can then tell in which wire the break is by joining one end of the loose coil to C, and taking the other end

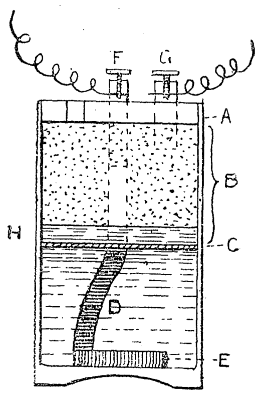


to E, up to which you have already found the wire F E D is all right. If no deflection, it shows that the break is in B C; if there is the deflection, it shows that A B C E F is all right, and you must then join the E end of the loose coil on for a moment at X, and see in the same way if A B C X E F gives a deflection, when the fault will be between X and D, and so on. If you have a loose coil and circumstances admit of your applying it as above, you can dispense with joining B E at all. If you have no coil or cannot use it, then you must, after having, by joining B E, "localised" the fault, as it is called, to the right half of the circuit, divide this half into half again by a temporary joint at X Y, and see whether the fault is right or left of you, in the same way. In the case of short circuits, which are much more frequent than breaks, and much more troublesome, you can trace them down in a similar way by keeping the extreme end of the circuit open between C and D, by cutting the wire if necessary, and working on the reverse principle—that a deflection on the galvanometer is wrong. A "deflection" is the sharp twitch of the needle that occurs when a current passes. The detector, or galvanometer, as it is generally called, is connected up in series with the battery, as shown. Dynamo testing and some other matters I must leave for the present—E. CONRY.

[60298.]—**Norway and Sweden.**—Heat of summer upon Arctic circle in Norway sometimes outstrips any summer in the south of England. Sultry, oppressive, and in many parts relaxing. Porridge-eaters fare happily. Do as natives do; and eat their mild white cheese, with flat bread. Spent all summer just on spot, 1884; fared well, independent of meat. Recommend route Newcastle—Bergen. Language: Bennett's "Norwegian Conversation," published at Christiania. Detailed information direct, if desired.—WEALD.

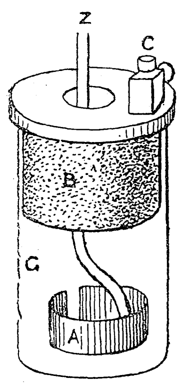
[60303.]—**Captive Balloons.**—As you kindly inserted a previous letter giving some particulars of my apparatus, and as this query contains several misstatements which, if not contradicted, might be calculated to give the public false impressions, I shall feel much obliged if you will allow me the opportunity of answering "Palace." "Palace" states he understands that the balloon was withdrawn because it proved a failure, and asks me the cause of the failure. He adds that it never was lit up with electric light: also, his whole query is full of inaccuracies as to dates, not one being near the mark. In reply, I beg to inform him that my balloon was not a failure, my patent apparatus working without a hitch. Further, my balloon was lit up with electric light most brilliantly, and witnessed by thousands. I withdrew the balloon from the Crystal Palace owing to circumstances which compelled me to commence a legal action against the Crystal Palace Company. Those circumstances I leave to reveal themselves in the fitting place. I thank "Palace" for the extreme interest he takes in my invention; but I think it is a pity that, before he wrote on the subject, he did not take care to be rightly informed in at least one particular. I am not surprised he did not see the electric light in the balloon on July 6th, as for some days previous to that date the balloon had been quartered some hundred miles away. If "Palace" requires further assurance of the success of my electric balloon, I refer him to the unanimous opinion of the London press, and to the fact that I have supplied my apparatus by order of the War Office to the English Government, and that I am now negotiating for its adoption by various foreign Powers.—ERIC STUART BRUCE, M.A. Oxon, Pangbourne House, Tunbridge Wells, September 8.

[60314.]—**Pollak's Battery.**—This battery consists of a cylindrical glass jar of suitable dimensions, the exciting fluid being salammoniac, as in the ordinary Leclanché cell. A is a wooden cover, having in it three perforations—two for binding-screws and one for filling purposes. B is a carbon block occupying about half the cell, having on its under surface a layer of copper (C), which has been electrolytically deposited. E is a strip of zinc bent into a cylindrical form, and connected by means of a strip of the same metal (D) passing through the carbon block to the binding-screw F. The other binding-screw is in connection with the carbon block B; H shows the height to which the liquid reaches, though it is only necessary that the copper should be wetted in order to give a current when the circuit is completed. As the battery depends a good deal upon gravitation, it should be moved as little as possible. Local currents are set up between the carbon and the copper, which decompose the NH_4Cl, forming chloride of copper. The nascent hydrogen liberated at the copper reduces the cupric compounds, which are formed again by the copper, the battery thus constantly charging itself anew. It maintains a current of $\frac{1}{80}$ ampère for six months, consuming $6\frac{1}{2}$oz. of salammoniac and $2\frac{3}{4}$oz. of zinc, at a cost of about 3d., the carbon block being said "to last for ever." E is given as



0·932 volt. For lighting purposes it would be about as efficient as a Leclanché; but for bells a simpler or cheaper battery could not be desired.—R. E. F.

[60314.]—**Pollak's Battery.**—The peculiarity of this battery consists in the ingenious arrangement whereby not only the depolarisation of the plate, but also the regeneration of the electrolyte, is effected. It consists of a vessel, in the bottom of which is placed a strip of zinc (A, Fig. 1) rolled



up into a cylinder $1\frac{1}{4}$in. in height and 3in. in diameter, which forms one of the electrodes. The other electrode consists of a porous, coarse-grained carbon cylinder, B, its upper part being formed of agglomerated carbon. The lower part is covered with an electrolytic deposit of copper. This cylinder is $3\frac{3}{4}$in. in diameter and $3\frac{1}{2}$in. in height. It is supported on the edge of the vessel by means of three projections. From 200 to 250 grammes of salammoniac are placed in the vessel, which is then filled with water until its level reaches from $1\frac{1}{4}$in. to $1\frac{1}{2}$in. above the lower edge of the carbon. This at once sets up a local action between the carbon and the deposited copper, which has the effect of decomposing the salt, and of producing other combinations with the copper; in other words, the carbon forms with the copper a couple, of which the metal is the positive element. A portion of the copper forms a soluble compound, whilst the hydrogen is burnt by the oxygen, which is condensed in the pores of the carbon. This local action is termed the formation of the element. It is this secondary copper carbon couple, or rather the metal of this couple, which really constitutes the negative electrode of the cell. The hydrogen disengaged upon the electrode thus composed is employed to reduce the salt, from which it precipitates metallic copper, but which is again formed afresh in the presence of the carbon, and so indefinitely. The cell furnishes a constant current, and has the advantage that the depolariser constantly renews itself. The E.M.F. is 1·3 volt, with an internal resistance of 0·5 ohm to 0·8 ohm. Trials recently made with this battery tend to show that it is well adapted for domestic lighting. By modifying its form and dimensions, the battery may be made to yield a constant current of ·5 to ·75 amp.,

which is sufficient for maintaining a small glow lamp. For instance, six cells 14½in. long, 9in. wide by 4in. high, are sufficient to supply the current necessary for a 2-candle lamp of 6 volts burning for ten hours daily. During the fourteen hours of repose the battery becomes entirely regenerated, so as to be ready for a fresh period of lighting. The work thus distributed may continue for about a month without its being necessary to disarrange the apparatus, and it is only when the solution is quite exhausted that it requires to be renewed.—W. HABGOOD.

[60320.]—**Fossils.**—The fern-like markings found by "Spes" in the cleavage division of the slate was not organic, but the phenomenon called *dendrites*, from "dendron," a tree. It is purely physical, in some cases the result of a kind of crystallisation, and quite common.—DUBLINIENSIS.

[60324.]—**Terrestrial Telescope.**—Having given a large amount of attention to this subject, my experience may possibly be of use to "D. G.," especially as I am acquainted with and have used the "International Code." At Dover there are two reporting stations, "Lloyd's" on the Admiralty pier, and another one to the east of it. Lloyd's use two telescopes, which I should estimate of 2½ aperture and about 3ft. focus. The other station uses a larger glass mounted on an altazimuth stand about 3½in. aperture. I had two telescopes, one 1⅜in. aperture, 14in. focus, power, 10; another 1⅓ aperture, 11in. focus, power, 14½. These reporting stations both send up an answering pennant when they have read a ship's letters, and then repeat the signal. As many as 60 ships signalled one morning. I read all those with the exception of four or five with the low-power glass; one ship I read with my little 1⅓in. was hull down from my window (first floor). This signal was not answered by either of the signal stations. For my own part, I would prefer a glass moderate in power with plenty of light for flag reading, as a high-power dark glass does not show the colours well. I make a point of examining all the telescopes I can get hold of, consequently see a good number in the course of the year. It is quite exceptional to find one that is not a dummy—*i.e.*, has its object-glass stopped down. The last glass I came across was the property of the Commissioners for Northern Lighthouses. Object-glass, 2in., of long focus; body of telescope, 2½ or 2¾; far larger than neecssary, to give it an imposing look. Object-glass stopped down to 1¼ or 1⅜, definition, notwithstanding the stop, was woolly; my little 1⅓, though of less power, beat it hollow. My last achievement with this little 1⅓ was to see a stick, 7ft. 6in. long and 2⅞in. thick, on the top of a cairn on a hill 700ft. high at a distance of 25 miles. If "D. G." wants to get the maximum amount of light he must, as I have before stated in these columns, have an emergent pencil of ·11in. In other words, for a power of 50 he ought to have at least an effective aperture of 5½in. A power of 50, however, is only suited for exceptional weather. A 3in. glass cannot be called portable, and could not be used without a rest. The glass I should recommend for "D. G.'s" purpose would be a 2in. of 18in. focus; three draws, pancratic eyepiece, power 20 and 30. Mine weighs 2lb. 11oz., is 11in. when closed, and 28½in. when focussed. I have never seen this glass equalled; it may interest our astronomical friends that it shows the *comes* to "Polaris" with the 20 power. If I had only one telescope I should not have such a large one, but would prefer my 1⅓ as above or a 1½ of 14in. focus, and pancratic eyepiece with power of 15 to 25, if such a thing is made. Finally, let me urge "D. G." to take warning from the glass supplied to the Commissioners of the Northern Lighthouses, and paid for by the Board of Trade, and 'ware makers to the Admiralty!—EDWARD M. NELSON.

[60330.]—**Engine Filling.**—As none of "Ours" gave "Coach Painter" the information he required last week, I may tell him that if he is a practical hand, the proper thing to fill up an engine with is "hard stopping," as used in the coach trade. I am surprised that he should attempt to rub anything with glue in it with water; if he had rubbed it with any stone or the coarsest glass-paper it would have been all right, for sometimes the companies will not go to the expense of lead. If he is not clear on the subject, and will write again, I will afford further help.—HARRY.

[60332.]—**Ferments.**—Perhaps the best all-round work on ferments and their function for "Ignoramus" to study is "Fermentation," by Schützenberger; it is a cheap work (and very well translated) of the International series. On the isolation and culture of organisms, Mr. Crookshanks' "Bacteriology," just published, contains nearly all that is known to date, with the exception of a proper and exhaustive description of the best means of conducting cover-glass culture, and I believe this will appear in the next edition of his work. If "Ignoramus" can read German or French, there are many other works in these languages treating on the subject. The choice of a microscope and its cost is a more difficult question. I believe that English powers are as good as any; but that the cost of those of the best makers keep them out of the reach of many workers. I began my microscopic work when living on the Continent, and bought my instrument at Berlin for about £6 with two objectives, ¼in. and ⅛in., and two eyepieces; magnifying power ranging up to 700 diam. with very fair definition. I have, however, since then obtained objectives by Zeiss, and find them worth all the extra money, especially for prolonged observation in bad daylight. For studying yeast, "Ignoramus" would find the Zeiss ⅛in. an invaluable power, and for Pasteur's "Maladies" the same maker's ⅛in. is a fine working glass, magnifying power being less important than good definition with the maximum light obtainable. I am sorry I cannot give experience of English objectives and their price.—CYGNET.

[60334.]—**Falling Bodies.**—Surely the eastward velocity cannot be independent of latitude. How much would "R. E. F." make it at the pole, and what direction is east at the pole? A balloon or cloud n feet above the equator doubtless describes a circle exceeding the equator itself by $2\pi n$ feet; but anywhere else its journey can only exceed that of the ground by as much less than this, as the cosine of latitude is less than l.—E. L. G.

[60334.]—**Falling Bodies.**—A stone allowed to drop freely *starts* along the vertical, though it will reach the ground to the eastward of the plumb line let down from its point of starting. The curve described by it (the stone), relatively to the plumb line, will be a tangent to said line at said point. The time of fall being t, the height of fall is proportional to t^2, and the advance eastwards is proportional to fall $\times t$, or to t^3. Therefore, when the time is indefinitely small, the advance eastwards is indefinitely less than the fall. In one second the plumb line (at equator) moves through an angle of 15″. In that time the body would fall 16ft., and the advance eastwards would be 16ft. × tan. 15″, or 1 ÷ 71in. In 1-1000 of a second the fall would be 1-1000² of the above, and the advance eastwards 1-1000³ of the above.—DUBLINIENSIS.

[60336.]—**Keeping a Pony.**—If this querist can come across a little book called the "Handy Horse Book," I think he would find it of great use. The price, I think, is 4s. 6d.; but, being from home, I cannot give the publisher. It is difficult in the space of a reply to give much useful information on such a subject. One piece of advice might not be amiss: have your animal amply strong enough—a bit stronger than you may at first think necessary.—D. G.

[60336.]—**Keeping a Pony.**—Size, 13 to 14 hands, say £14 to £20 for a warranted animal; don't buy unless it is warranted, and beware of dealers. Food: corn, peas, and Indian corn, crushed and mixed with a little—a very little, say about one-sixth part—of cut hay; give it, say, 1lb. or 1½lb. three times a day, but quantity depends on the work it is doing. Feeding will cost 7s. 6d. or 8s. per cwt. To clean, use curry-comb and dandriff brush, and finish with body brush. A little "condiment" or linseed boiled with the food occasionally will help the gloss on the skin. Harness cost £7 to £10; conveyance, dog-cart or inside car, or phaeton for a lady, cost, say, £14 to £25. Harness and machine could be got for less second hand. If you advertise your address, I could give you rough plan and probable cost of stable and coach-house, and perhaps other information.—I. LOW.

[60337.]—**Small Compound Engine.**—H.P. cylinder 2in. diameter, l.p. cylinder 4in. diameter, both 4in. stroke; 80lb. pressure, cut-off at ¾ in h.p. cylinder. Heating surface, say, 8 or 9 sq. ft., and surface condenser 6 sq. ft.—T. C., Bristol.

[60337.]—**Small Compound Engine.**—Taking the boiler pressure at 80lb. per sq. in., to develop one horse-power the h.p. cyl. should be 2⅝in. diam.; l.p., 5in. diam. by 6in. stroke. The cooling surface should be at least 6 sq. ft.; the length and number of tubes will, of course, depend on the shape of condenser. The condenser tubes should not be less than ½in. internal diameter. If you intend having the pump ½ stroke of engine, the air-pump may be 3in. diam., and circulating pump 2in. diam. For the above size of engine the circulating pump can be of the ordinary plunger type, and a good pet-valve should be fitted. Heating surface of boiler, about 10 sq. ft.—ENGINEERING, MANCHESTER.

[60341.]—**Mechanics.**—The pull on the rope would be as you say, 8 to 1 of the power, or 8 × 30 × 2 = 480lb. The pressure on the spindle is only due to the pull of the rope (as the moments of the men are equal and opposite), as above—viz., 480. This neglects the strain due to leverage of height of rope from ground line, tending to break off the spindle. Get some of the old vols. of *Engineer* for firebox stays and illustrations.—T. C., Bristol.

[60343.]—**Heating Small Conservatory.**—"Householder" will need to convey all gas fumes out of his greenhouse, as they contain sulphur, and would damage almost any plants. The fumes from a petroleum lamp, if free from soot, do no damage. The light certainly will do no harm—rather the reverse, as greenhouse plants suffer more in the winter from want of light than want of heat.—998.

[60343.]—**Heating Small Conservatory.**—Ninety-nine persons out of a hundred would tell you that in a conservatory heated by gas it is necessary to have a flue to convey the "fumes" outside, as they are inimical to plant life. To make free ventilation of that kind is to lose, say, half the heat, and I do not think there is any necessity for it, as the injurious products of the combustion of gas might all be seized by compelling them to pass through suitable materials, such as pumice or coke kept continually moist. The light certainly does not damage plants, and when the heat source is a paraffin-oil stove, there is certainly no necessity for a flue.—ORCHID.

[60346.]—**Charging Accumulators.**—The evolution of gas in charging is a waste of power, as it means that the dynamo is sending through the cells more current than they can take up in charging, and the surplus gas escapes in the form of bubbles. The battery acid should be stronger—eight parts acid to one water. You do not say what current you get from your dynamo, or what E.M.F., so it is almost impossible to judge the exact effect of your charging. Have your cells ever been properly formed? Reversal "many times" is not enough; cells require from time to time, during formation, certain intervals of rest, to allow of the carrying on in them of certain chemical reaction, which is necessary to the proper formation of the plates, and without this you might keep on reversing for a year and get no more effect than if you did so for only a week. I am inclined, from your description, to think this is the case. With ordinary dynamo machines and accumulators you could not charge only six, especially in two rows of three. It would short-circuit the machine, and either stop it or burn the armature; but from the circumstance of gas coming off, it would seem that you have sufficient current. The drop of potential when the cells are left standing, is bad. It shows they are short-circuited somewhere; either within the cells, from plate to plate, or by wet along the edge of the cells, or by the acid leaking right through the cells, and carrying the current along the table where they stand. You should lift all the plates out, and wash them and clean the cells out. The grey sediment is sulphate of lead; and if there is enough of it on the bottom of any cell to touch the positive and negative plates at once, that would short-circuit the cell internally, and they would run down just as you say they do. If they drive the dynamo as a motor for five minutes, it is not bad, considering the size of the cells and the fact that they would be running through a very low resistance, as the joint resistance of the dynamo armature and shunt (I suppose there is a shunt) would, I should think, be not more than about half an ohm. The length of time that cells will last depends on the resistance of the circuit they are run through; the greater the resistance the longer they last. You must remember that six cells or series give no greater quantity of current than a single one. Wash and clean your plates and cells as above, then set up battery again, keeping everything very dry, and the cells standing on little bits of thick china or flower-pot soaked in hot grease, and, if possible, keep the cells where there is a circulation of air; then charge, and if they do not run out of themselves as before, but are all right, leave them standing for at least a week; then discharge and reverse, and continue reversing for about a week (six or seven reversals); then leave standing for another week, and probably they will then be better. I shall be glad to hear from you how you get on with them. If you cannot quite follow my description, or want to know further, write again.—E. CONRY.

[60347.]—**Westinghouse Brake.**—To "TRIPLE VALVE."—The statement that the Westinghouse brake does not work well upon trains of more than 12 carriages is incorrect and absurd. I have myself seen it work perfectly upon 35 vehicles; and at the Burlington trials in America just recently it was highly efficient upon trains of not less than 50 cars.—CLEMENT E. STRETTON, Leicester.

[60348.]—**Testing Gold.**—A mark is made on the stone with the piece of gold you wish to test; a drop of nitric acid is then applied to the mark. In proportion to the quality of the gold the mark will be more or less effaced by the acid. I presume the studs are made of a known quality of gold, and the stone is also marked with them or one of them for comparison with the gold to be tested.—OS.

[60349.]—**Florida.**—I have by me a sort of magazine about the size of the *Graphic* or *Illustrated* on the resources of Florida, and if you like to advertise an address, I will send it to you; but you must remember it is written to attract emi-

grants, and therefore describes the country as a sort of earthly paradise; so you must discount the statements considerably.—E. CONRY.

[60351.]—**Coil.**—I would advise Mr. Peckham not to interfere with his medical coil, but to make a new spark coil at once. He will find it quite as cheap in the end, and far more satisfactory. There are dozens of coils fully explained in back numbers of the "E. M."—OS.

[60351.]—**Coil.**—TO MR. BOTTONE.—Do not alter the primary wire, but put on ¼lb. No. 39 silk-covered for secondary, carefully insulated between each layer with paraffined paper. Let the condenser be built up of 50 sheets of tinfoil, 5in. by 3in., interleaved with paraffined paper. One pint bichromate will give a ½in. spark with such a coil if well put together. This sized spark will do for most experiments.—S. BOTTONE.

[60351.]—**Coil.**—A single-wire medical coil can easily be converted into a spark coil by taking off all wire in excess of two layers. The two layers that are left on will do for the primary wire, provided the wire is not too thin. If the wire is between Nos. 16 and 24, it will do. The length of spark obtained will depend on how much secondary wire the reel will now hold. A little more than ¼lb. of No. 36 silk-covered, carefully wound and thoroughly insulated, should give ¼in. spark. For condenser, begin with 20 sheets of tinfoil, with the full battery power, and add more sheets, one at a time, as long as good results are obtained. The number of sheets is really best determined by experiment, and their size will depend on the cavity of the base-board in which they are placed. For many of the ordinary experiments, ¼in. spark will be sufficient.—BOBADIL.

[60353.]—**Testing Water with Nessler.**—Nessler's reagent is a solution of mercuric potassium iodide, containing excess of potash, and in reacting with ammonia, forms the brown insoluble body oxydimercuric ammonium iodide:—$(4\,HgI_2 + 6KHO) + 2NH_3 = 2NH_2Hg_2OI + 6KI + 4H_2O$. Hard waters, treated with Nessler's reagent, separate out a portion of their lime, magnesia, iron, and alumina, as a white flocculent precipitate, and in presence of small quantities of ammonia displays itself as a yellowish opalescence.—NORMAN McCULLOCH.

[60359.]—**Freezing Meat.**—The means employed in the Atlantic steamers for preserving meat is the following:—Cold rooms (in which the meat is hung) are constructed, having a lining of wood, outside which there is a packing of 12in. or 15in., either of dry sawdust, silicate cotton, or some other good non-conductor, this packing being inclosed by another wood casing. Into these rooms is conveyed cold air at a temperature of from 20 to 40 degrees below freezing. The cold air is obtained by compressing it in a suitable machine to a pressure of about 50lb. or 60lb. on the square inch, and afterwards allowing it to expand, the heat due to compression being removed by the circulation of cold water. Usually the air is taken from the cold rooms by a suction pipe, compressed, cooled, and returned by a delivery pipe; a constant circulation is thus maintained.—S. G.

[60362.]—**Cold Compressed Air.**—It is made in many sizes; any apartment will do, as a rule, where the dirt of a steam-engine does not matter. Steam power is usually used; but refrigerators can be made with other methods.—E. CONRY.

[60362.]—**Cold Compressed Air.**—Cold-air machines are made suitable for dairy work; they answer well both for cooling cream and milk, and hardening and preserving butter. A properly constructed cold room is required, also power for working the machine, either a steam or gas-engine. The capacity of the cold room, as well as the size and power of cold-air machine, would depend on the size and requisites of dairy. I have recently been engaged in connection with the arrangement of cold-air room and machinery for a large dairy in Berkshire, where they make about 1,200lb. of butter per day.—S. G.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

59884. Pyroligneous Acid, p. 425.
59886. Rainwater tank, 425.
59896. Slags of Iron Smelting and Other Metals, 425.
59898. To Mr. Wimshurst.
59899. To Mr. Wimshurst.
59904. Watch, 426.
59911. Tinplate Working.

60070. Brick Die, p. 515.
60093. New Brighton Engine, 516.
60108. Geneva Watch, 516.
60122. Sinking Fund, 516.

QUERIES.

[60380.]—**L. and S.W. Locomotives.**—(1) Could any of your readers give me details of L. and S.W. goods engines built by Neilson and Co., such as 151, 395, 433? (2) Are 135, 460, 470 classes all alike in dimensions?—V. J. B.

[60381.]—**L.B. and S.C. Locos.**—(1) Are all the engines in the two following lists respectively alike? Four-coupled: 208 Richmond, 209 Devonshire, 210 Cornwall, 211 Cavendish (was formerly Beaconsfield; why changed?), 212 Hartington, 213 Norfolk, 214 Gladstone, 215 Salisbury, 216 Granville, 217 Northcote, 219 Cleveland. Single drivers: 326 Grosvenor, 327 Imberhorne, 329 Stephenson, 332 Shanklin, 333 Ventnor, 334 Petworth, 335 Connaught, 336 Edinburgh, 337 Yarmouth, 338 Bembridge, 339 London, 340 Medina, 341 Parkhurst, 342 St. Lawrence, 343 Wilmington, 344 Hurstmonceux, 345 Plumpton, 346 Alfriston, 349 Albany, 350 Southbourne. (2) Are 197 Cavendish, 451 Lancing, 452 Worthing now scrapped? (3) What are the dimensions of 301 Caen class?—V. J. B.

[60382.]—**Equal Balance.**—I use a balance, or pair of scales, having a light sling hung at one end and a heavy scale board at the other end of the beam. To poise it, I have placed a heavy ball of iron midway between centre and end of one arm of beam, and strapped tight to underside of it by means of an iron band passing round beam and screwed to ball. As this ball projects about 8in. below underside of beam, would any of "ours" please tell me what influence it will have when weighing, seeing that it moves in the same circle as the beam when it leaves the horizontal?—A. J. W.

[60383.]—**Resistance of Battery Working.**—In "Munro and Jamieson's Pocket-book," page 111, a method (similar to Muirhead's) is given for this; but what value should be given to the shunt s? Unless high, there will be free passage of currents, with much heat—in fact, will not a temperature correction be necessary in any case?—AJAX.

[60384.]—**Dead Black Lacquer.**—Recipe wanted for use on fine steel articles and to withstand washing.—GUN.

[60385.]—**Work on Carpentry and Joinery.**—Can any reader give me the name of a work on the above giving details and instructions for making panels, framing, and dovetailed and mortise work? I am fairly expert in the use of tools; but being an amateur, of course I have had no shop experience to guide me as to proper proportions in joiner's work. I am aware of the various articles that have appeared from time to time on this in the "E. M.," but want the information in a more concise form.—NEMO.

[60386.]—**Letters on Brass.**—TO MR. S. BOTTONE AND OTHERS.—I have a brass door-plate to fasten small bolts on. During process, the mixture falls out off the letters, leaving bare the brass. Will anyone kindly tell me what to get, and how to use it? I want black and red letters.—A. D.

[60387.]—**Toolholder.**—Will "J. K. P." kindly inform me what is the best kind of toolholder for a slide-rest of 6in. centre? Is the "Willis" holder a good one, or is it superseded by more modern forms? What is the proper way of fastening bolt in top of rest for toolholder to swivel round? What should be thickness of table for tool to rest on? Is the step in front of slide of any great advantage?—ANGLO CELTIC.

[60388.]—**Wimshurst Influence Machine.**—Will Mr. Wimshurst, or Mr. Gray, kindly answer the following questions? (1) If a Wimshurst influence machine has discs 24in. or 30in. in diam., how thick should the glass be? (2) How long should the bosses be, and how many inches in diam. should they be at each end? (3) How long and how broad at each end should the sectors be? (4) What size should the driving wheels be? (5) How should the glass discs be drilled and the edges rounded and smoothed? (6) What should the diam. of the steel spindle for the bosses be? (7) Are machines furnished with large discs of 30in. or more worth the extra trouble and cost in making, and are they far superior to those furnished with 17in. discs?—INFLUENCE.

[60389.]—**Apparatus for Ringing Hand-bells.**—I have a set of eight hand-bells without tongues, and am anxious to make a self-acting apparatus to play tunes on them. Can any reader of "E. M." kindly give me a few hints on the subject?—CYMRO.

[60390.]—**Carving.**—Will some kind reader give us hints on machine and hand carving? Have searched from Vol. XII., and the information is altogether meagre for "Ours."—T. WOOD.

[60391.]—**Inspector.**—TO "GLATTON," OR "T. C., BRISTOL."—I have been in charge of a pair of horizontal engines for about three years, and have passed a 2nd elementary steam exam. If I continue my studies on steam, &c., do you think that in course of a few years I shall be able to hold the situation of engine and boiler inspector for an insurance company? Would you please state what is required of one who holds such a situation?—YOUNG AND HOPEFUL.

[60392.]—**Magic or Inexhaustible Inkstand.**—Years ago I bought an inkstand, so-called. Different ones were sold for black or coloured inks. The one I bought was for black ink. I believe they were of English or American make. To obtain ink it only required to put water in it, and when it was exhausted to put some more. I used mine for about five years, writing profusely, and left it when the tin, being oxydated, it could no longer keep liquid. Could any kind reader tell me what substance was used to produce such results, which are so very handy?—ONE WHO WRITES.

[60393.]—**Straight Wires.**—How can I get perfectly straight brass or copper wire, in lengths of about 9in. long? Is there any special machine for the purpose?—A. S. J.

[60394.]—**Pocket Magneto Machine.**—TO MR. BOTTONE.—Will you kindly give me the full dimensions and details of a small pocket magneto machine?—A. S. J.

[60395.]—**Water Motor.**—I want a 6-horse water motor, or turbine. Water is unlimited, and costs me nothing. The main considerations must be simplicity and non-liability to get out of order, as I live far away from a town. Do Bailey's water motor (Haag's patent) or the Vortex turbine fulfil these conditions? They are the only two motors I know of.—F. E. A.

[60396.]—**Electric Lighting.**—I wish to light a shop with, say, 50 incandescent lamps. I have the steam power from an engineer's shop; but this would be too irregular for an ordinary dynamo. I propose, therefore, to use an accumulator. Will you be good enough to refer me to any work which would give me dimensions and details in the construction of a dynamo suited for the purpose? Also any hints as to the accumulator?—AMPERE-METER.

[60397.]—**Engine Query.**—Is Cornish boiler 12ft. by 4 sufficiently large for engine; cylinder, 10; stroke, 24; tube, 28½in.?—IRELAND.

[60398.]—**Photography.**—I am thinking of building a studio, 15ft. long, 8 wide, and 7 high. Would this be large enough for all cabinet work? I shall run it from east to west, with light on the north side. How large should window be, and which end (I don't want to make it double ended)? Should I have any glass in roof, or on south side? Any other hints would be very acceptable to—Z. Y. X.

[60399.]—**Electrical Foot Warmer.**—Did M. Tommasi (No. 1118, p. 574), by means of electricity, really improve the acetate of soda foot warmer? Perhaps so; but he surely complicated it so as to render it impracticable. Has the system a real value? I doubt it. When the invention broke out, I procured an apparatus made on the best principle, and compared it with a common stone bottle—in this manner: I put water in a tank, in which I placed both the acetate instrument and the bottle full of water, and heated it at 100° C. for a time, sufficient to be sure that both were at boiling temperature. I took them out, put a stopper to the bottle, and placed both instruments at opposite ends in a bed. After twelve hours, I found that the bottle was still warmer than the acetate instrument. Several trials gave a similar result. This suggested to me a system entirely different, in which no water nor acetate is used. Heat to any wished degree can be applied, up to 300° C., and even more. The heating is very quick and economical, and the heat keeps much longer. The system can be applied for almost any sorts of warming. Should you know an honest, enterprising man who would feel disposed to patent it, under your recommendation I will send full particulars to him.—CH. RABACHE.

[60400.]—**N.E. Locos.**—Can any reader kindly give the dimensions and weight of 6-coupled goods engine bearing the company's name (Gateshead works)? Also, if possible, the weight of No. 14, 8-wheeled, winged tank, 6-coupled, in full working order? The above are new engines, and, I believe, designed by Mr. Worsdell.—W. R. B. A.

[60401.]—**To "A., Liverpool," or "Fiddler."**—I am making a violin belly of cedar wood, and should be glad of any information as to graduation. Should it be thickest at middle, or outside edges? I have made sound holes, and roughed out to uniform thickness ⅛in. I am leaving bass bar in the solid.—FRANK.

[60402.]—**Violin D String.**—What is the cause of defective D string on violin? I have tried several strings, both thick and thin, without success. The violin is good on all strings except D.—FRANK.

[60403.]—**Revolving Cylinder.**—Will some reader please tell me how to make a cylinder, revolving upon parallel axis, revolve slowly, say once in three or four hours, the cylinder being unevenly weighted? I don't like clock-work because of the ticking, and because it occasionally comes to a stand before the weights have run down. Could it be done by strong springs and a fan like musical boxes, or by some other method? The cylinders weigh 50lb. or more.—BEE.

[60404.]—**Condensing Tube for Launch.**—I am wishing to fit my 4in. launch engine with a condensing tube, simply to condense the exhaust steam that it may be pumped into the boiler. Will anyone tell me the length and dia. of copper tube for outside condenser, and will an ordinary horizontal feed pump draw the condensed water out of the tube, or is an air pump absolutely necessary to deliver it into a hot well for the feed pump to draw from? I don't want any vacuum. The engine is 4in. by 4in.; working pressure, 80lb. to 100lb., 300 revolutions. I would like a sketch of natural draught boiler to suit, with dimensions for working from. Please say area of grate, heating surface, and size of tubes. Exhaust pipe from engine is ⅝ dia., now contracted to ⅛in. in chimney. Present boiler is vertical, with 10 sq. ft. heating surface.—ENQUIRER.

[60405.]—**Chimney Rain Guard.**—Can any of your correspondents tell me the method of marking out the shape of a sheet of metal, so that when joined together at the edges it shall form a cone, such as are placed on the top of a chimney to keep the rain out? I believe it is to be done by some method of projection; but have tried several ways without success.—NEMO.

[60406.]—**Photographic Exposures.**—Burton's table of exposures is a very handy form for reference on subjects and various lenses. Can someone, however, supplement a little by what I have recently found myself at a loss? Suppose one has, as per table, a lens of $\frac{f}{11}$, which on a sunshiny day requires for an open landscape ⅛ second exposure at noon. Here we have as constants the lens and the subject; but let the time of day or weather vary and I want a little guide—i.e., what will exposures probably be at (1) noon if sun was obscured, (2) if a dull day, (3) at, say, 6 p.m. with sun, without sun, and dull. Would anything like this do: For (1) multiply exposure by 2, for (2) multiply exposure by 3, for (3*a*) multiply exposure by 2, for (3*b*) multiply exposure by 4, for (3*c*) multiply exposure by 5?—N. Y., Plymouth.

[60407.]—**3in. Telescope.**—I should be greatly obliged if some reader would kindly give me instructions for making an astronomical telescope. I have a 3in. achro. object-glass, focal length 42in., mounted in brass cell.—ENQUIRY.

[60408.]—**Iron Workshop.**—I am about to erect an iron shed, 36ft. by 12ft. by 9ft., to be used as a workshop and showroom for pianofortes. I have chosen iron, as it is fireproof and portable. Will anyone who has had ex-

perience with iron buildings point out their defects for my purpose?—T. E. D.

[60409.]—**Boiler.**—Would any of "ours" assist me in the following? What dimensions and how many tubes will be required for a $1\frac{1}{2}$ H.P. copper boiler? Also, I should like a sketch of same and the experience of anyone having one of these or similar boilers. It is intended for practical work, and not a plaything. Also if an iron vertical will have any advantage over the above? It will not be in constant work, perhaps for two or three days in each week.—DOUBTFUL.

[60410.]—**Electro-Motor.**—Can some reader give me a drawing and description of a model electro-motor to drive screw boat 3ft. long? Please, if possible, give measurements and length of wire.—ROCHDALE.

[60411.]—**Engine.**—Wanted, drawing, with description, of model electro-magnetic engine, if possible, with measurements, quantity of wire, and cost.—ROCHDALE.

[60412.]—**Steam.**—TO "GLATTON," OR "T. C., BRISTOL."—Will you be so kind as to give me the why and the wherefore of the following questions in plain figures? I understand decimals. The engines are compound; cylinders, 16in. and 27in. dia.; stroke, 4ft. 6in. What I want to know is how to find out what the saving will be, steam cutting off at $\frac{1}{2}$-stroke at 50lb. pressure, in the boiler? We want to raise the pressure in boiler to 65lb. What will be the terminal pressure at 50lb., cutting off at $\frac{1}{2}$ stroke? Where shall we cut off at 65lb. pressure to get the same terminal pressure? We have no indicator, only when the inspector comes every three months. I hope the questions will be fully answered in plain figures. Will you please say how it is there is a greater saving with high-pressure steam when higher the steam gets and heavier it gets, so I understand?—FIREMAN.

[60413.]—**Steam Escape, or Relief Valve.**—Required, a valve (to act automatically) which will allow steam to pass from a boiler, pressed at, say, 30lb., into a pipe connected with other boilers at a lower and constantly varying pressure (10lb. to 25lb.), in order that whenever the steam should rise above the 30lb. it would escape into and assist the others. Will someone kindly say whether there is a valve to meet the case, and, if not, whether there would likely be any demand for such an article?—TYNESIDE.

[60414.]—**Overhead Wires.**—I am about to connect my house to that of a friend's by means of an overhead wire; and, the distance being about a mile, whose permission must I get to allow me to cross the several public roads and streets? A reply to this, with other particulars relating to the law on the subject, will be a boon to—BRADFORDIAN.

[60415.]—**Brazing.**—Will some reader tell me how to proceed with brazing a brass plug $\frac{3}{8}$in. long into the end of a steel tube, so as to make a strong air-tight joint?—MOORGATE.

[60416.]—**Portable Forge.**—I have a circular portable forge, which I cannot get to work satisfactorily. Will some reader be good enough to instruct me how to get a good fire?—MOORGATE.

[60417.]—**Railway Fish Plates.**—Is it not the fact that the nuts on fish plate bolts often fall off the bolts when in place, through vibration, or from being improperly screwed up? Have any means been devised at any time to prevent this occurring? I have an idea, and not, I think, too expensive, which would prevent this, provided a railway company would not object to pay some slight extra cost on their permanent way. I should be grateful if any of your practical correspondents on railway subjects would kindly tell me whether such a thing has been attempted, or, if an effective method were introduced, whether it would be commercially valuable, and to what extent? Any information on this head, and a reference to the best work treating on this subject, would be highly appreciated by—ADAM BEDE.

[60418.]—**A Novelty.**—Could any kind reader please give me any information on the following? At "The Convent" on the Stourhead Estate, Wilts, is a novelty which to many has been the subject of much discussion. It is a fly, which some say is painted on the glass window, others argue that it is a real fly imbedded there—in fact, there are so many different opinions that it is impossible to know which is correct. In whatever way it is done it shows great skill and ingenuity, and is the admiration of all who see it. Any information, therefore, bearing on the subject will, I know, be received with gratitude by all interested in it, and, amongst others, will greatly oblige—CONSTANT READER.

[60419.]—**Clark Cell.**—In report of discussion at Birmingham on Prof. Blyth's current meter, Lord Rayleigh is stated to have said, "the Clark cell would measure the current at any moment." How is this effected? Kindly explain, with diagram of connections. Prof. Forbes also said: "People were abolishing every sort of standard instrument except the Clark cell."—X. Q. Z.

[60420.]—**Steam Whistle.**—I am about to make a small steam whistle for a $\frac{1}{2}$ horse-power boiler; steam, 80lb. per sq. in. Could I not make them without the bell? I have seen them something like the common whistle, but forget how they were made. Any information, and sketch, would oblige—STEAM WHISTLE.

[60421.]—**Carriages.**—TO MR. STRETTON.—I notice in a Manchester paper that Mr. Stretton, under cross-examination in connection with the railway mystery, stated, as an expert, that a pistol would ride on a carriage step from London to Leicester. Will he kindly give the class of carriage and weight, and perhaps his reason for his opinion?—INTERESTED.

[60422.]—**International Association for Protection of Life.**—Can any reader give me the full name and address of the Protection of Life Society, and the class of work they undertake?—INQUIRER.

[60423.]—**Zither.**—Would any kind friends favour with necessary instructions as to how I should proceed in making a zither, and its dimensions and material?—MUSICAL COUNTRY LAD.

[60424.]—**Acid Stains for Wood.**—Can any correspondent give particulars of how to stain wood a cherry-red colour by the fumes of acid, what acid, and what degree of heat to be applied in a closed chamber?—CAUSTIC.

[60425.]—**Hard Soldering Aluminum.**—Can anyone give me information through the columns of your valuable newspaper as to the best process of hard soldering aluminum?—W. S. F.

[60426.]—**Nickel Polishing.**—Will any of your readers kindly inform me what are the best materials for buffing and polishing nickel silver by the lathe process? I have tried a course of the following, and in the order here given—viz.. emery-flour and oil, rottenstone and oil, and rouge; but find it unsatisfactory, as it does not leave the polish free from scratches. Also, what description of bobs or buffs are most suitable for the work?—POLISHER.

[60427.]—**Sheet Wax for Micro Objects.**—Will some correspondent give particulars of the best method of using sheet wax for mounting micro. objects?—THETA.

[60428.]—**Silvering Glass.**—I shall feel obliged if any correspondent will tell me where I can find an account of the mode of depositing silver on glass, such as is used for astronomical reflectors.—J. M.

[60429.]—**Electric Pen.**—In order to expedite the copying of specifications and other lengthy manuscripts of a similar nature, I should be pleased to have directions and sketches for making one of these useful instruments to work with about six cells of a Daniell battery (gravity form), which latter can be placed in a cellar or other convenient position, wires being led from that to the desk, and thus the power might be always at hand and constant in strength; or, for the sake of portability, I should like to work it with two chromic acid single-fluid cells. Description of paper, ink, and hints on working same would oblige—PI.

[60430.]—**Gravity Daniell Battery.**—I have trouble with mine as follows: Zincs were well amalgamated at start; but though very lightly worked, they become alarmingly corroded in a short space of time, turn black, are covered with a dark flocculent coating; and this goes on even with open circuit, being at the same time accompanied with an abundant evolution of hydrogen. Will some electrician kindly explain my probable error, and describe a reliable and efficient form of Daniell gravity cell which would answer for working an electric pen?—RHO.

[60431.]—**Lattice Work.**—I am required to fix wooden block letters, about 3ft. in height, upon a suitable lattice or net work, so that while the letters are prominently visible, the groundwork of lattice may be unobserved. Practical instructions for securing this effect will be welcomed by myself. N.B.—They will be in an exposed situation.—TAN.

[60432.]—**Architecture, &c.**—I am articled to an architect. I have plenty of out-door experience, but unfortunately, through the limited amount of time my principal has at disposal for the purpose, I am unable to obtain much assistance in the theoretical portion of the subject, and being left to myself in a great measure to grope my way through the various arts and sciences which are included under the head of architecture, my progress is much slower than I care for. Consequently, in order to give me a helping hand, will some professional reader indicate a course of study, giving the names of the text-books necessary to use under the following branches, as well as under others, which may be thought needful to pass the R.I.B.A., Surveyor's Institute, and those examinations required to qualify as a district surveyor? The branches referred to above are: Architectural History, Building Construction, Draughtsmanship, Law concerning Building Operations generally, Mensuration and Land Surveying, Quantity Surveying, Sanitation, Hygiene, and Natural Philosophy.—UPSILON.

[60433.]—**Manure.**—My sincere thanks to any fellow reader who will recommend a good work on the manufacture and trade analysis of superphosphate and other artificial manures.—LEVERAN.

[60434.]—**Crank Movement without Dead-point.**—I have made a small crank movement to work by hand with connecting rod, the power of which is equal the whole length of stroke. By placing my guide in an eccentric position, it reverses and does away with the deadpoint, at the same time enabling me to lift a weight without a flywheel. By keeping the guide in centre of gravity, a flywheel is necessary; but as soon as the crank moves $\frac{1}{8}$in. in the direction of the circle it has as much power as at the highest part of stroke. My object in making it is believing the piston of the present has to wait at each end of flywheel (mine has not), I would like to hear from some of your correspondents—their view of my theory that a vast amount of speed is lost through the piston being retarded waiting on the flywheel.—SCOTTY.

[60435.]—**B.A. Degree, Dublin University.**—Will any of your readers kindly give me information respecting examinations for above—when held, subjects required, and, if possible, where questions set at previous examinations may be obtained.—SCHOLASTIC.

[60436.]—**Telegraph Connections.**—I should be glad if Mr. Conry would inform me, by means of a sketch, how to connect a single-needle telegraph, so that by pressing a push I could ring both my bell and the bell at the far end of the line together. Also the number of large sized Leclanché cells that would be required to work a line of one mile in length.—E. M.

[60437.]—**Zinc Stencil Plates.**—Will some kind reader say what tools are required to make the above, or is there a book with instructions?—VERY ANXIOUS.

[60438.]—**Photography.**—Will some reader kindly give me a few hints on burnishing and enamelling photos.? I have tried burnishing, but get my photos. spotted in doing it. I have also tried enamelling, but lose the gloss in mounting.—AMATEUR.

[60439.]—**Petroleum Engine.**—Can any reader inform me as to the working of the above engines, such as Spiels, Eteve-Humes, &c., as to the modes of compressing the air, the proportions of oil and air, formation of vapour, the manner of injecting it into the cylinder, and the method of firing or exploding it, and also if there is any work of instruction on anything of the kind published, or drawings or illustrations obtainable?—ARCHBALD.

[60440.]—**Frogs.**—I want to keep some of these animals. What food and conditions will best suit them?—KENSINGTONIAN.

[60441.]—**Engraving Ivory Tablets.**—Will some one kindly describe the process of engraving the small ivory, bone, ebonite, and celluloid tablets which makers of instruments affix to the articles they vend? Where may the tools and ivory plates be had? The engraving in ebonite is finished white.—C. C.

[60442.]—**The Thimble Battery.**—Could "Penruddocke" (letter 26326) kindly give dimensions of his battery, sizes of zincs, carbons, porous pots, &c.? Also, could he inform me how his mercury connections are made, as I do not understand them, and whether clamp screws would do instead?—AMATEUR ELECTRICIAN.

[60443.]—**Japanning.**—I want to make a stove or other apparatus for japanning small articles. Will some of "ours" tell me the most economical, as well as efficient, method of going about it?—HARRY.

[60444.]—**Turning Vulcanite or Ebonite.**—What tools are best for turning hard rubber in the form of vulcanite or ebonite? What speed and what lubricant?—G. H. B.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 15, and unacknowledged elsewhere:—

ARCHIBALD AND PECK.—Morris Cohen.—A. Hirst.—R. Card.—G. Plant and Son.—G. L. Scurfield.—Vibrator.—A. C. and Co.—J. M. Chadwick.—G. O.—F. M. Rogers.—Carstairs.—Young Engineman.—I. Low.—S. Bottone.—W. A. Haren.—B.—W. G. Penny.—Thomas Pearson.—H. Gilbert.—V. J. B.—P. H. Marrow.—Salus.—E. T.—W. R. L. N. W.—X. Y.—Atom.—Amateur.—Chimney.—B.—Sober.—Paul Ward.—G. H. H.—C. D. R.

NIL DESPERANDUM. (The current may do good; but seek medical advice. See pp. 243, 306, Vol. XLI., and the indices of back volumes for many hints on the subject.)—MIKADO. (To prevent the hot steam coming in contact with the tube or metalwork of the gauge. It is usual to fill the siphon with water, but the steam would soon be condensed in the bent portion.)—FONS. (The small fountain referred to was illustrated and described in No. 402, p. 294; No. 405, p. 366. Your idea of the construction is correct. The glass flasks must be reversed from time to time, to keep up the action. They revolve with the joint piece.)—W. GRIFFITHS. (An improved Æolian harp was illustrated in No. 1,048, p. 163. See also No. 742, p. 344; and the indices of some of the earlier back volumes.)—J. TOWNES. (Entirely depends on whether they are to study in class with laboratory practice; but see the lists issued by Macmillan and Co. and J. and A. Churchill.)—EBLANA. (We do not know of such a book. You do not say what kind of workroom.)—E. T. H. (It is a useless receipt, as was stated so recently as p. 539, No. 1116. The only serviceable method of cold soldering is that given in No. 888, p. 81.)—HORLOGER. (Yes, electric launches have entered the sphere of practice—one has already crossed the Channel. Accumulators are most convenient, and cheapest because they are charged by a dynamo. See the indices commencing with Vol. XXXVI. As to cost, so much depends on circumstances; but the price of the accumulators can be ascertained, and where a dynamo is used for lighting purposes at night the cost of charging the cells in the day would not be much.)—JASON. (For bright plating—that is, for plating surfaces which cannot easily be scratch-brushed, it is usual to add a little bisulphide of carbon. Put an ounce of the bisulphide into a pint of strong silver solution, having cyanide in excess; shake frequently, and in a few days a drop or two may be poured into the bath.)—YOUNG BEGINNER. (You should procure an illustrated list. Briefly, a "grand" is a horizontal (as a rule) with strings of full scale; a "cottage" is an upright, and a "cabinet," stumpy upright.)—ELECTRO-BELL. (The mat should be placed on a hinged part of the flooring, which will sink down when trod upon, and so make contact.)—W. S. (Have you a dynamo, or do you want to light up by batteries. Full particulars have been given many times. See, for instance, pp. 147, 148, 268, 285, 369, 390, 543, Vol. XLII.)—GEORGE. (Explained many times. You know that it is a patent, of course. Two wires are better, as "earth" return is not satisfactory with telephones. See any recent volume, or p. 266, No. 1079; p. 198, No. 1049.)—E. D. (A good form of mechanical telephone was described in No. 1061, p. 447.)—MOULDER. (When not cut out of retort scurf, they are made by moulding a paste of carbon dust and sugar or treacle under hydraulic pressure, and carbonising in vessels from which free air is excluded.)—T. SMITH. (Why use cement at all? Developing dishes are cheap enough, and can be readily moulded up in guttapercha to any desired size. However, if you must have cement,

use marine glue.)—F. E. A. (There are plenty of small portable mills in the market for making meal. Probably you would find some at any large ironmongers in your town.)—E. W. (Red, green, and white. The number of sails on the foremast depends on circumstances; but say five at the outside—the foresail, or fore course, the topsail, topgallant sail, royal, and sky-scraper.)—IGNORANT. (Clean the metal thoroughly, and then coat with any good paint of the desired colour, and varnish with copal. Properly, it ought to be stoved.)—AMBULANCE. (See pp. 200, 220, last volume. Do not understand what is meant by "cannot fill it to the required height by 1 or 2 degrees"? There are no "degrees" in a barometer.)—H. WALKER. (Apply to Mr. Wray, North-hill, Highgate, for his lists, and compare with others.)—G. H. B. (If it is pure, the tools used for brass will do, keeping the work moist with water; but it is often adulterated with silicious matter, and the tools consequently require frequent grinding. Use a slow speed. As the question is of importance, we insert the query, as some reader may know of a better method.)—CHEMICAL. (The metals potassium and sodium inflame when in contact with water. Calcic phosphide will also do the same, so also will the gas obtained when potassic hydrate is allowed to act on phosphorus. You require special apparatus for the preparation of the metals.)—THOMAS ARMITAGE. (There is no remedy. Either have it regalvanised, or run solder over the parts—cleaning them thoroughly first.)—H. G. S. (Get Stainer's book from Metzler and Co., and see the lists.)—R. CARDWELL. (Full instructions for building American organs were published in Vol. XXVI., which has long been out of print; but you might obtain a copy by inserting an advertisement in the Sale Column. The method of tuning reeds has been frequently described; see No. 587, p. 384, or No. 1082, p. 322.)—LEVIS. (You will find something about it even in the last number; also in recent numbers, and in many back volumes.)—E. G. (You will want hydraulic pressure: cannot be done without.)—ECONOMICAL. (You have inferior plaster. They are made of any suitable clay. Well burned pipe-clay will do; but something rather more porous is better.)—SHUTTER. (Sue the vendor for damages; he is equally liable with the maker. You had better act through a solicitor.)—D. H. (The husband has no remedy. He cannot oblige the workhouse authorities to keep his drunken wife; but if she goes into the workhouse they will soon compel him to pay for her maintenance.)

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ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

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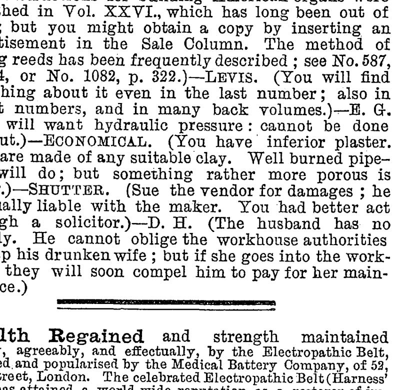
Black.



White. [8 + 8

White to play and mate in three moves.

SOLUTION TO 1007.

White.	*Black.*
1. Q-Q B 8.	1. P takes Q (*a*).
2. P takes Q, becoming Kt mate.	
	(*a*) 1. Anything else.
2. Q, B, or Kt mates.	

(Seven variations.)

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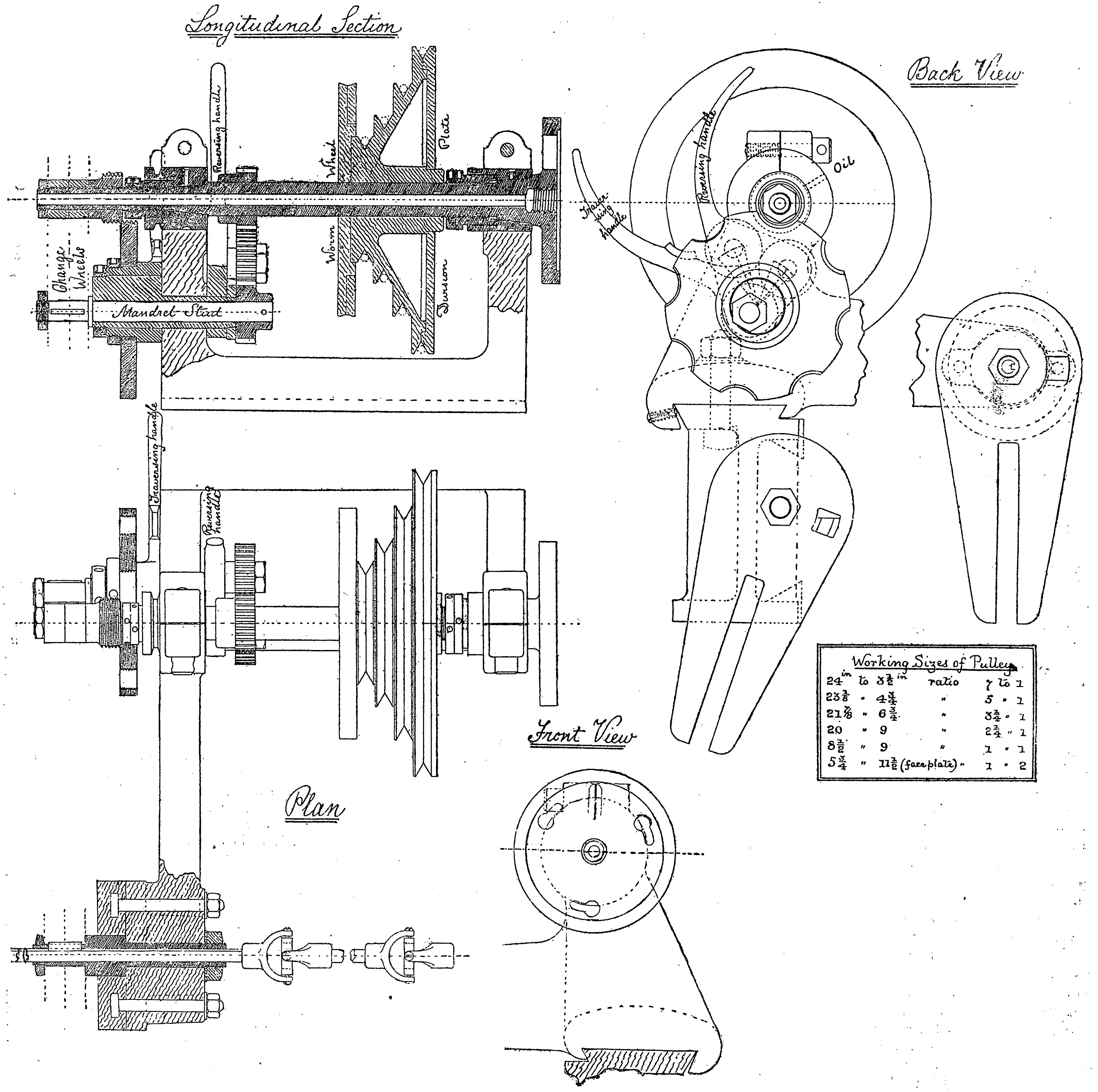
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 24, 1886.

A NEW FORM OF HEADSTOCK.

THE accompanying drawings show a headstock in which there are many departures from the orthodox form. Each of these appears to have some advantages, and perhaps some of them may be considered to be improvements. Some of these devices originated with correspondents in the columns of the ENGLISH MECHANIC, and have been partly discussed already, and they are here embodied in the design. The drawings include also plans of the lathe-bed with saddle, having the front and vertical slide so many times discussed, and now put into practical shape, and these can be sent if desired.

The first feature in the new headstock which requires explanation is the traversing mandrel. This has conical necks, and could not traverse at all if the collars were fixed in the usual way. These collars are, however, so fitted into the split bearings of the headstock that, when the grip screws are released, the mandrel, collars and all, can traverse forth and back. They fit, however, rather tighter than the running part, as, since this movement is very small, friction is here of no account. When the grip-screws are tightened, the collars are grasped all the way round, and held as firmly as when shrunk in, so that, when using the lathe for ordinary work, the traversing movement not being required, it would act with exactly the same steadiness. The fit of the collars to the conical necks can be adjusted with the same nicety as with a lathe having a non-traversing mandrel. Moreover, were this mandrel fitted to traverse in the usual way, and were it then frequently used for small metalwork, milling, &c., it is only reasonable to suppose that, however hard the mandrel might have been made, there would be a danger that at last it should become necked, and so run too loosely, which looseness would be naturally fatal to good work, and could by no means be taken up. This form of mandrel with traversing bushes is intended to give the power to take up all looseness caused by wear, and it appears therefore well suited to a lathe intended for small metal work, as well as for ornamental turning. One of the nuts for setting up each collar is very long: this is to insure a good and true bearing on the end, and it enters within the collar in order to shorten the surface exposed to friction. The average diameters of the two bearings are 1¼in. the larger, and ⅞in. the smaller, both being 1in. long. This is as large a surface as could well be driven by the foot at a speed ratio of 7 to 1, which speed is required by those who do small work in hard wood. It would, of course, be much better for the metal-work, and especially for milling, to have the necks a great deal larger in diameter; but then all thought of small work in wood requiring speed would have to be abandoned, whereas this headstock is intended for small ornamental turning as well as for metal-work, such, for instance, as making the chucks and appliances required in eccentric turning. Another matter in connection with the collars is the method of oiling. These collars, as well as sliding endways, are free to turn; it has not been sought to prevent this, because it may tend to equalise the wear and insure continued centrality. A shallow groove has therefore been cut round the collars, and two



or more holes are bored through the collar at the bottom of the groove for the passage of the oil. A hole must be drilled through the casting to introduce oil into the groove: this hole may be seen dotted in the back view. The mandrel is shown with a female thread, and a large flange, which is not a necessary part of the design. The small chucks would screw into the mandrel in the usual way, also the lathe centres, except that they would have rather large shoulders. The ornamental chucks and faceplate chucks would have no central screw, but only a plain fitting and three small screws, similar to those used in mounting the American universal chucks, except that, instead of removing these screws to fix and unfix, their heads would be passed through the holes seen in the front view, the chuck would be turned slightly round, and the three screws would then be fixed one after the other by half a turn of a small spanner. No doubt this would take a little longer than the usual plan, and it would apparently be impossible to pass the ring of the oval chuck over the flange; but the interchangeability by this method should be more perfect than by any other, owing to the size of the flange fitting. We come now to the traversing mechanism. The star-guide is mounted upon the strap of an eccentric, and from this strap proceeds an arm forming the reversing handle. When this handle is depressed, as shown in three views, the star-guide is raised into contact with the screw-ferrule, and the mandrel will traverse; by raising the handle the star is disengaged. This should be done when the mandrel has taken up its proper position; the tongue or wedge seen on the reversing handle will then fall into the deep groove in the hinder collar and hold the collar and mandrel from further endlong movement. Thus the movement of the reversing handle is all that is required to fix or set free the mandrel for traversing; moreover, the retaining wedge does not take effect upon the revolving mandrel, but upon the sliding collar, so that it would not add to the friction nor tend to wear itself away.

The reversing arrangement is another new feature. In order that it should not interfere with the traversing mechanism, the eccentric on which the star-guide is mounted is bored, and the mandrel stud passes through it. A fair-sized wheel can now be placed upon the stud without interfering with the mandrel. If, however, a larger wheel still were required, as, for instance, when cutting a quick-pitch spiral, it would be better to avoid the looseness caused by the small reversing wheels, and in this case the pin securing the small-gear wheel on the mandrel stud would be removed, and then the stud would be pulled out to the left, leaving the mandrel end free to receive wheels of any size.

In the plan, an arm is seen carrying a boss with wheel-plate, and a sliding shaft with long key-way and Hooke joints, to carry the motion to the screw of the ornamental slide-rest or to the traversing screw of the saddle for surfacing metalwork, or for giving the feed in milling with the slide at any height. A lead-screw and second wheel-plate may be added, as seen in the back view, if long work is to be done, and in that case the wheel-plates could be used together, if necessary.

There are 4 grooves on the speed-pulley running into 4 on the flywheel, and giving speed ratios of 7 to 1, 5 to 1, $3\frac{1}{4}$ to 1, $2\frac{1}{4}$ to 1; besides these four speeds there are two others by a shorter band running from the largest groove on mandrel to a ring the same size on the wheel, giving a ratio of 1 to 1; and a still slower speed may be obtained by a groove cut round the large 12in. face-plate, and working into a small 6in. pulley beneath, on the crank shaft, giving a ratio of $\frac{1}{2}$ to 1. This last speed ratio should be slow enough to allow of iron of 4in. or 5in. diameter being turned—as much as the mandrel is fit for; it would, therefore, be of no use to add back-gear.

To assist in determining the scale, it may be added that the extreme length of the mandrel is 16in., and the largest diameter of the pulley $9\frac{1}{4}$in., whilst the height of centres is 6in.

F. A. M.

IMPROVEMENTS IN VOLTAIC BATTERIES.

AMONGST recent improvements in voltaic batteries which deserve more than a passing note, we find several that have features which will recommend them for certain purposes, and some which may be specially suited for electric lighting, though it is as well to observe that the advantages and disadvantages of any given battery are never fully recognised until it has been tried for a considerable period in critical work. Schanschieff's new sulphate of mercury cell, which we described in No. 1094, p. 26, has for its principal improvement a new liquid, though the general arrangements make it a handy and useful cell, giving little trouble in recharging, while the zincs can be worked until they are practically worn out without amalgamating them. The Schanschieff cell consists of elements of carbon and zinc, and the exciting liquid is prepared by mixing basic sulphate of mercury with three times its weight of water. To this is gradually added drop by drop strong sulphuric acid, which dissolves the sulphate until at last a drop of the acid produces a precipitate. This preparation is then cooled and filtered, and the resulting liquid forms the exciting fluid for the battery. In working the mercury is recovered, being found in a metallic form at the bottom of the cells.

In the battery devised by M. Desruelles, of Paris, and patented in this country by Mr. J. H. Johnson, two liquids are employed—one being an exciting liquid for dissolving the soluble electrode, the other a depolarising liquid whose function is to absorb the hydrogen set free during the electrolysis. The exciting liquid is composed of water and sulphuric acid which has macerated for about seven or eight days with peroxide of manganese, bisulphate or sulphate of peroxide of mercury, oil, and glycerine in the proportion of, say, about one thousand parts weight of water to three hundred of the prepared sulphuric acid (at about 66° sp. gr.), eight parts of the sulphate, one part of colza oil, for example, and two of glycerine. The depolarising liquid is composed of water, with the addition of an alkaline bichromate, such as bichromate of soda or potash, in proportion varying from, say, about one hundred to one thousand parts by weight of the bichromate to one thousand parts of water, and an equal quantity of sulphuric acid at about 66° sp. gr. This sulphuric acid is soaked or macerated with peroxide of manganese for about one month before it is used. To this mixture is added about one quarter of its weight of nitric acid at about 40° sp. gr. The zinc employed as the soluble electrode is carefully covered before being introduced into the existing liquid with a fatty or greasy coating composed of, say, about one hundred parts by weight of tallow, twenty-five parts by weight of paraffin, and three hundred of mercury, ground or pounded together. The electrical resistance of this coating is not sufficient to interfere with the working of the battery, but it protects the metal from the corroding action of the acid when the circuit is open. The positive electrode of the battery is formed of plates of carbon prepared by soaking in water containing sugar, after which the plates are dried and exposed to a smoky flame, so that the sugar melts and is converted into caramel or burned sugar. The specific gravities above given are probably degrees of Baumé, but it is not stated.

A German device of Messrs. Pollak and Wehr, of Berlin, patented here by Mr. H. J. Haddan, is a battery cell in which the depolarising substances are stated to be always regenerated. The patentee uses zinc and "metal" elements, the "metal"—copper, say—being in conducting connection with carbon, which dips only partly into the exciting liquid. The liquid will vary with the nature of the element. The patentee claims (1) in an element with two metallic electrodes the combination of porous carbon in electric connection with the positive electrode, for changing by local action the positive electrode partly into depolarising salts when the circuit of the element is not closed, from out of which salts, when the circuit is closed, the metal of the positive electrode utilised for their generation is again precipitated upon the positive electrode. (2) The porous carbon for use in the element made from small pieces of carbon and carbon dust by pressing and baking in the shape of plates or blocks, forming compact and good conductors of electricity, which plates may or may not be provided with perforations.

The Howard battery is an American device, patented in this country by Mr. Loeb. Like most American inventions of the kind, the claims are numerous, but the cell appears to be one of those using bichromate of soda with dilute sulphuric acid. There are two patents dated this year, Nos. 2647, 2648, but as the second seems to include the first it will be sufficient to indicate the nature of the chief claims, which are:—In a galvanic battery an outer jar of some infrangible material, as wood, with an inner cell, preferably of paraffin, or similar material. A porous cell with a grooved bottom, constructed to hold free mercury and the zinc element, which is a cylinder having its inner surface coated with paraffin. The liquids are bichromate of soda and salt, with (preferably) sulphuric acid in an aqueous solution. The salt is added with the object of producing free chlorine.

A "compound" battery has been patented by Mr. S. H. Emmens (10011, 1885), in which he employs one or more peroxidised lead plates in each cell, so mounted as to be readily removed and replaced when they are exhausted of their available oxygen. One or more plates of zinc, with dilute sulphuric acid or any suitable saline solution, complete the battery, which, however, requires a charging bath. This latter is composed of sulphate of copper, and the lead plates are charged with oxygen by being used as anodes.

SPEED-CHANGING MECHANISM FOR LATHES.

IMPROVEMENTS in speed-changing gear for lathes, which are also applicable to cycles and other machines, have been recently patented by Mr. A. G. Meeze, of Redhill, and the principal features are shown in the annexed engravings. One of the leading objects of the invention is to improve the construction of turning lathes—especially such lathes as are designed for the use of amateurs—by providing a cheap, compact, and efficient means of regulating and controlling the motion of the headstock mandrel and of adapting the angular velocity of the latter to the work in hand. To this end the ordinary back-gear is dispensed with and the headstock is constructed as described.

In Fig. 1, *a* is the frame of the headstock shown partly in section, and *b* is the mandrel, all of ordinary construction. To adapt the invention, at a suitable point near the middle of the mandrel, *b*, which may if desired be made of the traversing pattern, there is keyed or otherwise securely fastened a small cogwheel, *f*, and on opposite sides of this cogwheel is arranged a pair of step or cone pulleys, *d* and *e*, so as to turn freely and independently about the mandrel, *b*, as an axis. The face of one of these pulleys—preferably the pulley, *e*, on the righthand side of the said cogwheel *f*—carries one or more, by preference two projecting arms *h*, *h*, which serve as axles for secondary cogwheels or pinions *g*, *g*, turning freely thereon and at the same time running in gear with the cogwheel, *f*, upon the mandrel. The adjacent face of the second step-pulley, *d*, carries a cog-wheel, *i*, which is larger than either of the others and furnished with internal or hypocycloidal teeth cut and allocated to gear with the secondary cogwheels or pinions, *g*, *g*, described as mounted on the arms of axles *h*, *h*, which project from the face of the first pulley, *e*. The whole is thus arranged in gear to form an epicyclic train. In Fig. 2 is shown a sectional elevation (on the line 1, 2) of the essential elements of the epicyclic device; the similar parts of which are lettered to correspond with Fig. 1. From the arrangement of the elements of this combination it is obvious

FIG. 1.

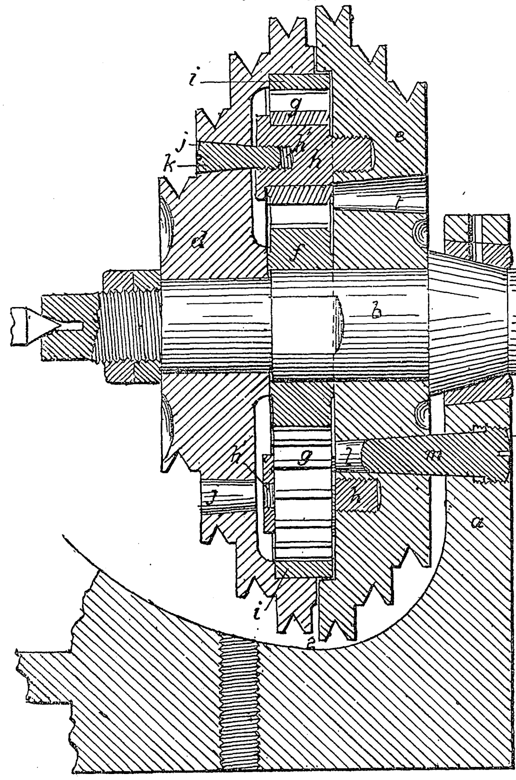
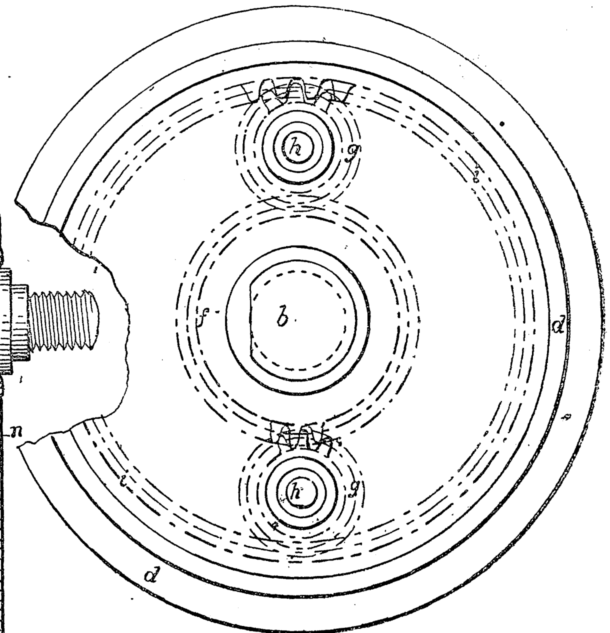


FIG. 2.



that if the first described pulley, *e*, be driven, while the second, *d*, is kept fixed, the headstock mandrel, *b*, will be caused to rotate in the same direction, though not with the same velocity, as the moving pulley, *e*; and it is also evident that if the first pulley, *e*, be fixed and the second, *d*, driven, the motion of the mandrel, *b*, will be retrograde. If, therefore, both pulleys, *e* and *d*, be driven in the same direction with a certain determinate difference of velocity, depending upon the relative diameters of the cogwheels, *f*, *g*, *i*, forming the epicyclic train, the mandrel will remain at rest. Any departure from this fixed ratio, as, for example, an increase in the relative velocity of the pulley, *e*, will result in a differential motion of the mandrel, which motion may be quick or slow as desired.

The way in which the patentee provides for the suitable and convenient motion of the step-pulleys of the headstock is by attaching to the driving or treadle shaft of the lathe a step-driving wheel or wheels, from which motion is transmitted by means of a pair of driving belts to the pulleys *d*, *e*, of the headstock. By this device each of these pulleys has an independent motion, and, by adjusting their driving belts to the proper steps or grooves of the driving-wheel, a convenient difference of velocity is created between them, suitable to the required velocity of the mandrel. Normally, the patentee uses only one driving belt and provides a suitable bolt or fastening for locking the two loose pulleys firmly together at will, by which means they are constrained to move as one with the headstock mandrel. In Fig. 1 is shown a device for this purpose consisting of a taper pin, *k*, contrived to fit a hole of corresponding shape bored through the pully *d*. One end of this pin screws into a hole, h^1, in the stud axle, *h*, and thus firmly bolts the two pulleys *d* and *e* so as to move as one with the mandrel. Also he provides means of locking or fixing, at will, one of the pulleys—for example the pulley *e*—so that it shall not revolve, while the other is left free to be driven by a belt from the driving-wheel; and, in this manner, a very much greater range of velocity is obtained in the headstock mandrel than has been hitherto possible. A simple device for fixing the pulley *e* is a taper pin, *m*, inserted as shown in Fig. 1 through a partially threaded hole, *n*, in the headstock frame into a conical aperture, *l*, in the pulley. In some cases a bolt is used (not shown in the drawing) attached rigidly to the frame of the headstock and contrived to be shot into the opening, *j*, in the pulley *d*. By this means pulley *d* may be prevented from rotating while the pulley *e* may be driven, and thus an additional set of velocities secured. Altogether the range of velocity possible to the mandrel of a headstock, proportioned as in the drawings, varies from the slowest conceivable creep up to three times that obtained in the normal way when the driving belt runs from the largest step of the main wheel to the smallest step of the headstock pulleys.

ENAMELLING COLOURED PHOTOGRAPHS.*

THE main objection to tinted or partially-coloured photographs lies in their unfinished and smudgy appearance, the albumen surface being in some parts covered and in others left untouched. To obviate this means either to fully work up the picture or to provide it with a new surface altogether. Enamelling, at first sight, seemed to offer an easy remedy, but was soon announced to be impracticable, at least by the same method used for the enamelling of plain or uncoloured photographs. The colours were found to run into each other, and over parts of the picture where they were not required, and where their presence in no way enhanced the pictorial or realistic *tout ensemble*. Such being the case, photographers naturally gave up the idea, and enamellers do not seem to have continued their research. Personally, I at one time gave a great amount of thought to the matter, and was somewhat agreeably surprised to meet, while in Malta, an artist who also seemed to think considerably on the subject. With his aid, I conducted a series of experiments, and after meeting with many rebuffs and failures of all descriptions, we were at last gladdened by the production of a genuine coloured enamel photograph. . . . In the first place, the picture which is to be subjected to the double process of colouring and enamelling should be printed a shade lighter than one meant to be treated in the ordinary way and turned out plain. Care should be taken not to over-tone it, a sepia grey being the tint calculated to produce the best results; and it should be untrimmed, a margin of at least ½in. all round being left. After fixing and washing it should be pinned, while still damp, on to a drawing-board, and when dry it is ready for the artist's hands. Ordinary moist or cake water-colours may be used; but to minimise the chances of failure we found the so-called albumen colours the best to use. The colours I refer to were introduced by M. Lambert some years since for colouring chromotype photographs, and were sold on cards by the Autotype Company, from whom I believe they are still obtainable. Care should be taken not to put the tints on too high, as enamelling serves to intensify them, and carmine should be used very sparingly, not only because the colour is fleeting, but because it has a tendency to run into spots, and give a rough appearance to the finished picture. The print being coloured and ready for enamelling, a sheet of glass (preferably plate glass) is prepared in the usual manner—that is, either with a solution of yellow wax in benzole, or with powdered talc. I personally prefer the first-mentioned, as the print usually comes off cleaner and more easily. A few drops of the solution are poured on the glass, which should be perfectly clean and free from scratches or flaws, and gently rubbed over the entire surface with a piece of clean flannel until it begins to set. It is then polished off with another piece of the same material until it appears clean, and polished again. To test if enough wax remains, the tip of the finger should be pushed along the surface near the edge, when, if properly prepared, it will meet with a considerable resistance, and produce a grating noise. It is then coated with enamel collodion in the same manner as a plate used to be coated for the wet process, or as a negative is varnished, and care taken that the collodion be not allowed to run into crapey lines. Immediately the collodion sets (not dries) it is immersed in a dish of cold water until all greasiness disappears. The coloured print should then be carefully collodionised in the same manner as the plate, and when the film is thoroughly set it should be passed through a solution of gelatine in hot water, then laid upon the plate and carefully squeezed until all air-bubbles disappear, which may easily be seen from the back of the glass. It is then put aside under pressure for an hour, when it is ready for mounting—or, rather, for a sheet of thin cardboard to be attached to the back by the aid of thin Russian glue, gelatine having a tendency to reduce the gloss of the finished result. It is then again placed under pressure for about an hour, and then set up to dry in a cool place. When thoroughly dry, the blade of a knife may be placed under the edges, and the picture will come off perfectly flat, and with a high enamel surface; and if the operations have been carefully performed the colouring will be found as clear and perfect as when first done. It now only requires trimming and affixing to the final mount, which is best done by the aid of coaguline, applied to the edges only. This may appear at first sight a very tedious and difficult process, but after one or two pictures have been enamelled it will become quite easy to manage.

* By C. Brangwin Barnes, in the *Photographic News*.

A COMPENSATING PENDULUM WITH SOME SUGGESTED IMPROVEMENTS.*

By Richard Inwards, F.R.A.S.

THE best pendulums are already so delicately true in their timekeeping powers, that if any improvement be still possible, it seems likely to be in the direction of minute correctness in the compensation adjustment. Hitherto, in lengthening

* From the *Horological Journal*.

or shortening the pendulum for regulating purposes, the whole alteration has been necessarily made in the length of the steel centre rod of the pendulum. Now a minute error here occurs because the pendulum being built up of tubes of zinc and steel in the lineal proportion of, say, 7 of the former to 17 of the latter metal, it is evident that this proportion is disturbed if you shorten or lengthen one of the metals without doing so to the other in a proper degree.

The suggestion illustrated by the lower part of Fig. 1 shows the way in which I propose to remedy this defect, by the introduction of a peculiar form of nut A which is provided with two different interior threads, one in the lower part, of 20 to the inch, working on the end of the central steel tube B of the pendulum, and the other, of 50 to the inch, working on the lower outside end of the zinc tube C. The effect of this arrangement is that when the nut A is turned ever so little it shortens or lengthens the two tubes in the proportion of 20 and and some mechanical contrivance for easing the movement of the adjustment will be an advantage. Of course, the system of tubes must be prevented from turning on each other, and this may be done by the insertion at two or three points of screws and distance pieces as shown at E in the upper part of Fig. 1, the various tubes, except the middle one, being perforated with slits which allow of a slight up and down movement. It will be seen that the tangent screw operating on the nut A is prevented from turning round with it by a screw F traversing a depression G in the solid part of the centre rod of the pendulum. The arrangement of the worm wheel and tangent screw is shown in Fig. 3, in which it will be seen that the screw is carried by two pieces of metal (aluminium by preference), fastened together round the central screw; and it is also furnished with a lock nut I to fix the whole when adjusted. The upper part of the nut A is split, and when in its place is firmly pressed against the zinc tube by a ring J, so

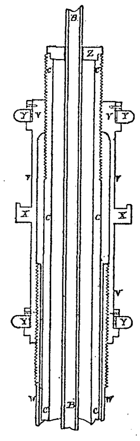


FIG. 2.

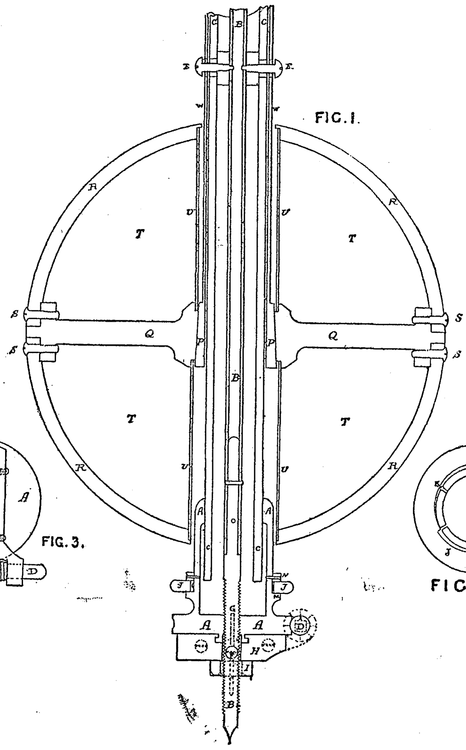


FIG. 1.

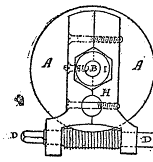


FIG. 3.

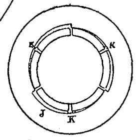


FIG. 4.

50, instead of affecting only one of them as in the arrangement now generally adopted. (I have put the screws as of 20 and 50 threads advisedly. The proportion given in books is generally 21 to 51 or 7 to 17. But I am informed that in practice the zinc almost alway comes out too long, and that two samples of zinc tube will give different results. Of course there is no difficulty in making the threads 21 and 51 to the inch if preferred; 14 and 34 would leave the central screw too coarse.) It is proposed to turn the nut by means of a tangent screw D, which will give almost any desired delicacy of adjustment. In round numbers, if the tangent screw have 20 threads to the inch and the worm wheel on the rim of the nut A have 125 notches, then $\frac{1}{8}$th of a turn of the the screw will raise or lower the nut by about the $\frac{1}{20000}$th of an inch, and as, of course, the screw may be turned much less than $\frac{1}{8}$th at a time, any required degree of fineness may be secured. It is besides to be remembered that this pendulum bob will weigh between 50 and 60lb., arranged (see Fig. 4) as when turned to press with great force on the small studs K, and so close the nut firmly on the tube. J is kept in place on the lower side by a flange M turned on the nut, and on the upper side by a ring N secured by fine screws (there is no great strain on them). This has been thought better than the more obvious plan of a screwed ring working on a taper, as the present plan secures against any minute difference which might be caused by using more or less force in screwing up the ring, and so leaving it in a different place. Naturally the precaution must be taken to loosen both I and J before turning the head of the tangent screw D. The balancing of the pieces H may be secured by slightly varying the form as found necessary, or by drilling small holes in the side opposite to the screw, and filling them with lead to the requisite extent.

With respect to the other features of this design, some of which are by no means novel, it will be seen that the central rod is made tubular except at the ends, where plugs of steel are inserted, secured by soldering and riveting as at L, and, of course, at the upper end of the pendulum not shown in the sketch.

It will be seen that the pendulum bob is supported at its centre, as Mr. Buckney has shown that it should be, so as to throw the expansion and contraction of the bob itself out of the question. In this pendulum I propose to fit it into the foundation plate Q bob by a cone fitting such as that of a lathe mandril. P is the turned and coned end of the *outside* steel tube of the pendulum which ends here, and Q is a turned disc of gun-metal on which the bob is built up; R R being hemispheres of gun-metal turned inside and out, screwed at S to the central disc Q, and the space T filled with lead, which may be conveniently done after fitting the parts together, by means of holes in R, which can be afterwards plugged. U U are brass tubes to confine the lead at the central aperture. The bob is preferentially spherical, on account of exposing the least surface in proportion to its mass.

As to the upper part of the pendulum (see Fig. 2), another refinement has to be considered. In finally adjusting the compensation, it is desirable to do this without repeatedly cutting the zinc tube, which is very liable to be cut off too short, and when once fixed cannot be altered without great trouble. Now the proportion of zinc to steel may be, by the means shown, minutely altered (and it is with minute quantities we are dealing) by raising or lowering the tubular casing nut V which embraces the outside steel tube W of the pendulum. At its upper end it similarly embraces the end of the zinc tube C. It is threaded at each end by inside screws of the same pitch, so that its only effect when turned by means of the milled projection X is to grip the zinc tube at a higher or lower point, and to raise or lower itself on the steel tube W. This latter action has no effect on the compensation, as both tubes are of steel, but its altered position on the zinc tube gives to that metal a slightly different proportion of length to that of the steel. For instance, if the total lengths of zinc and steel were in the proportion of 20 to 50, and the tubular nut V were raised half an inch, the proportion would then be $20\frac{1}{2}$ to $50\frac{1}{2}$, so that a very minute change in the relation of the two metals may be secured. It is, of course, taken for granted that an approximation has been made as nearly as possible (always leaving the zinc a little in excess) before the tubes are fitted with their screws. When in place the tubular nut V is firmly fixed by turning the rings Y which act on the split ends of the tube in the same way as already described (see Fig. 4). Z is a cap to close the upper end of the zinc tube.

The plan I have just described differs from that of Mr. Buckney (whose invention I had not heard of when this idea first occurred to me) by having the outside threads on the pendulum tubes proper, and not having to cut an inside thread on the large steel tube of the pendulum.

His contrivance for locking the screw between the two tubes is ingenious and beautiful, but I thought it better thus to give this plan to the light as showing another way of attaining the object, and without creating a large space between the zinc and outer steel tube. I prefer this space inside the zinc tube, as it allows of the said tube (which is the weaker member of the system, and has to act as a prop to the whole weight of the bob) being kept of larger diameter, and consequently stiffer as a pillar. As this pendulum would be an unusual weight, these considerations become of more importance. There is one other adjustment which might be made, and that is to compensate for what is called the barometric error. This could be done by a Bourdon tube, fitted outside the pendulum case, causing a properly-shaped disc or pair of discs of thin metal to project in a greater or less degree near the path of the pendulum according to the varying pressure of the atmosphere. When there was much pressure, and consequent tendency to retard the pendulum, the disc would be withdrawn and so offer less opposition, not to the pendulum itself, but to the air which must accompany it in its swing.

I am indebted to Mr. Thos. Buckney, F.R.A.S., for some important suggestions on this pendulum, which instrument might be found suitable for gravity experiments concerning the figure of the earth.

MOULDING SCREW PROPELLERS IN LOAM.*

THE foundation plate A, as shown in Fig. 1, should be levelled up true in the pit, and should be about $2\frac{1}{2}$in. thick, and made the shape of the screw, with allowances for joints and lugs at proper intervals. It may be perforated with holes, made with cores or pieces of brick, to allow the free escape of gases, and for better drying.

* By CHAS. A. DEVLIN, in the *American Machinist.*

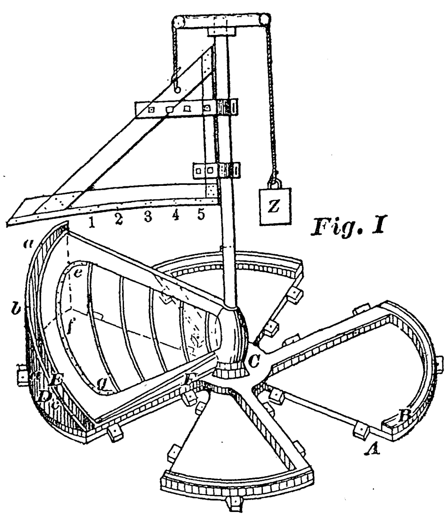
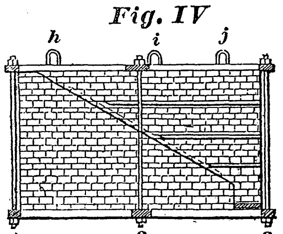


Fig. I

Fig. IV



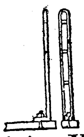


Fig. V

The bearing B and C are then swept up on one course of brick by a sweep that will also form the base of the hub high enough to allow the blades to be built. On this sweep notches are cut to indicate on bearing B the proper place for the guide board D and the joint board E. The bearing is thus divided into four right angles, with centre at the hub, which will show the true centre on bearing B to which the centre marked on the guide-board at *a* is placed. The false hub is then swept up by a sweep made for it.

The guide-board should be bevelled on the top edge, and a strip of hoop iron screwed on to insure easy and accurate travel for the sweep, which works with a counter balance weight Z, and when drawn down the guide-board describes the face of the blade. Notches are filled in the guide-board at *a*, *b*, *c*, and by scribing along the sweep from the notches to the hub gives the top, bottom, and centre of the blade. The joint-board E serves as a protection to the guide-board, and also makes a neat joint, as does the joint-board F on bearing B.

When the guide-board D and the joint-boards E and F are properly secured the bricking commences. Good, soft brick should be used, and kept the proper distance from the face of the mould to prevent scabbing. The pier should be built open with plenty of cinders champed in between the joints of the brickwork to allow vent; in the back of the pier brick should be left out occasionally for vents also. The brickwork finished, the pier should be loamed up and finished off.

The notches filed in the sweep 1, 2, 3, 4, 5 will describe on the pier the proper place for the thickness strips, which are cut out by the pattern-maker, and are cross sections of the blade at different intervals. They are generally about ½in. thick and pliable, so as to bend readily to the proper curve, marked on the pier. They are fastened on with nails or brads at their proper places.

A good idea is to make the form for the outer edge of the blade of a strip of lead properly shaped, as *e*, *f*, *g*; it makes a much neater job, and the outside will be uniform in thickness, especially in composition wheels, which are generally much thinner than iron ones.

When the thickness strips are fastened on, strong green sand is to be used to fill in with. It should be packed hard and struck off with small strips properly curved for the top of the blade. The strips may then be drawn and their places filled in with sand, when you have the proper shape of the blade. Clean the pier and spread oil over the face and joints, and shake on parting sand, then you are ready for the cope.

This style of a cope is interesting, shown in Fig. 2. The lifting and binding plates—1, 2, 3, 4—are cast in opening sand, as are the binding irons (Fig. 5).

Fig. II

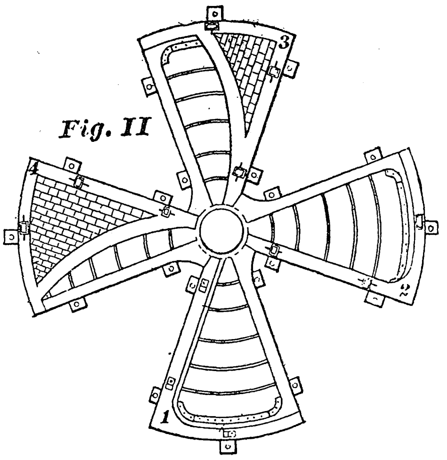
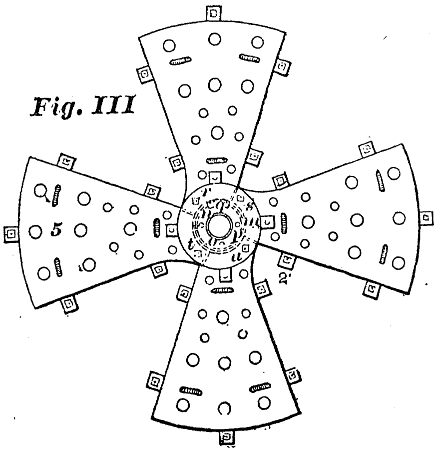


Fig. III



The lifting plate 1 is about two inches thick, with lugs at proper intervals. Three bolts are cast in this plate for securing the binding irons. The binding irons are made long enough to secure the top binding plates. After the cope is bricked up, a top plate 5, Fig. 3, about 2in. thick, with prickers about 1in. long, is then bedded on, after being loamed up. Binding bolts are then put through the lugs and screwed taut, when you have the cope safe and sound.

In the top plates staples are cast, as *h*, *i*, *j*, Fig. 4, to lift the copes by, after you have made proper marks and guides. After all the copes are built, the next thing is to make over the top of the hub. The best way is to sweep up a seat for the hub-plate *m*, which is cast with a hole for the core print and gates, *n*, *o*, *p*, and seeding head *g*. This plate is cast with prickers the proper length to extend down to the top of the hub; it also has four bolt holes cast in the lugs to correspond with small bolts cast in the top plates to secure it by, as *r*, *s*, *t*, *u*.

After the mould is all bricked up, it is taken apart, the thickness sand taken off and the false hub dug out, when it is ready to be dressed. If the screw is too large to be put in the oven, the piers may be dried by building fires between them, and placing a curbing around and plates over the top of it. The copes can be put on a carriage and dried in the oven. When dry, set the core and put the mould together, and bolt up by the binding bolts 1, 2, 3, Fig. 4, from the lugs on the foundation plate, through the lugs on the cope plates. Risers may be taken off from the highest point of the blade if the blades be thin. For greater safety in securing the mould, the cross and slings may be used, but it is hardly necessary.

GENERAL PRINCIPLES GOVERNING THE ACTION OF CARRIAGE WHEELS.*

A WHEEL is a contrivance to utilise some of the principles of motion of a ball or sphere. A ball or sphere moves upon a level surface easier than any other form of solid matter. This is because its centre of gravity is not changed in its progress. If a ball moves upon a level surface, its centre of gravity describes a line parallel to the surface. A ball is balanced in every direction when it is at rest. The power required to set it in motion is just enough to unbalance it. Like a pair of scales balanced with a ton weight on each end of the beam, a few ounces added to either end will move them.

A carriage wheel, in principle, is a slice from the centre of a ball. So long as such a wheel moves uprightly upon its rim, it has the facility of a ball to move in two directions only. To keep it in this position an axle is put through its centre. This adds friction to it, and also shortens the leverage by which it is propelled, from its rim to its centre.

A carriage wheel has to do duty generally upon a common road, the best kind of which is the macadamised. A wheel sinks somewhat into the loose material upon the surface, which it has to surmount in its progress. This is called traction or rolling friction.

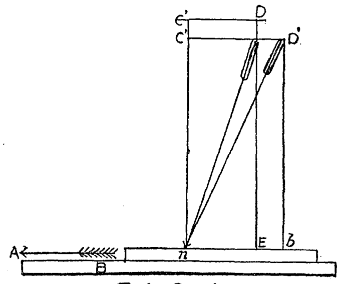


FIG. 1.

The rubbing of two substances together causes friction. It is the resistance to the motion of one substance bearing upon another. It increases with the weight or pressure of objects at their frictional contact, but not with the extension of the frictional surfaces.

If four blocks of wood or other material, of one kind and of similar weight, be placed one on the top of the other, and dragged upon a board or other smooth surface, and the weight or force be noted that is required to pull them; and then, if the same four blocks be spread side by side, and dragged upon the same surface, it will be found that the same weight or force will pull them. This shows that, if the surfaces in frictional contact be extended, but the pressure upon them be not increased, the resistance called friction is not increased. This law applies to axles.

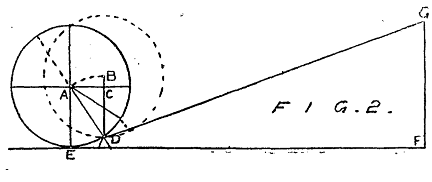


FIG. 2.

Friction does not increase with the size of an axle; but a wheel loses power or leverage with the increase of the size of its axle, and also by increased weight.

To find the amount of resistance there is to two smooth plates of metal—such as an axle and its box, with a layer of oil between them—sliding upon each other, we proceed as follows:—

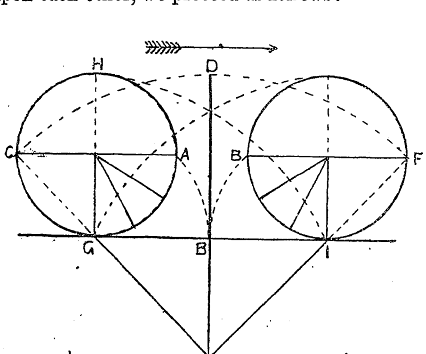


FIG. 3.

Let A B in Fig. 1 be the plates, and A C a perpendicular to their two surfaces. Draw E D parallel to A C, and C D parallel to the plates, thus resolving the force D A into two forces, one D E pressing A upon B, and the other D C tending to make A slide towards F. It will clearly depend on the strength of the friction between A and B how far the force D A may be made to decline from the perpendicular without actually causing A to slide upon B.

Suppose the pushing force be brought into the position of D′ A, and as A is just ready to slip on B; then, since D′ E′ and C′ A are the forces pressing

* By J. G. Cameron in *The Hub.*

together A and B, and D′ C′ and E′ A the forces tending to produce motion, D′ C′ will be $\frac{2}{25}$ of C′ A. D′ A C′ is called the limiting angle of resistance of the surfaces A and B. If 500lb. be the pressure, made to decline until it reaches the limiting angle of resistance, $\frac{2}{25}$ of 500lb. = 40lb., or 0·08, would be required to pull the plate A on B on a dead level. The figure 0·08 is called the coefficient of resistance of these substances, and may be used to compute the friction of oiled metals.

The actual friction going on within an axle-box is more than 0·08, because we have not taken into consideration the rubbing of the washers on the axle end and collar, and the gather of the axle; but these are so little in good-running waggons that they may be neglected.

Traction, or the resistance to the progress of a wheel upon a macadamised road, has been practically proved to be about $\frac{1}{30}$ of the load. The power required to move 500lb. would be 17lb. Upon a good, hard road, therefore, a horse will require to pull at the rate of 40 + 17 = 57lb. to draw 500lb. on free-running wheels.

The Power of a Wheel.

If an obstacle, say 4in. high, be in the way of a 4ft. wheel, the centre of gravity will have to be raised 4in. to overcome it. The lever to do this with is just half the height of the wheel—viz., 2ft. This lever is of the third order of levers—that of having the power come between the load, which is lifted, not pried, and the fulcrum. Neglecting any momentum the waggon may have, and calling it a dead lift, by the law of virtual velocities "the power multiplied by the distance it moves vertically, or in a right line, equals the load or weight multiplied by the distance it moves vertically or in a right line." See Fig. 2.

In Fig. 2, let the power be at A, the axle; the load 500lb.; and D be the height of 4in., to which it has to be raised. A will move through the curve A B, while the centre of gravity is raised upon D; then A, the power, will be plumb over it. The power A will have moved forward the length of from A to C, and up from C to B upon the resultant curve A B. It is clear that the length from A to C is just one-fourth the diameter of the wheel, equal to 12in. Now, according to the law of virtual velocities, it is with a right line from A to B, upon which the force was truly effective, that we have to do; and this is found by taking the square root of the base line A C times the square root of the upright line C B, which is $\sqrt{12^2 + 4^2} = 12{\cdot}65$. Now the load, 500lb., times the height, 4in., which it is to be raised, equals 2,000, which should be equal to the product of 12·65 times the power. If we divide 2,000 by 12·65 we have 158lb., which is the force required to put 500lb. upon the obstacle in front of the wheel.

This can be proved by the inclined plane E G. Let a base line from the point E be drawn, equal to the length of the circumference of the wheel, which is its diameter, 4ft., multiplied by 3·14169 = 12·566. Now, as the incline rises 4in. to the foot, as is shown by the object in front of the wheel 4in. high, and 12in. from point of gravity upon the ground at E, therefore, an upright drawn upon the extremity of the base line at F, to be of the same proportions, will require to be four times $\frac{12{\cdot}566}{12}$ in height, which is 1·0472 × 4 = 4·1888ft. high. The length of the incline to this base and upright equals the square root of the base line times the square root of the upright:

$$\sqrt{12:566^2 + 4:1888^2} = 13{\cdot}20\text{ft.}$$

The power of an inclined plane is as its length is to its height; therefore the load multiplied by the height of the upright, and divided by the length of the inclined plane, which is 500 × 4·1888 ÷ 13·20 = 158lb., the power required to sustain 500lb. upon it.

Now, by adding the friction of the axles, and traction, already found to be 57lb., to 158, we have 215lb., which is the force a horse will require to exert to haul 500lb. up such a slope of a macadamised road. This 500lb. means all that bears upon the axle-boxes—that is, the total weight of waggon and load, minus the weight of the wheels.

The Motion of a Wheel.

That the part of a carriage wheel above the axle moves faster and through more space than the part below it, is because this kind of wheel is a lever of the third order. Such a lever has the power applied between the weight, which is to be pushed, pulled, or lifted, and the fulcrum; the same as in raising a ladder. Imagine two spokes in a line to be a ladder; the lower end is on the ground, the force or hand being exerted at the hub; the point on the ground, which is the fulcrum, remains stationary, while the upper end moves through a space which will be double the distance that the middle or hub goes. The rim, being endless, each point as it touches the ground becomes a new fulcrum. A carriage wheel is thus called a perpetual lever of the third order.

In Fig. 3 the reader will observe that, while the point of spoke A moves to the ground at B, the opposite end C of the spoke in a line with A goes up to D, and the line of spokes A C there coincides with the line B D. The wheel has now made a one-fourth revolution upon its rim, from G to A, upon the ground G B. When it makes its next quarter-revolution, B goes up to E, and D goes to F. Thus it is clear that the point A, on the dividing line between the upper and lower halves of the wheel, goes down to B, and up to E, while the point C on the same line sweeps through the great curve C D F. The wheel has now made one-half of a revolution, and the line of spokes A C now coincides with the line E F. The upper part of the wheel has now become the lower, and, with the onward movement of the wheel, the same thing is continuously repeated.

To show the ratios in decimal notation of the curves which the points opposite in the lower and upper half of the rim of a wheel describe, or of their motions, would require the use of a calculus, which would be of no practical value here, as these curves are graduates—that is, having no centre.

USEFUL AND SCIENTIFIC NOTES.

Cheap Battery.—Each of the zinc plates is 2in. square and covered with fustian or other fabric, outside which thick copper wire is wound to form the other plate; the exciting liquid is weak chloride of zinc. Pairs of plates thus made can be arranged in series to form a battery to give out weak currents for a great length of time.

Amalgamating Zincs.—The simplest and quickest method of amalgamation of battery zincs consists in immersing the zinc in a liquid composed of nitrate of mercury and hydrochloric acid. A few moments are sufficient for the complete amalgamation of the zinc, however soiled its surface may be. With a quart of this liquid, which costs less than 50 cents, 150 zincs can be amalgamated. The liquid should be prepared in this manner: Dissolve in warm water 200 grains of mercury in 1,000 grains of aqua regia (nitric acid 1 part, hydrochloric acid 3 parts). When the mercury is dissolved add 1,000 grains of hydrochloric acid.

Warping of Wood.—Straight-grained woods are not subject to any considerable change in the lengthwise of the grain, but a distortion called warping is very prevalent in the soft, as well as in the hard varieties, in the cross directions. Thin boards are sometimes curved like a bow in their cross sections. The first method to be tried to restore these to their original condition is to range them round the shop with the convex sides to the fire, or place them in the sun, when the evaporation of the moisture causes the wood to contract, and so bring it to its proper shape, but the wood must not be too long exposed, as the board will become convex on the side next to the heat. This may be avoided by frequently changing the sides. If the wood is too much distorted to yield to this treatment it is to be bent as straight as possible by the hands, and if still retaining a warped form must be placed between two stout planks drawn closely together by hand screws. Any after prominences must be removed by the plane. The finely figured woods, which chiefly owe their beauty to the great irregularity of the grain, would be very liable to twist if employed of the same thickness as the straight-grained descriptions; it is their being cut into thin slices that saves them.

New Submarine Torpedo Boat.—A new submarine torpedo boat, the invention of Prof. J. H. L. Tuck, of New York, and constructed at the yard of Messrs. C. H. Delamater and Co., has just been tried on the Hudson River. The vessel, which has been named the *Peacemaker*, is of iron, 30ft. long, with a breadth of beam of 8½ft. and a depth of 7½ft. The bow and stern taper off from amidships, the forward end being surmounted by a small dome 12in. high, set with glass, and just large enough for a man's head, while at the stern is a circular scuttle, which may be hermetically closed from inside. The interior is half-filled with machinery and apparatus, including a 14-horse power Westinghouse engine, supplied with steam from a caustic potash boiler, and driving an ordinary screw propeller. Compressed air is stored in 6in. pipes running round the interior. The boat is steered by a rudder of the usual pattern, but she has also two horizontal rudders, by means of which she may be deflected up or down. A gauge registers the depth of the vessel beneath the surface. The hold is lighted by a glow lamp. The *Peacemaker* is to carry two torpedoes, held together by a chain and fastened to corked magnets, which will attach themselves to the iron or steel sheathing of the vessel to be attacked, and are fired by electricity after the boat has reached a safe distance. The torpedoes were not tried during the experimental run, but in other respects the boat is said to have behaved well, reaching a depth of 40ft. and attaining a fair rate of speed.

SCIENTIFIC NEWS.

THE death of Rowland Mason Ordish removes from our midst one of the most skilful of constructive engineers, though he was little known to the world outside the profession. He was born at Derby, where his father practised as a land-agent and surveyor, and coming to London in 1847, he speedily found employment, and in 1851 was an assistant draughtsman to Sir Charles—then Mr.—Fox, a large part of the more important work in connection with the Exhibition of 1851 falling to his share. Before the Exhibition opened Mr. Ordish was engaged in making the working drawings for the New-street Station, Birmingham, and subsequently assisted in working out the constructional details of the Crystal Palace. By this time his abilities were well known, and he became a real consulting engineer, designing amongst other important works the roofs at St. Pancras station, and at Enoch-square station, Glasgow. The roof of the Chapter House, Westminster Abbey, is now in reality suspended from a hidden polygonal iron roof designed by Mr. Ordish. He also designed the Farringdon-street bridge of the Holborn Viaduct, and with the help of his chief assistant, Mr. Max am Ende, the roof over the Albert Hall. Outside professional circles Mr. Ordish was little known, but the most distinguished architects and engineers were accustomed to consult him, and place the designing of difficult works in his hands. Many engineers throughout the world will hear with regret of his death—he was only in his sixty-second year—for he was pre-eminently one of "those who know," and he was never chary of imparting information to his pupils.

Mr. Sampson Gamgee, the famous Birmingham surgeon, died suddenly last Saturday at the age of fifty-nine, it would seem from the effects of an accident he met with in Devonshire while on a holiday trip. The Saturday Hospital Collection is due to his initiative. He was a brilliant operator, a fluent speaker, and a member of several learned societies.

Winnecke's comet was observed at Algiers on the 23rd ult. by M. Trépied, and on the 28th by Prof. Zona at Palermo Observatory. Their observations confirm the conclusion that the comet must have passed its perihelion twelve days earlier than was assumed as the probable date in Dr. Lamp's ephemeris.

A "Handy Map of the Moon," drawn by Mr. T. K. Mellor, F.R.A.S., has been published by Messrs. Horne, Thornthwaite, and Wood, of the Strand and Cheapside. It is 11¼in. in diameter, and has been photographed from the drawing and mounted on cardboard (about 14in. by 13in.) so that it can be conveniently held in the hand while the eye is at the telescope. About 300 formations have been delineated and clearly named, and on the back of the map is a description of the principal features. It will be found very useful by lunar observers who are not yet familiar with the principal markings on the moon.

Mr. H. C. Russell, the Government Astronomer for New South Wales, has published his paper on "Local Variations and Vibrations of the Earth's Surface," which he read before the Royal Society of N.S.W. last year. The paper is supplemented by a number of tables and curve diagrams, including automatic records of the height of the water in Lake George, Murray Co., which reveal the effects of terrestrial motions. Sydney and Greenwich level curves are also supplied for comparison.

Mr. M. Auty, of Front-street, Tynemouth, sends us two prints of lightning flashes taken by him on the night of August 9, 1884, the only successful attempts in six exposures. They do not represent so remarkable a flash as that illustrated in No. 1118, but they both show the ramifications of "flashes" of lightning.

At the meeting of the Royal Scottish Society of Arts last week, the report of a committee on Mr. W. M. Hardie's fluid prisms was read, in which it was stated that Mr. Hardie obtained widely separated spectra of various kinds of light, and enjoyed views of the composition of some groups of lines therein, which were beyond the optical power of not a few modern spectroscopes of the orthodox and expensive kind for measuring. There might be ultimate doubts as

to whether the prisms could ever be made so large and so perfect as to bear being looked through by the powerful telescopes now beginning to be employed in spectroscopy. Another paper read was that by Mr. George R. Primrose on a new electric scale-reader. The instrument is one designed to measure the height of a varying column of mercury at any distance from an observer to which it is possible to convey one wire. It is intended to be used principally to register atmospheric changes in high altitudes, or deep and dangerous places. The scale may be divided into almost any degree of fineness. The principle of action is applied to a siphon barometer. A small wire rod in the electric circuit is passed perpendicularly into the exposed end of the mercurial column. When the contact is broken by the rod moving out of the mercury, the height of the mercury is indicated at the distant station. The necessary motion is conveyed by an electro-magnet acting upon a toothed wheel, which, by a succession of beats, turns a second diminishing wheel, gradually raising the rod. The rod, on arriving at its highest point, falls again, and the operation is repeated. This movement is got by a section of the wheel having no teeth. The instrument is also intended to be applied in recording the flow and ebb of tides, and the amount of water in a distant river or reservoir.

According to American papers, the sea-serpent has been seen in the river Hudson, near Albany, N.Y., and two members of the United States Fish Commission have expressed an opinion on the probability of such animals existing. Prof. Gill says: "The true serpent is an air-breathing animal, and could not exist indefinitely beneath the surface of the sea. Such monsters were common in the cretaceous age of the world, and their remains are common enough in the deposits of those times, but nothing remotely resembling them is found in the deposits of later geological ages." On the other side, Prof. Goode does not wholly discredit the statement that a monster as yet unknown to science, of reptilian shape, and having the power and habit of lifting its head far above the surface of the sea, may still be in existence. From time to time captured creatures which are reported to be sea-serpents fall into the hands of naturalists, but when submitted to the tests of science, they uniformly prove to be abnormal specimens of familiar forms, such as the basking shark and the oar fish.

The Secretary of State has directed the Inspectors of Mines to call attention to that portion of the report on Accidents in Mines which says that "The source of light within the lamp should be unable, under any circumstances at all likely to occur in working coal, to cause the ignition of any inflammable mixture of fire-damp and air, even when this is passing at a high velocity." Neither the Secretary of State nor the Inspectors of Mines point out which lamp will comply with those conditions, though they imply that there is one.

A writer in the *Revue Scientifique* affirms that, from a comparison of animal and steam power, the former is the cheaper power in France, whatever may be the case in other countries. In the conversion of chemical to mechanical energy, 90 per cent. is lost in the machine, against 68 in the animal. M. Sanson, the writer above referred to, finds that the steam horse-power, contrary to what is generally believed, is often materially exceeded by the horse. The cost of traction on the Mont Parnasse-Bastille line of railway he found to be for each car, daily, 57f., while the same work done by the horse cost only 47f.; and he believes that for moderate powers the conversion of chemical into mechanical energy is more economically effected through animals than through steam-engines. Similar calculations have been made in this country without, however, affecting the position of steam-engines.

The waterfall of Teverone is now used to supply power for driving two dynamos for the illumination of the city of Tivoli. The motive-power is equal to that of several thousand horses. The illumination of Rome by electricity is contemplated.

Another school is about to be added to the numerous practical and technical schools established by the City of Paris. Next month an *école de meublement* will be opened, the object of which is to rear able and skilful workmen who will maintain the artistic traditions of the furniture industry in France. Instruction will be given by professors in cabinet-making, sculpture, in wood-turning, joinery, and tapestry. There will also be classes for geometry, the history of art, technology, industrial design, modelling, &c. The period of apprenticeship will be for four years. Sixty pupils will be admitted every year, and they will be selected by competitive examination in French composition and ornamental design, and must be between 13 and 16 years of age.

At the meeting of the San Francisco Microscopical Society on August 25, a number of specimens of *Teredo navalis* and *Limnoria terebrans* were exhibited by Mr. Manson, who called attention to some interesting questions regarding the food of *Teredo*—it being asserted on the one hand that the albuminous sap of the wood bored by that mollusc was assimilated as food by the animal, while others contend that its food consists of organisms found in the sea-water, and that not only the woody fibre, but the albuminoids of the sap as well, pass through the alimentary canal of *Teredo* unchanged. Dr. Ferrer gave an exposition of the nature of various microscopic moulds, which, he said, were formerly regarded as nothing more serious than annoying invaders of the jams and jellies of thrifty housekeepers; but it is now recognised that they frequently exert a baneful influence upon some living plants and also living animals. The destruction caused in the vine by *Oïdium Tuckeri*, in the potato by *Peronospora infestans*, and in the silkworm by *Botrytis bassiana*, were cited as instances. The active part played by many moulds in some diseases of the skin and mucous membranes in the human subject was also alluded to.

Messrs. Whittaker will publish shortly, in their "Specialist's Series," a work by W. Anderson, M.I.C.E., on the "Conversion of Heat into Work;" and another, by W. H. Preece, F.R.S., and J. Maier, Ph.D., on "The Telephone and its Practical Applications." Amongst the works announced by the same firm, we note "A Bibliography of Electricity and Magnetism," by G. May and O. Salle, Ph.D.

The annual congress of the Amalgamated Society of Railway Servants is to take place at Brighton during the first week of October. We understand the Brighton Railway Company will on one day place a train and engine at the disposal of the Society, so that the delegates can carefully examine the design, construction, and practical working of the Westinghouse brake used on that railway.

A party sent out by the United States Geological Survey, under the command of Captain Clarence E. Dutton, has succeeded in making a complete survey of Crater Lake, in Oregon, a body of water whose shores, with the possible exception of one point on the south, have never before been touched by the feet of white men. The party's boats were hauled 100 miles by mule teams, dragged by a detail of soldiers up the snow-clad sides of the ridge which surrounds the lake, and lowered by ropes from the crest to the water, 900ft. below. One hundred and sixty soundings were made, the result of which gave the general character of the lake bottom. Two large submerged cinder cones were found, respectively 800ft. and 1,200ft. high, the rest of the bottom being flat. Captain Dutton believes this to be the deepest body of fresh water on the Continent. The greatest depth attained by the sounding line was 2,005ft. He writes to Director Powell: "As regards the origin of the basin, I now have a decided opinion. It has, I think, been formed in much the same way as the great *calderas* of the Hawaiian Islands, by the melting of the foundations of the original mountains, the blowing out of the molten material in the form of light pumice and fine tufa. It cannot have been formed by an explosion, like Krakatoa and Tomboro, for there is no trace of the fragments anywhere in the country round about. But the pumice and tufa which surely emanated from this crater are seen in vast quantities anywhere within a radius of 20 to 60 miles, and in quantities ample to fill the whole vast crater twice over. The age of the crater is wholly post-glacial. I have found at the extreme crest of the wall on the western side splendid examples of glacial striation while the old moraines are half a mile to a mile below. That the age of the *caldera* cannot be great is evident from the fact that though the walls are crumbling at a very rapid rate, the talus has not only not reached the water surface anywhere, but the sounding discloses little of it at the bottom."

A statement made by Sir William Dawson at the British Association meeting, in the course of a discussion on his paper, "Arctic Geology compared with that of Canada," will surprise many. It was to the effect that "the colonists in Greenland kept fuchsias and roses and geraniums in their houses during the winter, and were extremely successful in cultivating them."

USEFUL AND SCIENTIFIC NOTES.

King's College, London, Evening Classes.—The evening classes at this college form an important branch of the teaching work carried on, and we note that the Workshop classes commence on the 28th inst. Prof. Huntington will deliver a course of lectures on "The Properties of Metals and Alloys, and their Uses in the Arts," commencing on Oct. 4th, and Mr. W. G. McMillan will deliver a course on "Fuels, their Uses and Economy." There is also a class of Practical Metallurgy held on Friday evenings in the metallurgical laboratories.

University College, London, Engineering Department.—The examination for the Gilchrist (entrance) Engineering Scholarship of £35 per annum is to be held on the 28th and 29th inst. Candidates must be under nineteen, and the subjects of examination are:—I. Mathematics; II., any two or more of the following: (*a*) mechanics; (*b*) mechanical drawing; (*c*) examination on some subject connected with engineering; (*d*) French or German; (*e*) the use of tools. The examination is intended to be of such a standard as can be passed by lads from school who have begun to acquire some knowledge of mechanical pursuits. The appliances of the engineering laboratory—under Prof. Alex. B. W. Kennedy—have been very much extended during the past year, mainly through a grant from the Gilchrist trustees, and are now very complete in the direction both of experiments in elasticity and the strength of materials, and in the economic work of engines and boilers. Laboratory work is so arranged that students go through a systematic course of experiments in these and other connected subjects during the session.

IN the spring of 1887 an exhibition of records and objects illustrating the history of the Jews in England will be held in the Royal Albert Hall, South Kensington. A large number of valuable and interesting objects have already been promised by public bodies and private individuals. An influential and representative committee of an undenominational character has been formed.

PRINCE PUTIATIN has presented to the Russian Archæological Society a stone slab which was recently found in the course of some excavations at the Boulogne Station on the St. Petersburg and Moscow Railway, along with some stone weapons and utensils. A representation of the constellation of the Great Bear was, although rudely, carefully drawn on the slab. It may be remembered that some years ago a similar slab was found near Weimar.

Aluminium.—Senet has devised a new process for obtaining aluminium, as well as copper, silver, &c., by electrolysis. He exposes a saturated solution of sulphate of alumina, separated from a solution of chloride of sodium by a porous vessel, to a current of six or seven volts and four ampères. The double chloride of aluminium and sodium is decomposed, and the aluminium is deposited upon the negative electrode.

Gold Bronze.—Gold bronze may be prepared in the following manner: Melt two parts of pure tin in a crucible and add to it, under constant stirring, one part of metallic mercury, previously heated in an iron spoon until it begins to emit fumes. When cold the alloy is rubbed to powder, mixed with part each of chloride of ammonium and sublimed sulphur, and the whole inclosed in a flask or retort which is embedded in a sand bath. Heat is now applied until the sand has become red hot, and this is maintained until it is certain that vapours are no longer evolved. The vessel is then removed from the hot sand and allowed to cool. The lower part of the vessel contains the gold bronze as a shining, gold-coloured mass. In the upper part of the flask or retort chloride of ammonium and cinnabar will be found.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE MAPS OF THE ORDNANCE SURVEY—COMITES TO VEGA—THE PSYCHOLOGY OF DREAMS—EYEPIECES FOR A 3¼in. TELESCOPE—δ CYGNI, &c.—FROGS.

[26279.]—ON a previous occasion I have commented in these columns on the shortcomings of the maps of the Ordnance Survey. Within the last seven days I have added to my previous unpleasant experience in this matter. I wanted the map of Weymouth and Portland, and wrote for sheet 342, which appears in the index map of the new 1in. survey. The answer came that it was "not yet published." Hence I had no option but to order Section 17 of the old survey, which has just reached me. As a single example of the shameful way in which the duty of keeping these maps up to date is neglected, it may suffice to say that *the Convict Prison at Portland, built in 1849, is not even marked upon it at all.* I say quite unhesitatingly that this is a simple disgrace to this country. I wonder what a German staff-officer would say were he supplied with so worthless a map of any country he had to operate in? The fact is that the Ordnance Survey is one of those Departments which is managed on the most parsimonious principles; and while any Brompton quack has no difficulty in getting State aid to advertise himself, this most important national work is starved to keep down the estimates. But, granting this, the authorities at Southampton are most culpable in issuing in September, 1886, a map in which a huge pile of Government buildings erected 37 years ago, is not indicated in any way whatever. I could point to half a dozen similar gross omissions in the map before me.

In the penultimate line of letter 26218 (p. 36), "⅝in. objectives" should be 1⅝in. objectives.

Writing these lines more than 110 miles as the crow flies from my own observatory, I am quite unable at present to accede to the request preferred by Mr. Sadler (letter 26219, p. 36), that I should examine the field near Vega. Upon my return home, however, I will take the earliest opportunity of doing so.

"Crumby" (letter 26231, p. 38) must not imagine that I advanced my own experience of dreaming that I was dreaming—and satisfying myself (quite erroneously) by a legitimate train of reasoning that I was *not*—as "curious," in the sense of being unique or peculiar to myself. I suggested this odd experience as throwing more or less doubt upon the operations of the mind in ratiocination of any description.

"A. R. B." (query 60360, p. 46) had better get a power of 25 to 30 for comets, nebulæ, and clusters. One of 150 for lunar and planetary detail, and two others of 200 and 250 respectively for stellar observation. These should all be of the Huyghenian form. Nothing is equal to it for all-round astronomical work.

Far away from books, I cannot at this present writing give any reply worth reading to query 60369 (p. 46); but 0·8" is certainly a ridiculous distance to be ascribed to the components of δ Cygni. Is this a misprint for 1·8"? May I once more reiterate that δ Cygni is emphatically a star to be observed in twilight; the brighter the better. On my return to more civilised regions I will endeavour to supply Mr. Atkinson with definite answers to as many of his questions as I can.

"Kensington" (query 60440, p. 74) should keep his frogs in a glazed vivarium, with a pan of water and some moss in it. They are fed on live flies and worms. I have kept them thus for years.

A Fellow of the Royal Astronomical Society.

LIVERPOOL ASTRONOMICAL SOCIETY—CIRCULAR No. 9.

[26280.]—GORE'S Nova (1885) Orionis was observed here last night (Sept. 14th), and found to have a magnitude of 9·2. The star is very red. The small *comes f.* was estimated as of 9·7 magnitude.

T. E. Espin.
Observer to the Society.

Wolsingham, Darlington, Sept. 15.

ON FLATS FOR REFLECTORS.

[26281.]—IN all the correspondence in "E. M." upon flats, &c., I do not remember anything being said of any means of using a flat otherwise too small in a way to obtain the light from the whole of large mirror. In the ordinary way a 9in. mirror requires a flat 1⅝in. for sun and moon, and not less than 1⅛in. for stars; but by using a Barlow lens in draw tube the flat may be moved another 4in. away from mirror, and then a flat ⅞in. minor axis is large enough for a star, and 1¼in. is abundant for sun and moon. This hint may be useful to some whose flats are small; and in another way, where a flat is provided only large enough for stars, by the use of a Barlow it can be made to be large enough for sun, &c. I do not recommend this, because the gain in light will be much less than will be lost at the surfaces of the Barlow lens; but a reduction in the brilliancy of diffraction rings would follow. Of course, it would be best to use a special Barlow of such focus as to allow the flat to be moved to an extreme distance from large mirror, and thus reduce it to the very smallest size possible.

Edwin Holmes.

THE ADVANTAGE OF STEAM DOMES.

[26282.]—I THINK that "J. T. M." is mistaken when he asserts that the use of a dome upon a boiler is to increase the area for containing steam. Surely the object of using a dome is to prevent priming by raising the mouth of the steam-pipe to a greater distance from the surface of the water, and thus, aided by the large diameter of the dome, as compared to that of the pipe, the sucking action, so to speak, is done away with.

A., Liverpool.

CONCERNING CHAMBER ORGANS, HARMONIUM PLAYING, AND HOME STUDIES.

[26283.]—MAY I express the great pleasure with which, in company with I am sure all musical readers of the ENGLISH MECHANIC, I have perused Mr. Audsley's "Notes on the Chamber Organ"? They are of the deepest interest to me. I thank him also for his kindly reply (p. 530) to my queries upon the subject of "Home Music." With reference to that letter, the juvenile portion of my family varies from about ten years to some ten days. I am now only anxious to be prepared for each child taking up some instrument in addition to the piano as early as may be. Of course I intend that the piano and Mustel shall accompany the other instruments.

I read with much interest, too, Mr. Audsley's programme of one of his musical evenings. It is upon an ambitious scale indeed. The only observation occurring to me upon it is that one rather regrets to see in it so much of the "music of the future," and which is to me simply drifting back to chaos. If Wagner's music and the music of others whose names appear in that programme is to be the music of the future, all I can say is I am sorry for the future.

I venture to subjoin a programme of a musical evening at my own house, and which I hope may not be unacceptable as showing what may be done by very unambitious amateurs simply with piano, harmonium, and flute.

"Brave musicians for the night,
Watch that time and tune go right."

1. Andante from Symphony in C minor. Beethoven.
Trio for Piano, Mustel Organ, and Flute.
2. ... ... Sonata No. 7. ... ... Haydn.
Piano Solo.
3. ... ... Marche Hongroise ... Schubert.
Duet—Piano and Mustel Organ.
4. Sonata No. 1 (Scherzo, Trio, Rondo). Schubert.
Piano Solo.
5. ... Sonata in F (first movement). Beethoven.
Piano Solo.
6. ... "Miserere and Ah che la Morte" ... Verdi.
(From "Il Trovatore.")
Duet—Piano and Mustel Organ.
7. ... "Auf Flugeln des Gesanges." Mendelssohn.
Song.
8. ... Adagio from Scotch Symphony. Mendelssohn.
Trio—Piano, Mustel Organ, and Flute.

Though a very insignificant-looking programme in comparison with that of our friend, I fancy it would be found to have been quite as satisfactory in the hearing, so far as the list of pieces is concerned, as that given by our friend. We make it a point to head our programmes with a musical poetical quotation, generally from Shakespeare. This serves the useful purpose of testing the Shakespearian and other poetical lore of the company. It is simply marvellous the number of passages admirably suited for the purpose which are to be found scattered throughout Shakespeare.

And now with regard to Mr. Audsley's comparison of the Chamber Pipe Organ with the Mustel. He must have struck sorrow, I think, into the hearts of those of your readers who, either like myself, are possessed of a purse of limited capacity or are bent on possessing a Pipe Organ of their own manufacture. Personally I agree with what is implied by Mr. Audsley, that to have a decent Chamber Organ of any kind it must be made by an artist and one thoroughly skilled and at home in every point of his workmanship; and that in ninety-nine cases out of a hundred amateur-built instruments are fit for one purpose only—firewood. But Mr. Audsley has satisfied me more than ever that for strictly *home* purposes the Mustel Organ is, after all, the instrument.

The catalogue price of it is easily ascertained, and, as everybody, whether in or out of the music trade, knows, cash will buy them for less. And whilst an instrument of the kind Mr. Audsley properly enough advises in a Chamber Organ must cost at the least from £500 to £600 for the instrument alone, Mustel's one manual instrument with the double touch and metaphone can be had for literally a fraction of the money. Moreover, when the price of Mustel's instrument is paid it is done with; but the Chamber Organ, which our friend considers alone worth having, must have a room to itself, and which in very many houses would have to be built expressly for it, thus putting the total cost at a sum which would have to be represented by four figures. If I am incorrect in this, I should be very glad to be set right, for with most of us in these bad times price is a matter of terribly serious moment indeed. I trust that in his future papers Mr. Audsley will deal fully with the probable price, the space actually taken up by, and the size, shape, and kind of room best adapted for such an organ as alone he is prepared to recommend. In even a moderate sized drawing-room a Pipe Organ seems entirely out of place. I even make bold to say that the organ proper is fit only for a cathedral or other building where the 32ft. pedal notes have room to speak.

Mustel's instrument is as perfect in a small drawing-room as in a large concert room. Only last week a friend of considerable musical knowledge and skill, hearing Mustel's instrument for the first time in a small drawing-room, exclaimed, "Why there is as much music in it as in our church organ," alluding to a very complete instrument of three manuals, pedal organ, and some fifty speaking stops. I quite agreed with my friend. After all is said and done, even Mr. Audsley must be constrained to admit that even his pet organ is a soulless instrument devoid of all expression—and, pray, what is music without expression?

In answer to your correspondent, "A Lady Reader," I am sorry to say I do not know Elliott's "Tutor." No doubt, however, it is an elementary one. If, as she says, she has worked well through this, and if she has thoroughly carried out the suggestions I made in my first letter on harmonium playing, she could not do better than work through King Hall's "Harmonium Primer," and the scales and exercises in the "Pianoforte Primer" of Novello's series. She might also practise well playing hymn tunes, say those from "Hymns Ancient and Modern," taking care to play them as smoothly with regard both to fingering and blowing as possible, practising also playing the treble with one hand and the remaining parts with the other. She might also work through Elliott's "Harmonium Treasury," taking, of course, the easier pieces first. The fault, however, of this "Harmonium Treasury," as of almost all other cheap collections of harmonium music, is that they are made to sell, and so are supposed to be arranged indiscriminately for harmoniums without stops and for large instruments. Unfortunately, music so arranged is almost worthless to the true artist. Instead of it he will go to the original and make his own arrangements; but to do this he must possess a knowledge of thorough bass, and without that, I say again, good harmonium playing is impossible.

Matters musical have occupied a good deal of your space latterly, and many of us rejoice that it should be so; but there is one consideration that should be borne carefully in mind, and especially by those who may contemplate making music their special leisure study. The bane of music is that to become a proficient in it hour after hour *must* be spent simply in finger practice, exercise neither for brain nor body. The mind meanwhile is unoccupied and no food supplied for further use or reflection, a twofold loss indeed. What happens to an idle mind may be judged from the fate universally accorded to idle hands, save that the result will probably be worse tenfold. An hour spent intelligently with the telescope, or in the careful consideration of the most elementary facts of astronomical science, or, again, with the microscope, upon a gathering from almost any pond, ditch, canal, or rock pool, or upon a slice of the commonest diatoms,

or of Enoch's insect preparations, will yield more lasting advantage, will infinitely more enlarge the mind, than ten times the amount of labour spent in music. For after much consideration I say deliberately, and after much reflection, that I think music must be looked upon simply and solely as a recreation, and is in its proper place only when made use of as such and nothing more.

Country Solicitor.

ORIGINAL ELECTRIC EXPERIMENTS, No. 8.—ERRATA—TO "SIGMA."

[26284.]—ON page 61, in the tenth line, for "Bunsens" read "brushes"; also 21 lines from the end the term "minus" has been left out.

No. 9. Upon repeating the experiments described in No. 8, I find that the theory propounded there cannot be upheld, because on applying a knuckle to a charged jar there is evidently a comparatively small quantity of electricity which comes "off" to same. But I am certain that, in the arrangement described, no electricity is given from either disc to any of the four brushes. It may be of some use to state that I do not, so far, coat any part of the glass with shellac varnish, applying it solely to the bosses and the framing, having discovered that it gives good results if the air be damp, to rub all the glasswork with the ordinary paraffin oil of the lamp shops, applied moderately by means of a rag sprinkled therewith. I have also discovered "that by inserting a plain sheet of glass between the discs, and, say 2in. larger in diameter than said discs, the machine will be greatly improved"; also, having found some difficulty in getting a Wimshurst machine to start, possibly on account of not using shellac varnish upon the discs, I find it advantageous to cut a strip of cloth or drugget rather larger than one of the sectors, cover the same with lining paper, and paste it upon one of the discs. When dry, apply paste to a suitable piece of tinfoil (don't put the paste direct upon the paper, or it will probably render it baggy by reason of a second wetting), and this small rubber won't seriously increase the friction of turning the machine, but will cause it to go ahead in almost any state of the atmosphere without any apparent injury to the action of the machine. It may be as well to warn anyone from putting a knuckle near a charged jar whilst the other hand is holding the driving handle, as a circuit is formed through the bands, and a dangerous shock will result if a large charge be in the jar, as I painfully experienced.

In "Sigma's" work upon "Electricity" I find it laid down that "static electricity is understood to mean that produced by frictional means." Also, that static electricity is only to be found upon the external surfaces of bodies. Will he kindly explain how these statements are to be reconciled with the following experiments? If we take a sheet of ordinary window-glass, and fix it so as to overhang a table by means of a weight, then placing upon this, say, an ordinary thin glass drinking-goblet, suspend so as to dip into this goblet a small strip of tissue-paper attached to a silk thread;—now, if we rub underneath with a rubber composed of a piece of wood, a piece of cloth or drugget, a piece of paper to secure same to the wood, and tinfoil over the face of said paper, the slip of tissue will fly out of the glass, in order to communicate its charge to the nearest conductor. What is this, if not electricity, upon the inside? Again, if we coat the goblet inside and outside as a Leyden jar, we can obtain sparks just as well from both sides, and if we give a rub then, whilst maintaining contact with the glass and rubber, we put a finger to either inside or outside, and then remove it, upon breaking connection between the rubber and the glass we get an increased spark, similar to an electrophorus, and, still more curious, we cannot apparently charge this glass similar to a Leyden jar, as the electricity seems to be the same inside and outside. Also I may mention that I find that if any part of a piece of glass be rubbed, the whole of it is electrified simultaneously. It also appears that the electricity produced by a metallic rubber is of the same nature upon both sides of the glass, and that wherever we move the rubber to, that already produced wants more especially to place itself opposite to said rubber, as may be noticed by placing pieces of foil near each other upon said glass. I omitted to mention that if a long glass tube be excited by the aforesaid rubber, or a dry hand, it can be proved that electricity is produced upon all parts of its inside.

A., Liverpool.

NEW TRANSMITTING TELEPHONE.

[26285.]—IN a recent issue of "Ours" (No. 1115) there is a short description of Turnbull's telephone transmitter. This instrument puts me in mind of another transmitter which has not been described in any of the scientific journals, but which, nevertheless, is a very remarkable instrument, and as it possesses some really novel features, and is of home manufacture, a short sketch of its principal

FIG. 1.

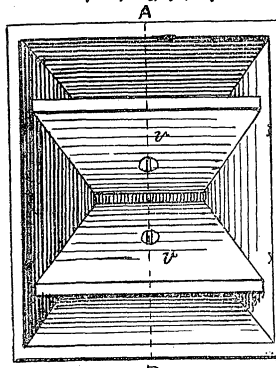


FIG. 3.

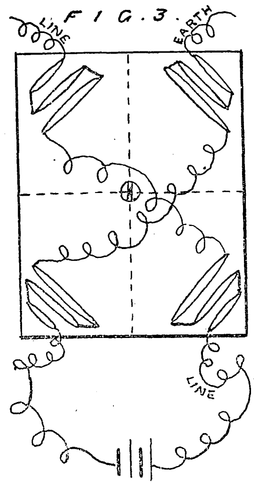
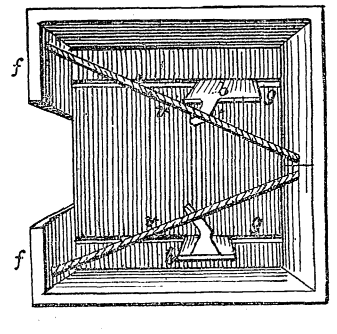


FIG. 2.



parts will no doubt be of interest to telephonists. Usually carbon transmitters have but one vibrator or diaphragm to which the carbon electrodes are attached. In one form of the instrument I am now about to describe there are two vibrators. These are placed at an angle or inclination to each other in such manner that the sound-waves pass along between them towards the vortex of the angle. By this means the sound-waves produce a maximum effect on the vibrators; each wave is compressed as it travels along between the diaphragms. Looking at Fig. 1 through a tube, or with one eye closed, the method of fixing the vibrators *v v* in the oblong box A B is at once seen.

Another important point is that these vibrators are fixed or suspended at their centres only. Consequently there is greater freedom of vibration. A reference to Tyndall's work on "Sound," where he exhibits the vibration of plates, will at once make this manifest. The centre may be said to be the natural position for fixing a plate; it can the more readily adapt its vibrations to those of the sound which produces them. The result is a remarkable clearness and distinctness in the words transmitted. Fig. 2 is a section of Fig. 1 through the line A B; *g g* are grooves in the side of the box in which slide the bridges *b b* carrying the supports for the vibrators *v v*. The shutters *f f* are not shown in Fig. 1. This figure is also best viewed through a paper tube.

Again, each vibrator has two sets of separate and distinct carbon electrodes; one set can be connected up to the line wire, and the other to earth. Or if there be two lines, each line can have its own carbon electrode. Fig. 3 shows a vibrator with its carbon electrodes attached at the more strongly vibrating portions of the plate.

Another remarkable feature in the construction of this instrument is that the contacts are automatic. The bridges, carrying the vibrator supports, slide in and out in grooves, so that the vibrator and its electrode may be taken out and examined, and put back without interrupting the circuit, or without any screwing or unscrewing, or a new plate may be put in the place of the old one, all in less than a minute.

The instrument, when in use, may be placed on a desk or table, or hung up on the wall. When speaking, the head is erect.

With the Editor's permission I shall, in another letter, give some more particulars respecting this rather novel transmitter.

Vibrator.

EGYPTOLOGY.

[26286.]—MR. SMITH must decide what value he attaches to Biblical dates and generations before coming to definite conclusions. I only look on them as rough approximations or poetical statements made in an uncritical age and long after the facts occurred.

In estimating the probable number of years spent by the Israelites in Egypt, it is necessary to consider the number of Israelites alive at that time, as the more they were the longer they must have been in Egypt. The period during which they were in Egypt cannot be found by simply adding up the generations as given in the Bible, for the following reasons:—

1. The number of generations, including Abraham, from him to David, and inclusive, is 14 (Matthew i.); but as the time was about 1,000 years, the average age of each generation before the birth of the first born of each would be 71 years—an absurdly improbable supposition. If 30 years—that usually allowed—be right, 33 instead of 14 generations must be considered. Some will confidently assert that the difficulty is got over by saying that the average duration of life is to be taken; but this is clearly not so, as the average duration of life has nothing to do with the number of generations which existed. The natural inference is that the numbers are wrong, and that no sure calculations can be based on them.

2. There were four generations before the going into Egypt, four while in Egypt, and six from the leaving of Egypt till the time of David; but according to Kings vi., the time from the Exodus to the fourth year of Solomon's reign occupied 480 years, so each generation occupied a long time. Those who insist on relying on Biblical numbers are obliged to alter the words, and insist that no generation can be considered to begin till every one of the previous generation was 70—an evidently false assumption.

3. Other things show forth the imperfections of the statements respecting the generations. The case of Canaan will show what I mean. The name of Canaan occurs as the son of Arphaxad in Luke iii. and in the Septuagint; but in the Hebrew Old Testament the name is not given as related to Arphaxad, whose son and heir is stated to have been Sala (Genesis). In Luke it will be noticed that the name Canaan occurs twice—once as fourth from Adam, and again as fourth from Noah; the second Canaan is unknown to the Old Testament—that is, the Hebrew Bible.

4. As Exodus distinctly states that "Israel dwelt in Egypt 430 years," we cannot at the same time attach absolute importance to Exodus and yet prefer Josephus' statement that they were in it but 215 years. Josephus saw the difficulty, but what historical authority had he to change it?

5. As the Israelites were said to have 600,000 men when leaving Egypt, we must suppose the total number to have been 3,000,000, which number, to arise in four generations, or 215 years, is absurd when we remember that but 70 persons went into Egypt, also when we remember that the powerful oppressor killed as many male children of Moses' generation as he could; so the males must have been well under their proper average. The case is rendered still odder by the statement that the large Israelitish population had only two midwives.

6. The difficulty as regards Egyptian history is very great, as no records whatever appear to exist to show that the Israelites were ever there, and yet the driving out or departure of 3,000,000 out of a population of 10 or 12,000,000, must have been a very serious matter. Still more strange is it that a short time before the same number of fighting men, &c. (the Shepherd kings), were driven out after serious work—of which plenty of records remain. Later records speak of the revolt of slaves, &c.; but not a word has yet been found about Moses, his mighty works, the troubles he caused, or the departure of the Israelites.

My impression is that the Israelites were a small body left behind by the Shepherds, and that they finally rejoined their kinsmen in Palestine, and that their numbers and importance were so small that the incident has escaped being recorded. The Jewish traditions referred to the main body, who were not peaceful descendants of a patriarch, but a hord of warlike Nomads.

7. One more difficulty remains to be considered—that is, of language and religion. If a few people went into Egypt and their descendants remained there for 200 or 400 years, we cannot doubt but that they would adopt the language, and probably the religion, of the country; yet we can find scarce any connections in language, and the Hebrews march out as a separate nation, and Moses writes in pure Hebrew, similar to that in use about the time of David—a most extraordinary occurrence, especially as the Israelites appear to have worshipped the Bull (Phah) in the desert, which (as the Golden Calf) shows they must have done so in Egypt.

Also, Moses was reared up as an Egyptian, in all its learning, which he apparently forgot in large part. All the Egyptians believed in the immor-

tality of the soul, and we do not find that the Israelites did so till after the Babylonish captivity. These things throw great doubt on the narrative, and I fear Mr. Smith will not be able to make it square with historical fact.

Memnon.

A PSYCHOLOGICAL PROBLEM—WAR DEPARTMENT TELESCOPES—HILL OF TARA.

[26287.]—I THINK the difference of opinion between "H. W." (letter 26270, page 67) and myself is little more than a question of the meaning attached to words. I find frequently, in argument, that the arguers are in agreement really as to facts, but do not see that they are so, on account of each holding a different view of the meaning of some word of ordinary usuage. In answer to the question he puts, my definition of "reasoning faculty" is put into words for me far better than I could do it by Browning. In fact, my whole theory may be contained in one quotation which, perhaps, "H. W." may not know, and if he do not, I need no apology for giving him the pleasure of reading it:

"Divers persons witness in each man,
Three souls which make up one soul: first, to wit,
A soul of each and all the bodily parts,
Seated therein, which works, and is what Does,
And has the use of earth, and ends the man
Downward: but tending upward for advice,
Grows into, and again is grown into
By the next soul, which, seated in the brain,
Useth the first with its collected use,
And feeleth, thinketh, willeth—is what Knows:
Which, duly tending upward in its turn,
Grows into, and again is grown into
By the last soul, *that uses both the first*
Subsisting whether they assist or no,
And constituting man's self, is what Is—
And leans upon the former, makes it play,
As that played off the first: and, tending up,
Holds, is upheld by God, and ends the man
Upward in that dread point of intercourse,
Nor needs a place, for it returns to Him."

The italics are mine. I call the second of these souls the "reasoning faculty," and the third the "will." I hope I have now made my case clear. But I own that I do not flatter myself on my power of metaphysical argument, and am not at all sure that it is not out of place in the practical pages of the "E. M.," so that I do not propose to trespass further on the patience of the Editor in this direction at present.

I cannot explain the phenomena of dreaming, nor do I believe that anyone else can. I tried to study it a little in one case where I was mesmerising a lady daily for neuralgia, and I directed her, when in the mesmeric sleep or trance, to dream of certain subjects in her natural sleep the same night. She always did so, without the least idea that the dream had been suggested in any way. But the amplification of the given subject, in the dream, was very remarkable, and often very beautiful. I have no doubt that in this way it would be possible to arrive at the true explanation of dreams, but I shall probably never pursue the subject further myself, for various reasons; not the least of which is, that I have long ago come to the conclusion that frequent mesmerism has a strong effect in altering the character of the patient, and, to quote Browning again,

"It's a dangerous thing to play with souls."

I cannot promise "H. W." to continue this discussion any further. I have not time to spare at present for metaphysics.

In answer to "Prismatique" (letter 26266, p. 66), I cannot say whether the *lenses* of the W. D. telescopes are English, but the mounting is undoubtedly of home manufacture.

I am much obliged to Mr. J. E. Gore for his trouble in ascertaining the facts about the excavations in the Hill of Tara (answers to query 59995).

Garrison Gunner.

FREE-WILL (?)—LOCOMOTIVES.

[26288.]—THE arguments by which, in letter 26230, page 38, "Garrison Gunner" seeks to establish the superiority of the will over the imagination and the reason are decidedly faulty, especially considering that reason and imagination have to do with the will only in so far as they are concerned in supplying motives of action, to the strongest of which the will submits. In the case cited by "Garrison Gunner," he has entirely omitted a very important factor—namely, that were he working a battery he would be subject to the orders of his officers; and that disobedience, more especially when caused by cowardice in action, would result in very disagreeable consequences to himself. Further, the idea of being considered a coward is in itself exceedingly unpleasant to the majority of Englishmen. Under the circumstances mentioned, there would be the danger of being hit by a bullet, or torn to pieces by a shell, producing most unquestionably a motive to run away; but, on the other side, there would be the dislike of being thought cowardly, and the knowledge that a display of cowardice before an enemy would be punished severely. In ninety-nine men out of every hundred, either of the last two considerations would produce a much stronger motive than the first; and hence they would stay at the guns. The hundredth man, being so constituted that the fear of being hit was the strongest motive, would of course run away; and probably be shot by one of his own officers for doing so. In reasoning like this I have, of course, taken it as axiomatic that a man always acts in obedience to his strongest motive, and I am quite prepared to find that some of our readers, perhaps "Garrison Gunner" himself, will question this statement. It is easy enough to quote cases in which, at first glance, persons seem to have acted in opposition to the strongest motive; but if these cases are critically and calmly analysed, it will be seen that in truth the strongest motive has been obeyed. Of course one man will often be very differently acted on from another by precisely the same set of conditions. A motive which under given conditions would be strongest for one man may possibly not exist in another. Initial constitution and life training come into play here. The action of a man at any instant is really a function of three things—two constant, and one variable. First, his initial constitution, by which I mean all the tendencies, tastes, and passions involved in the mechanism of the nerve centres in his brain; second, the training he has had, using the term to mean everything which has occurred to him up to date; third, his environment at the instant. Thus we may write $A = \psi$ (C. T. E.) Free-will is a term we use to express the fact that we cannot in any one case completely solve this question.

I am very glad that "M. R." (letter 26242, page 40) has come to my help in endeavouring to obtain practical data concerning express runs; and I hope in future our railway correspondents will give the requisite details. If an account of a run does not include coal burnt, and water evaporated, it loses much of its value, and unless the leading dimensions of the engine and the weight of the train are given it is of no value at all. To make a start I will ask for particulars of the run of the 10 a.m. express from London to Grantham.

Wm. John Grey, F.C.S.,
Analytical Chemist, Newcastle-on-Tyne.

LOCOMOTIVES, &c.

[26289.]—I AM glad to see that "P." points out some additional instances of misleading advertisements issued by our railway companies. I would have given those he mentions myself had I known of them, and consider it a lack of common honesty on the part of our companies to state deliberately what they know is not true. I agree with "P." in thinking that "Q." must have made a mistake in timing the marvellous run which he mentions, and should very much like to see full details. The G.W.R. engine No. 10 has cyl. 18in. by 26in. and 150lb. of steam, and is engaged on the South Wales trains.

"M. R." grumbles about not having the figures we want, and asks for tractive force, coal and water consumption, load, gradients, and average speed. Surely it is not necessary to fill the "E. M." with any such a catalogue.

The dimensions of our leading express engines are given *ad nauseam* in the inquiry columns, the coal consumption of each type is known pretty accurately by all who take the trouble to read the different engineering papers, the load is nearly always given when a run is mentioned, the gradients of our main lines are widely known, and Foxwell will give more information on the subject in five minutes than the MECHANIC can in as many weeks, and the average speed can be found by a glance at "Bradshaw." Add to which that probably 90 per cent. of those interested in the subject are already in full possession of required details, and I think "M. R." will agree with me that further repetition would be waste of space.

Mr. Scourfield asks if there are any inclines on the Brighton line as long or as stiff as that between Low Gill and Oxenholme. The fish train under discussion would have to *descend* this, so I cannot say I see much gained by reference to it. Owing, I suppose, to good arrangements, express trains are very seldom blocked at Oxenholme, Carnforth, or Lancaster, and never slacken speed appreciably in passing these places. "Kappa" adds this week that the fish train referred to reaches London in 7 hours 9 minutes after leaving Carlisle. Now, the N.W. Scotch expresses take 7 hours and 22 minutes between London and Carlisle; hence, I conclude, "it is better to be a dead mackerel on the N.W. than it is to be a first-class passenger by one of that company's most important trains." However, I agree with "Kappa"—the Brighton trains look slow on paper, even if the actual running is good.

What is to be done with the Midland 1669 set? The locomotive people seem almost in despair about them. There is some talk of lining up the cylinders; others say they are to be converted into single engines, whilst the only thing certain seems to be that they are no good as they are.

South-country readers may be interested to know that the G.S.W. have turned out four new express engines—leading bogie, $18\frac{1}{4}$ by 26 cylinders, 150lb. of steam, 6ft. 9in. four-coupled wheels. These, I am surprised to see, are fitted with the ball-valve vacuum brake for the train, and steam brake for engine and tender, the Westinghouse being discarded. It is curious to see the G.S.W. portion of the Midland Scotch express worked throughout with the vacuum whenever the Midland Company are content to use the Westinghouse on it. Are the N.B.R. to follow this example? On Friday the up Midland Scotch express left Carlisle 22 minutes late, owing to our old friend the N.B. train arriving at 1.24 instead of 1.3. Will "P." tell us what time it lost or gained before reaching St. Pancras? The N.W. up Scotch was more than an hour late at Rugby on Thursday evening (September 9th), but I cannot say where the time was lost.

"P." tells us of Harpy taking 21 coaches away from Euston. Can he say whether she ever arrived at Rugby on that occasion? This is pre-eminently *the* Compound for delightful surprises. I know no other in the southern division so erratic in her performances, so varied in her failures. Perhaps by now her injectors are beginning to put off the playfulness of youth, and to allow the engine to occasionally keep time.

The London Compound drivers seem particularly to dislike the 1.30 p.m. from Euston, and very rarely bring it into Rugby to time—that is, to the minute. What would they say to the 12 o'clock or the 4 o'clock down? And yet the 2.45 p.m., a very similar train to the 1.30, does not seem to trouble them much. How is it? **W. D. Thompson.**

[26290.]—I QUITE agree with "M. R." (letter 26242, p. 40) in his remarks. It may be interesting to know something concerning the speed of different trains, and it appears to me to be the principal thing under discussion, with occasionally a few dimensions of the locomotive. The compound system has been introduced, but only touched upon. To make this subject thoroughly interesting we want to know something about the coal consumption, &c. Because a train does not keep good time, I fail to see why the cause should always be put down to engine, which has to overcome such variable resistances. The compound type does not appear to be favoured by a number of correspondents, but I have not seen any argument conclusive why they are not as good as the ordinary type.

I have seen several times a compound running one of the Manchester and London fast trains. Now, as a practical question, can anyone give the amount of coal consumption of the compound against the consumption of an ordinary locomotive? Take the Manchester and London service, number of runs, and average weight of coaches.

Engineering, Manchester.

[26291.]—IT does not appear to be generally known that a four-cylinder tandem compound is working on the North British. I believe it takes expresses between Glasgow and Edinburgh. Its number is 224, and it is the engine which was in the Tay Bridge disaster. I should be glad to be furnished with the dimensions of this engine, and to learn some particulars of its working. I understand it burns as much coal as the non-compound engines.

In reply to "J. T. M.," I do not deny that it may be possible for a light engine to attain 90 miles an hour; but I attach very little importance to statements about railway speed which are merely vouched for by daily newspapers. As "J. T. M." thinks 90 miles an hour is so feasible that there cannot be any "beings conversant with railway work who would doubt it," I am surprised at his asking a question which compels me to think he cannot be conversant with railway work—*i.e.*, "can any of your readers supply authentic records of a train having been taken 60 miles in one hour." I should say that this is done on the G. N. R. every day; of course, I do not mean from start to stop, but that 60 consecutive miles are cleared at full speed in 60 minutes. I will publish shortly some particulars of a run I made on Tuesday from Manchester to King's-cross, in which G. N. R. "773" cleared 60 miles in $60\frac{3}{4}$ minutes, including the usual slack to 10 miles past Peterboro'. Mr. Rous Marten quotes three instances of 62 miles in an hour in the "E. M." of 25th Sept., 1885, p. 81. The up "Dutchman" has frequently done the 77 miles from Swindon to Paddington in as many minutes, one such instance at least having occurred within the last three or four months.

As regards steam domes, I fear that if the

"world" does not care about "the speeds of rival trains, or the performance of rival brakes," the "world" will evince scarcely greater interest in the steam dome question "J. T. M." wishes to start. I find on the G. N. the drivers would nearly all prefer domes, on the ground of the greater purity of the steam supplied to the cylinders, and the extra room for water in the boiler. I should think the absence of domes must be an advantage where the signals are placed on the wrong side, as giving the driver a much clearer view of the line.

May I give a hint to those correspondents who now and then send details of express runs? Let every train be timed from the absolute start to the absolutely dead stop. At King's-cross, for instance, the trains enter the platform at a very low speed, and continue to glide along it for half a minute or more before absolutely stopping. Passengers can, and often do, jump out; but, nevertheless, I say the time should be taken at the moment of dead stop, rather than at the time when it is practicable to jump out safely. The same observations apply to starting, and it is impossible to fairly compare trains except in this way.

I made the following capital run on Sept. 1, No. 503 (7ft. 6in. single) and five coaches:—

M.	Ch.		h.	m.	s.	Speed.
		Manchester	3	0	0	—
4	0	mile post	3	5	40	—
19	0	"	0	20	34	60·04
30	0	"	3	32	18	56·25
33	57	Liverpool	3	38	18	—

To Liverpool *viâ* Warrington is 28 chains more, and Warrington is 15 miles 55 chains from Manchester—not 16, as given in Mr. Foxwell's book. The 16 mile post stands on the bridge just west of Warrington Station, but the miles are not numbered from Central Station, Manchester, but from one of the other Manchester stations, I am not sure which. ? London-road. **Kappa.**

MIDLAND LOCOMOTIVES.

[26292.]—VERY much has been said about what these engines can and cannot do; but I have seen no mention of *one* engine lately with the 12 midnight express leaving St. Pancras with 25 coaches, then picking up three more at Kentish Town and going on to Bedford with 28, then took a pilot and went on again, and the few minutes lost was made up and the train ran into Liverpool to time. There was no pilot engine at St. Pancras or Kentish Town, so the one engine had to come and do its best. The result is pilots are to be kept at these places, and every train on the Midland with over 20 vehicles is to be divided and worked as two trains. **Anti-Vac.**

COMPOUND LOCOMOTIVES.

[26293.]—I AM much obliged to Sir Owen Scourfield in letter 26243 for giving the M.R. mileage viâ the Stoke Works loop. The run was undoubtedly a very fine specimen of Midland loco. work.

In replying to "P.," I can assure him that I was in "sober earnest" when I made the statement *re* the L. and N.W. Dreadnoughts that he refers to; and I do not think that this statement will appear so unreasonable as "P." seems to think it, if I may be allowed to offer some explanation.

With regard to "P.'s" remarks *re* bank engines, I may say that I have seen compounds leave Euston hundreds of times, and never to my recollection have I seen one leave without being "banked," unless a pilot was taken. Hence, the instance he mentions must, I think, be taken as an exception and not the rule. I would also remind him that this bank is the chief rise between Euston and Tring. After Willesden, the road is quite easy, rising gradually 1 in 400 all the way, except for a slight fall at Watford. On the other hand, the Midland road to Seagrave undulates considerably, and, to my mind, is incomparably harder than the N.W. The heavy express traffic of the North-Western Railway is now by Precedents and Dreadnoughts almost entirely. The only main-line trains worked by the compounds are the Irish Mails, work which is by no means exacting. It has, I think, been proved beyond all doubt that these engines were quite unable to perform the heavy work of the Precedents. It was quite certain that with a heavy fast train they *could not* keep time. They are now, I understand, working the Crewe local traffic with loads of 12-14 on an average consumption of 30lb. per mile, work which Mr. Stroudley's D class of bank engine would do on 20-24lb. per mile. I consider the compounds an admirable example of the fallacy of Mr. Webb's system. I contend that if the "system" was correct, the compounds ought to keep time easily with any train that the Precedent can, seeing that the compound has a tractive force of 104 (nearly) against the Precedent's 88, and at the same time have 10lb. of steam extra. But to return to the Dreadnoughts. They are doing very similar work to the Precedents. The former take heavier loads no doubt, but I consider that this is nearly counterbalanced by the higher speed at which the Precedents work. Now let us compare the dimensions of the two engines; I tabulate them for convenience:—

	Precedent.	Dreadnought.
Cylinders	17 × 24	$22\frac{1}{8}$ × 24
Heating surface.	1,083 sq. ft.	1,400 sq. ft.
Grate area.........	17 "	$20\frac{1}{2}$ "
Weight in tons...	33	$42\frac{1}{2}$
Tractive force ...	88	154
Boiler pressure	140	175

REMARKS.—As I have pointed out before, the Dreadnoughts have cylinder area equal to two $22\frac{1}{8}$in. ordinary cylinders.

A glance at this table is quite sufficient to show that the Dreadnoughts are (or perhaps I may be safer in saying should be) the most powerful express engines in Great Britain, while the Precedents are correspondingly just as small. Now, I argue that if a Precedent can keep time with nineteen coaches on some of the fastest N.W. trains, such as the 8.30 p.m. up—and they *can* do this, for I have seen them do it—such a load is but a trifle for engines of quite double the power. But the force of my argument is, I think, still more clearly shown when we turn to the all-important question of economy. I have been informed that a Precedent costs about £1,800 to build, a Dreadnought £3,000. Whether this is correct or not I am not in a position to say, but if any competent judge takes the trouble to compare the two engines, he cannot help being struck by the greatly increased cost of construction that exists in the case of the Dreadnought. The Precedents, however, are wonderfully simple engines. I feel quite certain that the difference in cost must be somewhere about the ratio mentioned above. Now let us consider the working expenses. The Precedents burn about 34lb. per mile between London and Crewe, the Dreadnoughts 36—40lb.; but lately I have heard terrible stories from the North. Several Dreadnoughts are reported to have burnt 50lb. per mile, and one, 504 Thunderer, has managed to consume 64lb., an achievement that only a Dreadnought can boast of. Surely this must convince "P." that my statement is not so very unreasonable after all, and I hope may act on him as a piece of digestive candy. The consumption of oil and grease, too, is equally amazing. As regards repairs, the Dreadnoughts are very bad, the enormous pressure being very trying to the packing-piston rings, valve faces, &c. While referring to the working expenses, I may mention that for some time a Dreadnought (Argus) and a Precedent (Courier) worked in turn the 8.50 p.m. from Euston in order to test the economy of the two engines. The trial, I believe, ended slightly in favour of the compound; but we may be quite sure that the economy must have been very small, as Mr. Webb has no objection to blowing his own trumpet. Compare the Dreadnoughts with Mr. Sterling's magnificent engines, that do on the road everything they undertake to do on paper. The G.N. 5.30 and 5.45 p.m. down and the 5.45 p.m. up are trains much harder than any N.W. to work, and yet they are worked to time and economically too by the 8fts.; but I feel certain I have said quite enough to substantiate my argument, which is this: It is far from being good work when engines of such dimensions and boiler power as the Dreadnoughts burn 36—40lb. per mile on such a good road as the southern section of the N.W., with loads which an engine of half the power and 9 tons lighter, costing far less to build and maintain, takes, with greater economy in fuel and oil, and keeps equally as good, if not better, time. I consider the Precedents very good engines for their size, but think they are too small and light to work the heavy leads imposed upon them with economy. "Kappa's" suggestion as to the disposal of the compounds to the "Celestials" is good enough; but I am inclined to think there is a still warmer climate than China which would be even more suitable. **G. D. Seaton.**

MIDLAND ENGINES.

[26294.]—I BELIEVE that the Midland Loco. Superintendent temporarily converted two of his coupled engines into singles by removing the side rods. These are 1313 and 1309. The former ran between Leeds and Leicester, and the latter between Skipton and Carlisle. I believe they did, or are doing, well, though possibly the side rods may have been replaced for the heavy summer traffic. Of course, a coupled engine without side rods would not be as efficient as a regular single, so probably one of the old 30 class mentioned by "M. R." with a large boiler and 18in. by 26in. cylinders would do far better than 1309 and 1313.

I wonder why, instead of trying two engines of the same type, Mr. Johnson did not try one of the 1309 and one of the 800 types. I was told as far back as 1883, at Derby, that they thought they should eventually return to the outside frames, and at Swindon they have done so, the last new goods engines (2361—2380) and the compound No. 7 having outside bearings, and a batch of 7ft. coupled express engines for the South Wales line are, I believe, to be on that principle.

I expect that much of the Midland unpunctuality is caused by the badness of many of the principal stations, which are much too small. The worst I know are Leicester and Nottingham. As for Gloucester, I do not call it a station at all, but a shed in a corner. Then they will send off long and important trains from St. Pancras within ten, and even five, minutes of each other from the same platform. This is bad enough in long stations like King's Cross, but St. Pancras is, I believe, nearly 200ft. shorter, and much room under the roof is wasted besides. I think that station might be very greatly improved if the booking-office were at the end of the platform instead of at the side. The short line along the wall might be carried to the end of the covered space, and then two long trains might load at the same time. The restaurant, &c., might be removed to the present booking-office, which is unnecessarily large, and might be made into a two-storied building.

Even in 1876 the arrival platforms at St. Pancras were too short for a very heavy train, for I came up from Glasgow at the end of September in that year by the night Pullman train, and several carriages were outside the covered portion, and trains are now much longer in proportion to their carrying powers than ten years ago.

The best-arranged station for the despatch of heavy trains at short intervals is Euston, because if two trains have to be loaded at the same time they are a good way from each other, and there is less chance of luggage getting mixed and confusion and delay ensuing; but then Euston is so very much larger than St. Pancras that a comparison of platforms is scarcely fair to the latter. Still, St. Pancras should either be rearranged or the trains started at longer intervals.

O. H. P. Scourfield.

LOSS OF LIFE AMONGST RAILWAY SHUNTERS.

[26295.]—SINCE my letter, p. 579 of last Vol. was written a further return has been issued.

The following comparative statement shows the number of railway servants killed or injured during shunting operations alone in each of the following years:—

	Killed.	Injured.
1877	167	1,175
1878	124	1,051
1879	99	1,047
1880	127	1,141
1881	125	1,339
1882	121	1,556
1883	130	1,449
1884	91	1,320
1885	138	1,236
	1,122	11,314

It will be observed that the number of men killed during the past year was the largest since 1878. That there should be 1,122 deaths and 11,314 persons injured in shunting only during nine years is a subject that cannot escape public attention.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.

Leicester, Sept. 17.

L. AND N.W. AND MIDLAND ENGINES.

[26296.]—I AM afraid there can be no hope of seeing Mr. Scourfield's (26243) suggestion as to building enlarged Precedents carried out just yet. In fact, we must wait till Mr. Webb finds out that his Compounds are a failure, and one wonders how soon this will be. There is no doubt in my mind as to the general excellence of the L. and N.W.; but it is really lamentable to see the way in which the company is throwing away money on these expensive and extravagant engines. That they have some good points is, however, proved, in that they can keep time with such fast trains as the 3.30 p.m. into Euston. As to punctuality, I am sure that in this respect the L. and N.W. stands far ahead of the Midland, and I can myself bear witness to the admirable punctuality of the service between London and Liverpool, as I often travel over this line.

I notice that the 11.5 a.m. express for London leaves Liverpool with a small Compound. Perhaps one of your correspondents can tell me whether this engine is taken off at Crewe or not; for south of Crewe the train is heavy and is timed fast.

I should like to see the particulars of the 80 minutes' run from Rugby to Willesden which "P." says the Precedent Avon made. **C. B.**

CONTINUOUS BRAKES.

[26297.]—I COMPLIMENT "Railwayman," page 40, 26241, upon putting this matter in such good form by his able questions. I take his questions just as he puts them, and add my answers. I don't wish to go into theory, but just give replies to what is asked, as below. **L. and Y.**

QUESTIONS.	REPLIES. So far as they relate to— The Westinghouse Automatic Air Brake.	The Vacuum Automatic Brake.
1.—Can the engine and tender (or both engines, when two are employed) and every vehicle in the train be fitted with the complete apparatus for each system?	Yes.	The engines are not provided with a reservoir; it is placed under the tender. Carriages and vans, Yes.
2.—In case of accident, or if the engine, tender, and every vehicle were uncoupled, would the brake act automatically?	Yes.	No, the engine having no store of power, the brake would not act automatically, and the breaking of the pipe leading to reservoir on tender would render the tender brake also useless. If the engines and tenders are fitted with so-called automatic steam brakes, the breaking of the pipe between the engine and tender renders the steam brakes useless. So far as relates to carriages and vans, Yes.
3.—If the brake on one carriage is out of order, can it be shut off without affecting the apparatus on the rest of the train?	Yes.	No, the pipe must be uncoupled in front of the defective vehicle, and the brakes on all those in the rear are then useless.
4.—Can vehicles be uncoupled for shunting purposes without trouble or delay?	Yes.	No, as soon as the pipes are uncoupled the brakes go on, and a man must walk down the train and open the release valves on every vehicle.
5.—In case of shunting vehicles when uncoupled from the engine, is the brake available either from the vans or automatically?	Yes.	No, there is no store of power available when detached from the engine.
6.—Is the brake instantaneous in action?	Yes, practically.	Quick, but not so quick as the Westinghouse.
7.—Can the brake be put on and taken off without trouble, especially upon long trains?	Yes.	There is often trouble and delay in getting the brake off, particularly upon long trains.
8.—Does the brake cause trouble by using steam from the boiler, and does it cause extra consumption of coal?	No.	The ejectors use very much steam; the extra coal used is quite two pounds a mile.
9.—Can trains be controlled when running down long inclines?	Yes.	Yes.
10.—Are there any parts in the brake which give trouble or require improvements?	Yes, the hose-pipes between the vehicles should be covered with some material to resist the action of the weather.	Yes, the engine should have its own store of power ready for automatic action, and the other defects above pointed out should be remedied or overcome.

MIXED TRAINS.

[26298.]—I HAVE read the letter of "Anti-Vac" (26237, p. 39) upon this subject with interest, and I think there can be no difference of opinion as to the necessity for mixed trains being discontinued.

With regard to the proper position for the passenger carriages to be placed in a train, very important points can be brought forward on either side; but I most certainly agree with the views of the Board of Trade and the Amalgamated Society of Railway Servants, that the balance of advantage shows in favour of placing the carriages next to the engine and in front of the waggons.

The carriages can then be fitted with continuous automatic brakes, and with a communication cord. The driver can without trouble stop the carriages at the platforms, which is a difficult matter when they are at the rear of a long coal train. Much greater fear is to be apprehended from the breakage of waggon axles, tires, and couplings, or from waggons leaving the line than from collisions.

It must also be remembered that the risk of collisions will be very greatly reduced by the use of the continuous brakes, and further, we must not lose sight of the fact that when the carriages are at the rear they are quite as liable to be run into by a following train. Quite recently a London and South Western mixed train became uncoupled near Crewkerne, and the two portions came into collision. The passenger carriage was at the rear, and six passengers and the guard were injured. That is one instance out of many in which, had the passengers been next the engine, they would have escaped all risk. **Clement E. Stretton.**

Consulting Engineer, Amalgamated Society of Railway Servants.

ENGLISH v. FOREIGN OPTICAL WORK.

[26299.]—THE recent letters on the making and selling of microscopes, as practised in England and on the Continent, have been most interesting, not only to those who have made a speciality of the microscope, but to many others having some general knowledge of optical matters. It might be profitable to extend the discussion to other optical apparatus, such as telescopes, opera-glasses, &c. Merely speaking as a buyer and user of such things, and not being in any way interested, save in procuring good instruments at reasonable prices, I cannot help expressing the opinion that "Prismatique" has shown prejudice in his unqualified admiration of English and depreciation of foreign workmanship.

Unlike our friend, I *have* seen poor work turned out by our countrymen—work decidedly inferior to some which I have seen produced by mere amateurs. Moreover, I *know* that lenses turned out by even eminent makers are not always uniform in quality, though, out of consideration to the parties concerned, I refrain from mentioning names.

In my own experience I have found it necessary to subject every fresh glass to a rigorous testing before accepting it as perfect, no matter whose reputation was involved. Seeing that no maker's name is an infallible guarantee of perfection, is it surprising that when any chance glass comes in the way, and turns out good, it should be duly appreciated—whether made by native Briton, Yankee, or even the "industrious foreigner"? By the way, I don't quite know whether Americans come under the category of "foreigners" (though I *do* know they regard us as such); but, if so, they can hold their own easily enough.

I am not at all surprised that the first living observer and discoverer of double stars should unhesitatingly prefer the instruments made by a certain American firm to those obtainable elsewhere; and I venture to think there are *some* first-class makers to be found on the Continent, too, even in such disreputable places as Munich and Paris! As to the cheaper class of terrestrial telescopes and opera-glasses, what sort of a price should we pay for them if entirely dependent upon home production? Some of these foreign objectives are of fair quality, and will bear favourable comparison with English ones costing a much higher price; indeed, between a first-class expensive English lens and a picked foreign cheap one, the difference is often so very slight that most practised observers would consider it out of all proportion to their respective cost. I have seen much more difference between two first-class objectives from the same eminent maker, and this has taught me to distrust every new piece of optical work until it passes the ordeal of a careful testing. **W. S. Franks.**

EYEPIECES.

[26300.]—RECENTLY experimenting upon the aperture necessary to see the *comes* of Polaris, I had occasion to try a variety of eyepieces. The night was not a good one, the Milky Way being barely perceptible. With 2½in. aperture the *comes* was easy, with Steinheil solid, and with 100 also. With 2in. I could just see it with the solid 275. I happen to have a very poor single lens about 550 ±, and on substituting this found the *comes* so much plainer I reduced aperture to 1½in. The *comes* was now more easily seen than with solid and 2in. But I could not with any eyepiece see it at all. There is much light lost at the surfaces of eyepieces, and plainly in looking for faint objects single lenses are of most service. If every surface loses 5 per cent., then four surfaces approach nearly to 20 per cent. of the light. The solid e.p. does not lose much at the interior surfaces; but as they are nearly ½in. in length, all solid glass, much light is absorbed in their substance. Is there no possibility of producing a single lens eyepiece to give good definition on a larger field than usual, as, of course, ordinary bi-convexes give good definition only in the middle? I have seen a single lens eyepiece by Browning which gave good results, but edges were bad and field narrow. Cannot something in the form of a meniscus be managed, or, if not, with a single lens? Could not a cemented achromatic on the pattern of the French button micro. lenses be made? These are thin, and would practically only have the two outer surfaces, and avoid the excessive thickness of the Stenheil solids. Of course, even if cemented, a considerable loss must take place when light passes from one kind of glass to another. I am sure this subject is worth attention. **E. Holmes.**

LAUNCH ENGINES.

[26301.]—I OBSERVE there is a correspondence going on about launch engines—high-pressure, or, rather, non-condensing, v. compound. I have had a considerable amount of experience with them—in former times in the Navy, and of late years in small steam yachts and launches. In my opinion the non-condensing are an unmitigated nuisance. If the blast is any good, smuts are thrown about the decks, and I well know the pleasure, with a party of ladies on board, of seeing, on first starting the engines, a shower of dirty water thrown over everything. Again, if the boats are used in salt water, it is almost a necessity to carry fresh for the boiler feed, which, of course, limits the duration of the trip.

I do not know much about the small compound engine, but it at all events would obviate the above evils, and if it be economical in fuel so much the better. Some of your correspondents seem to think economy in a small engine does not matter. It should not be forgotten that the man with a small engine generally has only a small income; and if he steams about much it may amount to something considerable, especially if he happens to live, as I did a short time ago, where coal was 25s. per ton.

Can any correspondent tell me the name of a German technical paper on the lines of the ENGLISH MECHANIC dealing principally with mechanical work.

Stuttgart, Sept. 13th. **R. N.**

[26302.]—IN reference to "Ingeniero" (letter 26254, p. 63), I admit that there is more friction in the compound non-condensing engine than in the single high-press. type. If we take the small cylinder of the compound to have the same amount

of friction as the high-press. engine, can we not use some of the exhaust to overcome the friction in the large cylinder and the rest to do useful work? Take as an example a single cylinder high-pressure engine: diameter of cylinder, 5in. by 6in. stroke; steam pressure, 80lb.; revolutions, 200 per min.; cut-off, $\frac{1}{2}$ stroke; we shall have a mean pressure of 67·7lb. Now taking the resistance of atmosphere at 15lb., and that arising from the various parts of engine at 1lb. per square inch, and again $\frac{1}{7}$ of the effective pressure to overcome the friction of engine when loaded, we shall have a useful pressure in round numbers of $\frac{(68 - 16) \times 7}{8} = 44$lb. The engine will thus give out about 6 effective H.P.

Now taking the compound and so dividing the work that each cylinder shall do about the same amount of work, which will be 3 H.P. to be equal in power to the high-press. engine; to do this we shall require cylinders 4in. by $7\frac{1}{2}$in. diam.

The useful pressure in small cylinder will be the same as in the high-press. engine, as will also be the terminal pressure—viz., 40lb.; this amount is really lost in the high-press. engine. As the ratio of the cylinders is $3\frac{1}{2}$ to 1, the average pressure in the large cylinder will have to be about 20lb. to do the same amount of work and to overcome the resistances as the small cylinder. It is needless for me to remark that a double cylinder engine is much more handy than a single engine; but this is not all, as the high-press. engine uses $\cdot125 \times \cdot25 \times 2 \times 200 \times 60 = 762$ cubic feet of steam per hour; whereas the compound uses only $\cdot07 \times \cdot25 \times 2 \times 200 \times 60 = 420$ cubic feet per hour. It may be argued that the compound is much heavier than the single high-press. engine; it certainly will be a little, but not much, as the flywheel is not required. I do not agree with "Ingeniero" that there is no advantage derived from tandem compound engines. I am rather pressed for time just now to state my reasons, but will do so in a future letter.

Engineering, Manchester.

CANTERBURY CATHEDRAL ORGAN.

[26303.]—I DO not doubt but that many readers of the "E. M." will be glad to see an account of the organ erected as above, which has recently been opened—maker, Henry Willis. The organist will occupy a raised position in the second arch of the south aisle. The instrument is in the triforium just above, and there is electric communication between the claviers and the sound boards; the wind is supplied from bellows blown by four men in the old singing school. There are four prismatic combination pistons to each manual, and four composition pedals to pedal organ. In the following list of stops, those marked * are from the old instrument, whilst those in italics are as yet only prepared for.

GREAT.

Double open ...	16 feet	Twelfth	$2\frac{2}{3}$ feet
Large open ...	8 „	Fifteenth	2 „
*Small open ...	8 „	Piccolo	2 „
Stopped wood..	8 „	Mixture	IV. rnks
Clarabella	8 „	Trombone	16 feet
*Quint	$5\frac{1}{3}$ „	Cornopean	8 „
Principal	4 „	Clarion	4 „
Harm. Flute...	4 „		

SOLO.

Harm. Flute....	8 feet	Corno di Bass..	8 feet
Concert Flute..	4 „	Tuba	8 „
Orches. Oboe...	8 „	Tuba Clarion ..	4 „

SWELL.

Double open ...	16 feet	Mixture	III rnks
Open Diapason	8 „	Contra Fagotto	16 feet
Gedact	8 „	Trumpet	8 „
Salicional	8 „	Hautboy	8 „
Vox Angelica..	8 „	Vox Humana ..	8 „
Octave	4 „	Clarion	4 „
Flageolet	2 „		

CHOIR.

*Gedact	16 feet	FlautoTraverso	4 feet
*Open Diapason	8 „	Harm. Flute...	4 „
Viol di Gamba	8 „	Gemshorn	4 „
Gedact	8 „	Clarionet	8 „
Salicional	8 „		

PEDAL.

Double open ...	32 feet	*Octave*	8 feet
Open wood......	16 „	Flute	8 „
Open metal.......	16 „	*Mixture*	*IV. rnks*
Violone	16 „	Ophicleide ...	16 feet
Bourdon.........	16 „	*Clarion*	8 „

COUPLERS, &C.

Each man. to pedals. Swell to choir.
Each man. to Great. Swell Trem.
Swell in each octave.

	At present.		When complete.
Sounding stops...	47	......	53
Pipes	3,012	......	3,282

John T. Lawrence, B.A.

THE CASE HEAT CELL.

[26304.]—IF any readers of this paper have made experiments with this cell, I should like to know if their results agree with mine.

I recently made up a cell with carbon plates at the top and bottom, carbon rods being inserted into each to form the poles. The granular tin and chromic chloride were not tested for impurities. For comparison of E.M.F. I made up a Daniell cell, the E.M.F. of which I took to be 1·1 volt.

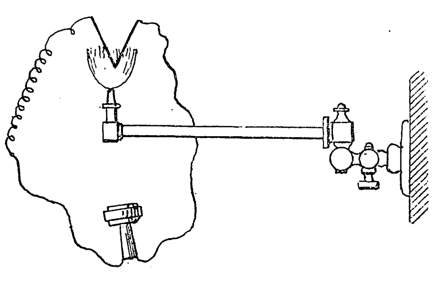
The following are the chief results worth mentioning I obtained from the heat cell. Average E.M.F. through 1,000 ohms resistance at a temperature a little below boiling point, 0·41 volt; average E.M.F. cold (60°), 0·12 volt; the internal resistance (hot) of my cell was about five ohms. On short circuit the current falls off rapidly, as if the cell became polarised, but I do not know the true cause. Impurities in the tin is the only explanation I can give for the E.M.F. being so high when cold.

Although this cell is undoubtedly a new departure as a practical means of converting heat into electricity by means of chemical action, I think other methods must be known. Water, for instance, may be decomposed by heat into oxygen and hydrogen, and the two made to furnish a current in a Grove gas battery, with the re-formation of water. **L. Miller.**

SENSITIVE FLAMES AND AIR WAVES.

[26305.]—I HAVE read with must interest in the ENGLISH MECHANIC of September 3rd your article upon "Sympathic Vibration of Jets of Air Impinging upon Gas Flames." If you deem the following of interest to your readers, you are at liberty to publish it.

Some two years ago I noticed, when conducting some experiments in my laboratory, the singular sensitiveness of a broad sheet of flame to very small air waves. I put together roughly some strips of brass and iron, so as to form a species of thermopile, thus:



This arrangement I suspended so that the broad flame from an ordinary fish-tail burner was in close proximity to it. A telephone was next inserted in the circuit, and I found that upon breathing upon the frame, or by interrupting it in any way, a very distinct sound was produced in the telephone. Speech was tried, whistling, and a variety of other effects depending upon or inducing vibration. In several instances the result was little inferior to that produced by an ordinary transmitter connected up in the usual manner. I did not follow up the experiment by making a thermopile consisting of a large number of couples; but I have little doubt that with properly-constructed apparatus a transmitter producing its own current could be made. So far as I was able to see, it was only needful to keep either the Bunsen or ordinary gas-jet at the predetermined distance from the ends of the thermopile which was found to give the loudest sound. This being done, the slightest vibration imparted to the flame was recorded distinctly.

Some of your readers may think this worth while experimenting upon. Lack of time prevented my doing so, and beyond mentioning the fact to one or two scientific friends, it has stood over.

F. M. Rogers.

HAS ENGLAND GONE UP HILL OR DOWN, &c.

[26306.]—BY an of error either myself or the compositor, in letter 26257, the amount of coal raised in 1850 and 1870 is stated as pound value instead of tons weight. **B. R.**

THE Northern Railroad of France has found by experiment that nickel can be rolled upon soft steel plates in such a manner as to produce a material for lamp reflectors of equal brilliancy with those made of silvered copper. These reflectors are reported also not to rust, and owing to the greater strength of the material, to be less easily knocked out of shape. The cost is only 55 per cent. of the cost of silvered copper reflectors.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[59842.]—**Space Filled with Spheres.**—For laying the floor of a box, evidently some mechanical guide is used. If square, a close row has to fit across each diagonal. If oblong, a thin diagonal lattice, whose laths are at least two-fifths as wide as their intervals, might be the best thing. There is an obvious reason for the square piling being mostly confined, as I said, to cannon balls, and for orange-sellers keeping the triangular base. The former needs a curb round the foot, but the latter none.—E. L. G.

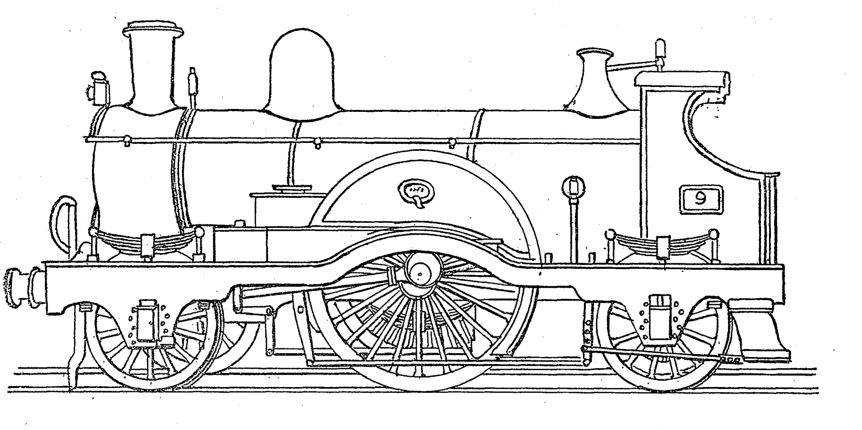
[59854.]—**Space Filled with Spheres.**—What "J. K. P." meant was plainly that the two kinds of pile he found to differ interiorly only in position as to the horizon. Tilting either of them through 54° 44′ makes its parts all correspond to those of the other. If he would see this very plainly, let him build half of a tetrahedron thus:—For the base, three rows of 5, 4, and 3; for a second layer, two of 4 and 3; and then a single ridge line of 3. This will make a solid of five plane faces, two half hexagons (on one of which it rests), two equilateral triangles, and a square. The last, he will see, is a chequer plane, though bisecting what would be a tetrahedron of five balls in each edge, and the same tetrahedron could have been bisected just the same in two other directions; so that it would contain three square chequer layers of nine, all intersecting in its sole inside ball. It has but one inclosed, though 34 superficial.—E. L. G.

[59854.]—**Space Filled with Spheres.**—"Does 'J. K. P.' really know what he wants?" Thus commences "G.'s" rather positive and slightly supercilious reply on p. 69, numbered 60050. Thanks, very much. "J. K. P." really does know what he did want, and is now quite satisfied. What he did want was to find out whether "G." was aware of the "fact" that the internal arrangement of a mass of spheres is the same, whether the building of the mass is commenced as in the base of a triangular pyramid, or as in a square one (see p. 42), and that this is the reason for the air spaces being of like capacity. "G." says it is not a fact at all, and tells me to buy some marbles. Hence I may conclude that he is not aware of the "fact" being a fact, which, however, it is. I have bought some marbles, and wonderful things they are, being nearly $1\frac{1}{4}$in. diameter, at $1\frac{1}{2}$d. per dozen; also I turned ten wooden ones of like size, and glued and nailed them up as a triangular, or "orange sellers'," pyramid, and have built them up in the inside of a square pyramid of the said marbles. Also I have taken a triangular pile, and by holding it in the right position, and removing some of the upper balls, have revealed the exact arrangement of the successive tiers of a square pile. As I said before, I do not concern myself with boxing them in. I had no sinister intention in calling "G." "Another G.," as I really believed he so signed himself, and am sorry for the oversight. The "original question" was 59854, and had nothing to do with the shot paradox, 60050.—J. K. P.

[59961.]—**Frosted Letters on Glass.**—TO W. MAIN.—I have tried the method described on page 42, "E.M.," Sept. 10th—viz., adding carbonate of ammonia to fluoric acid piece by piece, testing each time, till no more would dissolve, and the only effect it seems to have is to weaken the fluoric acid. If I allowed it to dry on the glass it would leave a matt surface; but that would wash off. Any further information would be thankfully received.—D. R.

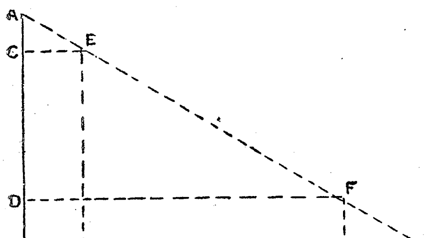
[60055.]—**House Boat.**—TO "PONTOON."—I suggested the boat cut in half on account of the less resistance I believe it offers to the water. It is the principle of the *Calais-Douvres*, now plying across the Channel, on behalf of which it was alleged by her designers that with two complete boats joined by a deck, the water was thrown off from the inner bow of each towards the centre, and being unable to readily escape, was heaped up and compressed between them so as to offer a considerable resistance as compared with the outside, which threw off the water into the open sea. I have not the exact formulæ by me for reckoning the displacement and buoyancy, as, though I have them somewhere, I cannot tell at the instant where to lay my hand on them, so will give you the figures next week.—E. CONRY.

[59762.]—**G.W. No. 9 Locomotive.**—I inclose sketch of the engine with outside eccentrics, but am only able to give a few dimensions. Driving-wheel, 7ft. 8in. diameter; leading and trailing-wheels, 4ft. 6in. diameter; cylinders, 18in. by 26in.; heating surface about 1,250 square feet; wheel-base, 18ft.; weight on drivers, 17 tons 5 cwt. The arrangement of outside eccentrics is not new on the



G.W.R., as I have heard of one of older singles being fitted in the same fashion about 15 years ago. —B.

[60058.] — **Fall of Potential.**— The fall of potential is simply the loss (or fall) of force along the circuit; it depends entirely on the resistance, and is the same no matter the length of the conductor. If you know the E.M.F. and the resistance of the various parts of your circuit, plot it out



thus:—Let A B be the E.M.F. in volts at the terminals of dynamo, and B G the resistance in ohms of the whole circuit (to the same scale), B I the R. of lead to lamps, I H, R. of lamps, H G, R. of return lead; count the number of volts between C and D and it will be the E.M.F. used in the lamps. A C + D B being that used in the leads I E, which equals B C, being the E.M.F. at the first lamp. If this is properly drawn to scale, you can see at a glance how your E.M.F. is used up, and also fall of potential in any part of the circuit. To find difference of potential at terminals of dynamo or lamp, connect voltmeter to terminals when full load is on.—I. LOW, Lenzie, N.B.

[60083.]—**Clematis.**—The following, clipped from the *Journal of Horticulture*, may be found useful to the querist:—These plants (C. Jackmani) can be increased by cuttings of nearly half-ripened wood in the spring of the year, if inserted in sandy soil, and placed until they are rooted under bell-glasses in a temperature of 50° to 55°. This, however, is not a certain method, and layering is never practised by the trade. The best, quickest, and safest method is to propagate them by means of grafting. Strong roots from any other kind must be procured during the winter, and kept moist in cocoanut fibre refuse, sand, or any similar material, until wood is ready for the scions in spring. Plants from which the wood is taken are generally wintered in cold frames, and brought forward in them by keeping the frames moderately close. The young wood should be used for scions, say, after it has attained 3ft. or 4ft. in length, and before it becomes half-ripened towards the base of the shoots. Each scion should be cut off just above a pair of eyes, and the wood between the joints left to each scion should be cut wedge-shape. The strong roots should be cut clean across the top, then split down the centre, and the scion fitted in between. The bark of the scion and the root must be fitted together on one side, and then bound into position by matting or worsted, the first being the best. One pair of eyes is sufficient for each scion. After this the grafted roots should be potted singly in 3in. pots in sandy loam. A gentle watering should be given, and the pots plunged in a propagating case where the bottom heat ranges about 75°, and the top heat 55° to 60°. Attention must be paid to dewing them over daily, preventing the sun from striking upon them, and lifting the lights of the case. Clematises are easy to graft, but unless care is taken with them for the first few days or a week afterwards, they will all go off. Union soon takes place between the stock and scion, and if they can only be kept from damping until they have reached that stage they will be perfectly safe afterwards.—NUN. DOR.

[60097.]— **Vacuum Brakes.**—The ball-valve goes back to its seat again. Perhaps there is too great an incline; that is what it seems to me. Say you have 10in. of vacuum (= 5lb.), and pistons $6\frac{1}{2}$in. stroke. The whole of the brake force is destroyed by the upward stroke of the pistons, and you have no brake left. This is why the brake does not hold.—TRIPLE VALVE.

[60131.] — **Muffin Plate.** — There is nothing very wonderful in a muffin-plate: it is simply a sheet of iron heated by the hot gases from a furnace—a small one—and coke is preferable to coal; while charcoal is better than either. A good recipe is flour, half-peck; warm milk and water, half-gallon; yeast, quarter-pint; salt, $\frac{1}{4}$lb.; mix these thoroughly for quarter of an hour, and add another half-peck of flour. Work up into dough, and put aside in a warm place to rise. Then roll up and pull into suitable pieces, which are baked on the plate or on tins in an oven, turning when half done and dipping into warm milk just before browning off. Crumpets are made by pouring a thick butter into rings laid on the plate.—THE BELLMAN.

[60139.]—**Transferring Prints to Glass.**—Clean the glass thoroughly and keep out of the way of dust. Coat the print carefully with gold size, copal varnish, or (best) Canada balsam, and when completely coated place carefully on the glass, rubbing down so as to exclude air-bubbles, and obtain perfect contact at every part. Allow it to dry, and then with the finger dipped in water rub the paper carefully off, so as to leave only the ink lines adhering to the balsam, which is the best thing to use. A good deal of practice will be required, but much may be done by a little experiment. If the paper is thick, you can gum a piece of wood or millboard on the back of the print after it is dry, and subsequently "split" that from the glass-plate, when it will bring away most of the paper. Apply a coat of varnish or balsam when the paper is removed.—SAML. RAY.

[60140.]—**Tobacco.**—The tobacco leaves when ripe should be cut and allowed to dry partly in the sun on the ground. In practice the stem is cut down and left until the leaves wilt, which will be in an hour or so, according to the heat of the sun. They are then hung up to dry, and afterwards the leaves are stripped from the stem, damped slightly, tied in bundles, and packed between boards, which are weighted down, when a process of slow fermentation commences. This must be watched to prevent mildew, and when complete the leaves will have the true aroma. It is no use for fumigating until after the fermentation—any vegetable refuse would do quite as well if that important part is left out. The Excise can prevent you using tobacco in that way, but as a rule they do not. They may be more strict, however, now that so much attention is being devoted to the subject.—SAML. RAY.

[60155.] — **Gelatine for Clarifying.**—Yes, gelatine and isinglass are used for clarifying beers but wines are generally cleared with white of egg or milk. As to the "process of manufacture," it is not clear what information the querist wants. The brewers' finings are made by dissolving fine-shredded isinglass in sour beer, and diluted with small beer after filtration. A pound of isinglass will make about 12 gallons of "finings."—NUN. DOR.

[60168.]—**Domestic Mincing Machine.**—Messrs. Churchill have a mincing machine in which the meat is really cut, a wheel of blades rubbing over the surface of a plate through perforations in which the meat is forced. You will find their advertisement in nearly every number.—NUN. DOR.

[60173.]—**Rusty Kitchen Boilers.**—The difference is far more likely in the water than in the iron, which is either cast or wrought. An effectual remedy is to boil hard water in it, which will coat the plates with "fur"; but, failing that, it is a good plan to rub the plates all over with paraffin wax when hot. The difficulty is that in the majority of boilers it is impossible to reach all parts of the interior.—SAML. RAY.

[60176.]—**Dyeing Flags.**—This querist should consult a work on dyeing, if he cannot find what he wants in back volumes. Surely he might have stated what material it is he wishes to dye, and what colours he requires.—S. T. N.

[60178.]—**Locomotive Cranks.**—It is advisable to have the driving cranks as long as possible.—C. M.

[60185.]—**L.B. and S.C. Locomotives.**—The dimensions of L. B. and S.C. 4 Mickleham, Class D, are as follows:—Boiler barrel: length, 10ft. 2in.; diameter outside, 4ft. 1in.; thickness of plates, $\frac{1}{2}$in.; tubeplate, $\frac{3}{4}$in. Outside firebox: length outside, 5ft. $2\frac{1}{4}$in.; breadth outside at bottom, 4ft. 1in.; thickness of plates, end, $\frac{5}{8}$in.; sides, $\frac{1}{2}$in. Inside firebox (copper): length inside at top, 4ft. 2in.; bottom, 4ft. 6in.; breadth inside at top, 3ft. 3in.; bottom, 3ft. 5in.; thickness of plates, $\frac{1}{2}$in.; tubeplate, $\frac{7}{8}$in.; distance between crown of inside box and shell, front, 1ft. $2\frac{7}{8}$in.; back, 1ft. $4\frac{7}{8}$in. Crown stays: number, 90; centre to centre, 4 and $4\frac{5}{8}$in.; area of firegrate, 15·2 sq. ft.; surface of firebox, 90 sq. ft. Tubes: number, 177; diameter outside, $1\frac{3}{4}$in.; thickness, 10 to 11 B.W.G.; outside heating surface, 858 sq. ft.; total heating surface, 948 sq. ft.; ratio of heating surface to grate area, 62 : 1; firegrate area to flue area, 6·75 : 1; firegrate area to least sectional area of chimney, 10·8 : 1. Safety-valves (two on dome): diameter, $2\frac{1}{2}$in.; effective load, 140lb. per sq. in. Smoke-box: length outside, 2ft. $6\frac{7}{8}$in.; breadth outside, 4ft. $6\frac{1}{4}$in.; thickness of plates, $\frac{3}{8}$in.; steam-pipe, diameter inside, 3in. Exhaust pipe: diameter at top, $4\frac{1}{2}$in.; height above centre of boiler, $9\frac{1}{2}$in.; above top row of tubes, 2in. Chimney: diameter at top inside, 1ft. 4in.; bottom inside, 1ft. 5in. Cylinders: diameter, 17in.; stroke, 24in.; centre to centre, 2ft. 2in.; diameter of piston rod, $2\frac{3}{4}$in. Ports: length, 1ft. 3in.; breadth of steam, $1\frac{1}{2}$in.; exhaust 2in. Slide valves: travel, 4in.; lead, $\frac{1}{8}$in.; outside lap, $\frac{7}{8}$in.; inside lap, $\frac{1}{8}$in. Valve spindles: diameter, $1\frac{3}{4}$in.; centre to centre, 4in. Valve gear: travel of eccentrics, $5\frac{1}{2}$in.; length of eccentric rods, 4ft. 10in. Connecting rods: length, centre to centre, 6ft. 6in.; diameter of large end, $3\frac{1}{2}$in.; small end, 3in.; diameter of bolts, $2\frac{1}{8}$in.; threads per inch, 7. Diameter of wheels: driving and leading, 5ft. 6in.; trailing, 4ft. 6in. Wheel base: leading to driving, 7ft. 7in.; driving to trailing, 7ft. 5in. Cranks: section of outer arms, 11 by $4\frac{5}{8}$in.; inner arms, 11 by $4\frac{1}{2}$in. Crank axle: centre to centre of bearings, 3ft. $11\frac{1}{4}$in.; length of bearings, 8in.; diameter of axle at wheel-boss, $8\frac{1}{4}$in.; at centre, $7\frac{1}{2}$in.; diameter of crank-pin, 8in. Leading axle: diameter at wheel-boss, $8\frac{1}{4}$in.; at centre, $6\frac{1}{2}$in.; length of bearings, 1in.; diameter of bearings, 7in. Trailing axles: diameter at wheel-boss, $8\frac{1}{4}$in.; at centre, $6\frac{1}{2}$in.; length of bearings, $8\frac{3}{4}$in.; diameter of bearings, 7in.; pumps (2); diameter of plungers, 2in.; stroke, 2ft.; Westinghouse brake; tanks on sides. Frames: distance apart, 4ft. $1\frac{1}{2}$in.; thickness, 1in.; depth, 1ft. 5in.; extreme length over all, 28ft. 7in.; length over buffers, 31ft. $9\frac{1}{2}$in.; height of footplate above rails, 4ft.; width over footplate, 8ft. Springs: driving, volute, diameter, $7\frac{1}{4}$in.; length, $11\frac{1}{4}$in.; section of plate, 8in. by $\frac{3}{8}$in.; leading (17 plates) and trailing (16 plates); length unloaded, 3ft. 6in.; breadth, 5in.; thickness of top plate, $\frac{1}{2}$in.; thickness of remaining plates, $\frac{3}{8}$in.; camber loaded, $3\frac{1}{2}$in. Weight of engine empty: leading wheels, 12 tons 10cwt.; driving wheels, 12tons 10cwt.; trailing wheels, 9tons 7cwt.—total, 34tons 7cwt. These dimensions are taken from *Engineering* for Jan. 14, 1876 (Vol. XXI. p. 28). They are not at all the same as those given by "G. N. R." on p. 20 in No. 1119. Where did he find them?—V. J. B.

[60186.]—**Mathematical.**—It cannot but be plain to "T. C.," I think, on looking at the smallest square holding two circles of 6in. diameter, that it is the face of the smallest cube that will hold four (or three) spheres of that size. If the question had been the least cube that will hold two of the given spheres, it would not have been quite so easy, and this would be worth the attention of those who have answered the other.—E. L. G.

[60194.]—**Strawberries.**—The following notes, extracted from a paper by Mr. J. Muir, of Margam Park, South Wales, in the *Journal of Horticulture*, may be found useful by those who have recently been writing on the culture of strawberries: "It is of no use," says Mr. Muir, "attempting to grow strawberries successfully under the 'odd corner' system. They certainly will cover any 'odd corner' with foliage; but they require a good position to obtain abundance of high-class fruit from them, and the first and foremost thing to do in either introducing them for the first time, or making a new plantation anywhere, is to select a spot well exposed to the sun, and where the soil is of a substantial nature. Strawberries can be grown in light soil; but they do best in heavy material, and a stiff soil will always produce more

robust plants and finish finer crops of fruit than light soil. I have known strawberries planted in very light soil bear excellent crops for a year or two, if the weather happened to be moist at the time the fruit was swelling; but when the season chanced to be dry at that time, they were almost a total failure. It is when the fruit is swelling and ripening that the quality of the soil is tested. Many are heard to complain that their strawberry plants were full of bloom, the fruits formed freely, but most of them were lost before ripening; and that is the evil of planting in light soil, as it is very rarely the crop fails in heavy material, and the fruit as a rule swells to the last berry. In many cases the surface soil of a garden is very fine and light, whilst the subsoil is heavy, and if trenching was done there before the strawberries were planted it would benefit them highly. The subsoil should then be brought well up to the surface, and the whole of the quarter for the strawberries should be trenched before any manuring is done. It is generally understood that strawberries delight in a rich soil; but there is a danger of giving them too much manure, especially at first. I have known beds to be originally composed of almost half-manure, and the plants made astonishing growth in it; but this was all, as leaves took the place of fruit in a great measure, and these strong plants were by no means so fertile as those of medium strength. A very moderate supply of manure will grow strawberries well for the first season, and afterwards they can be easily and advantageously fertilised by mulching in early spring, which is the best of all times for this operation. In dealing with strawberries from this point of view, the newly trenched ground and soil being dug for the reception of young plants should only have a medium coat of manure worked into the surface, but what is used should be as good as possible. It must be remembered that a new strawberry plantation ought to remain in prime bearing condition for four, five, or six years, and if a quantity of weedy manure is introduced to the soil at the first, it will give endless trouble or may lead to the plantation having to be dug up prematurely. There is never any satisfaction to be had from a plantation which is constantly full of weeds, and when these are introduced with the manure, it is a difficult matter to keep them down or clear them out. The best and shortest way of preparing the ground for strawberries is to clear everything from the surface, dig or trench it if necessary from 1½ft. to 2ft. deep, then fork a quantity of good clean manure into the surface and plant. If the soil is inclined to be light, use cow manure; if rather heavy, introduce stable manure. As a rule it is not an advantage to plant strawberries where strawberries were before. Like many other things, a change of soil is very beneficial to them, and they may follow potatoes, onions, or any kind of vegetable crop which is being cleared off about this time. As to the best time for planting, I do not think there is a better than the end of August or very early in September. The young plants have then time to form roots and become well established before November, and once this is accomplished, they will bear a light crop the first summer after planting. It is always a very great advantage to have strong runners to place out, and if these were cut off and lifted some time ago and planted closely in a nursery bed to form roots they may now be transplanted without receiving a check. Secure a ball of soil with each if possible, and plant without breaking this. Newly dug or forked ground is always loose, and as the young roots establish themselves much more quickly in firm soil than loose material, when the whole have been planted the ground around each plant should be firmly trodden down. We find that those of the Black Prince type do very well with a distance of 2ft. between the rows and 18in. between the plants, but the more robust-growing ones should have at least 6in. more room each way."—HORTULANS.

[60197.]—**"Take a Postage Stamp."**—There is one of these machines at the Midland station, Sheffield, and the name of the makers is "The Post-Card Automatic Supply Company, Limited, 13, Huggin-lane, Queen Victoria-street, E.C."—H. GILBERT, Sheffield.

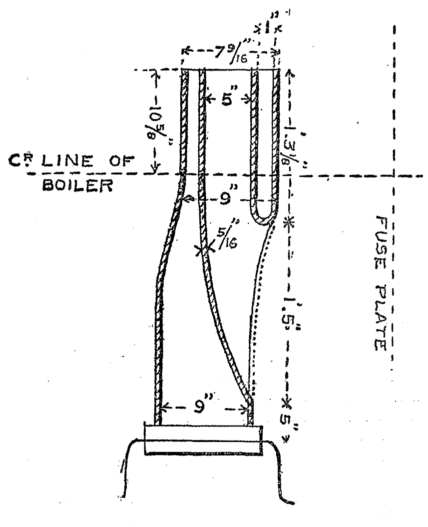
[60252.]—**Gravity.**—If, as "Red Light" states in answering the above that the portion of the earth left behind by the body in its passage through the shaft does not affect the motion of the body, how does he account for the alleged return of the body through the shaft? Has he not been rather too explicit?—G. H. H.

[60255.]—**Hydrostatic Pressure.**—I had not noticed this query until "T. C., Bristol," called my attention to it. I think it may be done without using the calculus. Suppose we have a beam of uniform section, hinged at one end to some object above the surface of a piece of water, and suppose that this object may be raised or lowered at will; if we raise it so that the other end of the beam just touches the water, the beam will of course hang vertically; if, then, we gradually lower it so that the free end of the beam passes below the surface of the water, it will still hang vertically until a certain point is reached, when the beam will then assume a sloping position. Now suppose the beam to be in this latter position, call the length of the beam l, the part submerged x (measuring along centre line of beam), then the portion of beam above water will be $l - x$. Now we have to take moments round the turning point of the hinge. Suppose W = weight of a cubic foot of water, S = specific gravity of the beam (in this case = ·82, water being = 1); also, let c = area of cross section of beam, the weight of portion above water will be $(l - x)$ S W c; this weight suspended at centre of gravity of this portion of beam gives a moment acting downwards, the length of the "arm" being $\frac{l - x}{2}\cos.\ \theta$ (θ being angle between slope of beam and horizontal); multiplying the weight by the arm, we get a moment of $\frac{(l - x)^2}{2}$ S W c cos. θ. Now for the submerged portion, the force tending to push the beam up will be the difference between the weight of the submerged portion and the same quantity of water, or (1 − S) W $c\,x$, applied at centre of submerged portion; the length of the arm is $\left(l - \frac{x}{2}\right)\cos.\theta$; multiplying them together, and equating to the moment already found, and striking out W c cos. θ, common to both, we get the equation—

$$\frac{S\,(l - x)^2}{2} = (1 - S)\left(l - \frac{x}{2}\right)x,$$

from which it will be found that $x = l\,(1 \pm \sqrt{1 - S})$, the lower sign to be taken; from this it appears that x (the length of submerged portion) is independent of the height of hinge above water, so that it will always be the same length. The depth of submerged end is easily found when we have found x; call depth = d, then, by similar triangles, $\frac{d}{x} = \frac{h}{l - x}$ when h = height of hinge.—M.I.C.E., Bath.

[60250.]—**Blast Pipe.**—The accompanying rough sketch will give a general idea of Adams's



blast pipe. I have as yet no details of its working; but I understand that on the L. and S.W.R. it is found to effect a considerable saving of fuel on engines to which it is fitted.—CARSTAIRS.

[60260.]—**The Aneroid.**—The table in the pamphlet named by Mr. Lancaster is not in a convenient form for ready use; but from it one can readily be constructed, which will show the heights corresponding to each tenth or hundredth of an inch of barometrical reading, and as the table is calculated for a mean temperature of 50°, the correction for temperature can be effected with the least possible trouble, and this is fully explained in the above-named pamphlet. I believe that some aneroids are graduated, and the works put together in much the same way as a watch; but the only correct plan must surely be to graduate after the works are in the case. Should an instrument be constructed on this latter principle, the spaces must naturally vary considerably. I imagine that "X." already possesses a copy of the table before mentioned, as his "limits" are peculiar, and correspond with readings given in this table. In the example he propounds, I make the height climbed to be 34ft., temperature being ignored, as it may safely be, in such a small range.—D.

[60263.]—**N.B.R. Engines.**—The engines which formerly had Ramsbottom's safety-valves underwent a slight change, but not a new departure on the N.B. The present standard safety-valve has two discharge tubes as before. In each of these is a spring in compression, coupled above to a bridge across the tube, the ordinary form of valve being used.—CARSTAIRS.

[60268.]—**C.G.S. Units.**—If my esteemed and most even-tempered friend, Mr. E. Conry, cannot perceive the difference between a force of a dyne overcome through one centimètre in a second, and a gramme lifted one centimètre per second, it is quite useless to argue with him; but, for the benefit of the querist, I may say that there is a difference of (only) 981 times in the values. I repeat my statement on page 44, that the latter is not a C.G.S. unit at all; and I will go further now, and say that it is not a unit in any system whatever. It is quite as much the duty of a correspondent to correct glaring errors as to answer queries. I am only surprised that Mr. Conry has not tried to defend his remarkable assertion that "on a frosty day the air is more rarefied than on a warm day," page 563. I promise Mr. C. that if he catches me making such absurd mistakes I will take his correction with much more equanimity than he has mine. *Humanum est errare;* but to persist in error after it has been pointed out is ———?—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60274.]—**Mushrooms and Salt.**—Since penning the reply on p. 21 I have learned that common salt is really a beneficial manure for mushroom-beds—though no explanation is offered of the cause. I have cultivated them for many years in all sorts of odd corners, but never tried salt. The fact mentioned by Mr. Wykes, p. 44, is, I find, corroborated by the practice of those who grow mushrooms for market, and we have consequently an interesting problem—How does salt act as a manure in the case of mushrooms? I do not think it can be merely because it assists in maintaining moisture, but rather because it acts chemically on some constituents of the soil, or of the bed.—SAML. RAY.

[60186.]—**Mathematical.**—It is quite clear that the balls cannot be arranged closer than to touch, and consequently with a minimum of waste room, and in working out the sizes I took the diagonal of the square as giving the size—viz., 14½in. divided by $\sqrt{2}$in.; and "E. L. G." appears to have done the same. But as yours of this week implies, I find the top ball is rather loose (by calculation), consequently the box cannot be the smallest, as one of the bottom balls could be raised a little, and therefore the box be reduced in size to, say, 10in. I also find that it takes me further into mathematics than I can now go, and will leave it to "E. L. G.," who seems pretty well up in these box puzzles.—T. C., Bristol.

[60297.]—**Testing for Faults.**—A detector simply shows, by the deflection of its needle, whether a current is passing or not. Join the instrument up to a cell, and if current is passing a deflection will be produced. If a bell is substituted for the galvanoscope it will ring, providing the current is strong enough. In testing a dynamo—the field magnets, for instance—to ascertain whether the wire with which they are wound is uninjured, the cell would be coupled to the detector, the detector to one end of the magnet wire, and the other end of the magnet wire to the remaining pole of the battery. If the needle deflects, the circuit is intact; if not, there is a fault somewhere, and the magnets must be unwound to find it. The instrument will not point out where the fault is situated automatically, as you seem to suppose.—C. D. R.

[60299.]—**Locomotives—N.B. Railway.**—Mr. Holmes's first bogies have only 6ft. 6in. wheels, not 7ft. as Mr. Seaton puts it. The principal dimensions are:—Cylinders, 17in. by 26in.; bogie wheel, 3ft. 6in.; coupled ditto, 6ft. 6in.; wheel base, 21ft. 4in.; boiler, 4ft. 4in. diameter; 196 tubes, 1¾in.; firebox, 4ft. 10⅝in. by 3ft. 6⅝in. by 5ft. 10in.; total heating surface, 1,030 sq. ft.; firegrate area, 17 sq. ft.; weight of engine loaded, 44½ tons; tender, 6 wheels, 4ft. diameter; base, 12ft.; tank capacity, 2,548 gallons. These engines are numbered 574 to 579, and run the Edinburgh-Glasgow expresses. One thing remains to be said, that as to the complaints of unpunctuality constantly being made about the N.B.R, no one can justly blame the engines, as No. 574 class do very good work, as also do some of the other classes.—CARSTAIRS.

[60301.]—**Electric-Lighting.**—What do you mean by "dimensions of electric-light wires." All wire is known by a certain gauge, the "B.W.G." usually, and the diameter and conductivity supplied by the makers. If you wish to know what current a certain gauge of wire will safely carry, tables are set out giving all particulars—for instance, No. 22 B.W.G. wire, copper, will carry a safe current of [illegible] amp.; No. 20, 3 amp.; No. 18, 4 amp. If you wish to calculate what thickness of wire will be required to carry a current of, say, 150 amps., it will, of course, depend upon the con-

ductivity of the metal used, and under these circumstances there is no help for it but to commence at the beginning. Get a knowledge of algebra, and be in a position to work the equation out. If I can help you further I will.—C. D. R.

[60307.]—**Analysis of Silver Alloys.**—I am obliged to Wm. John Grey for his reply to my query on this subject, p. 44, but should be glad of further information. I look to the ENGLISH MECHANIC as to an instructor of English working men, and I feel free to ask questions, and expect answers which shall help me, as a working-man, to understand the scientific principles underlying my trade or profession. Now, I am by trade or profession an electro-gilder and plater, and not altogether a stranger to some practice in the manipulation of metals, mechanically and chemically. I have been deterred (by lameness) from taking journeys to laboratories and workshops to get a practical acquaintance with my fellow men in analytical work; but I have studied works on analysis at home, and have put the lessons into practice in the workshop. With some of the processes I have been very successful, and can assay gold and silver with tolerable accuracy as tested by duplicates sent to some of the best assay offices in London. I find, however, that the loss of silver in assaying heavy alloys of this metal is variable, and, I think, as a consequence, that the usual checks are not to be depended upon to give strictly accurate results. I have known the variation to be, with the same composition, ·02gr. in a 7gr. sample, which is equal to 20gr. in the lb. avoirdupois. It is manifest that this is a serious variation when one has to determine the exact deposit of silver per pound avoirdupois on copper or brass in samples, where from 1dwt. to 2dwt. of silver per lb. only is allowed. I wish to ascertain the cause of this variation, and to avoid it if possible. I wish also to learn a more accurate method, and thought I could get it by a chemical analysis of the alloy. I find, however, that perfection and strict accuracy cannot be attained in this way unless one "has had a previous training in similar work." This is discouraging to an isolated student like myself. Is it impossible to train one's self by the aid of written or printed instructions? The instructions in the textbooks do not go far enough. The writers of those books appear to have had only a limited experience in assaying *manufactured* articles. I learn from them that alloys of silver can be quantitatively analysed with accuracy; but when I try the methods given in the textbooks I experience failure, as described in my query. I am therefore led to question whether they have ever tried to analyse alloys so poor in silver as those I name. I shall be glad to be set right on this point. I find that silver is always held in solution after NaCl or HCl is added in excess to a solution of copper nitrate containing 2 per cent. of silver.—G. E.

[60308.] — **Sound-Proof Doors.** — Close the doors on one side, and board up the other with match-lining, placing dry sawdust between the boards and doors as the work proceeds. This is most effectual and cheap.—C. D. R.

[60313.]— **Ozone.** — TO MR. BOTTONE AND OTHERS.—The method of producing ozone, described by Mr. Bottone, requires special plant. The trouble and outlay caused by purchasing and working this may be saved by obtaining pure ozone from Brin's Oxygen Co., Connaught Mansions, Westminster, who have perfected means of producing ozone in any quantity at such a rate as brings this hitherto costly gas within the range of practical application to numerous industries.—E. B. ELLICE-CLARK, M.Inst.C.E.

[60324.]—**Terrestrial Telescopes.**—My best thanks to "F.R.A.S.," "Garrison Gunner," and Mr. Nelson. Might I ask a little further assistance? I notice all three recommend a pancratic eyepiece. Has any description of this eyepiece appeared in "Ours"? (I have back Vols. to XXV. inclusive.) If not, how may I know one? Would it be possible to adapt one to my glass, or would the object-glass not be suitable? The instrument is by Bate, of the Poultry (now Potter), and was bought over thirty years ago. It has always been considered a very good glass; but I wish I could submit it to the criticism of a master like Mr. Nelson. Would that gentleman mind saying whether his telescopes are of English make? Any one like myself is rather helpless in purchasing a glass. One has to rely on what one is told about focus, power, &c., and as a rule there is not much opportunity of testing the capability of the instrument at the time, especially for such work as flag-reading.—D. G.

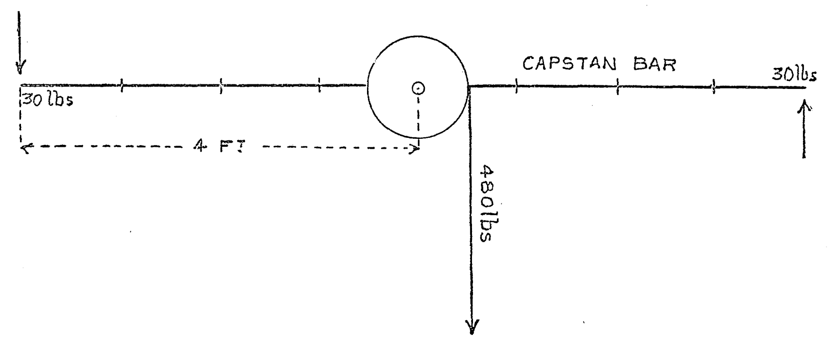
[60336.]—**Keeping a Pony.**—Does J. Low really mean that he would feed a 14-hand pony upon 3 to 4½lb. of solid food per diem, of which one-sixth part, or from 6 to 9oz., would consist of hay? I have read his reply several times, but can make nothing else out of it. It may be my ignorance, but to me such economical feeding is a revelation. I did hear once of a Welshman's mare which was by degrees reduced to a diet of one straw daily, but the historian of this wonderful animal records that she died before the experiment was completed. I have also read of one

"Captain Jinks, of the Horse Marines,
Who feeds his horse on peas and beans";

but in this case the metrical record is defective as to the results of the diet upon the animal economy. I had intended to reply to this querist with a word of warning, but it escaped my memory. I have a number of horses to keep, and have kept horses in both city and country, and unless querist wants some extra worry, he will not think of keeping a pony for pleasure unless he can also afford to keep a man to look after said pony—clean him, feed him, wash harness and trap, and attend to the many other matters connected with the stable. I never was able in a city to keep a horse under 20s. a week, and that was when the one man looked after three horses, and I got bedding for nothing. Even in the country, where I grow all my horses' eat, the food of each costs 10s. per week. Again, I cannot agree with J. Low. If you want a good horse, you are far safer, if you are not a judge, to go to a respectable dealer, tell him what you want, and get one on trial. He will, of course, expect a fair profit; but if he is a man of standing he will not knowingly sell you a screw. Such is my experience, and I have been using horses for 25 years.—DOCTOR MEDICINÆ.

[60337.]—**Small Compound Engine.**—There is such a large difference between my reply and that of "Engineering" that I think it as well to point out to querist that it all depends at what speed the engine has run at as to the power it gives. I have assumed 300 revs., and I think "Engineering" has assumed 150, so as to drive pumps direct; hence the larger cylinders required. Querist should remember that it is always as well to have more power than present requirements.—T. C., Bristol.

[60341.] — **Mechanics.** — The accompanying diagram will show the rationale of the forces



asked about by "Novice." If two ropes were wound round the capstan each in opposite ways, and each diametrically opposite to each other in their "pull," it is obvious that if each were weighted to 240lb. there would be no strain on the axle at all.—PAUL WARD.

[60341.]—**Capstan.**—Your first supposition is correct, $2 \times 4 \times 30 = 240$ being the strain on rope, and by supposing a strain to be applied to the opposite side of the drum to maintain the equilibrium, when the pressure is removed from the arm or bar, you will easily see that it must be 240 also, and, therefore, the shearing force on pin is $2 \times 240 = 480$. I do not think a diagram would simplify the case.—G. H. H.

[60343.]—**Heating Small Conservatory.**—A conservatory, 400 cubic feet, can be heated by an oil stove. A funnel fixed to 1in. pipe placed over the stove is sufficient to carry off the fumes, which cause an unpleasant smell, although not injurious to plants; neither is the light detrimental from the same.—G. O.

[60343.]—**Heating Small Conservatory.**—I would ask "Orchid" if he has ever used a gas-stove without a flue in a greenhouse for a whole winter, when the greenhouse contains plants which are in bloom or in an active growing state? If he has, I am afraid his results will be little, if any, better than doing without heat altogether. When he states that half the heat of a gas-stove is lost by using a flue, he states what is not true, unless the grossest carelessness and ignorance have been present when the stove was fixed. The flue of the stove or boiler should be used in the greenhouse, exactly in the same way as a hot-water pipe, and the products of combustion should not leave the flue at a temperature more than 20° Fahr. above that of the house. As a matter of fact, in my own greenhouse, when the house was at 50°, the products of combustion from the flue averaged 68° for four months in succession, and over 98 per cent. of the total heat was utilised in warming the air of the greenhouse. The only waste of heat necessary is to prevent down-draught: but for this, the whole of the heat could be utilised.—998.

[60346.] — **Charging Accumulators**.—Your cells short-circuit by the sediment you observe at the bottom of accumulators. This causes the E.M.F. to fall so rapidly after having been left some time after charging. To remedy this, cement strips of thin glass tubing at bottom of cells to prevent plates touching the bottom.—ZEMO.

[60346.]—**Charging Accumulators.**— Your plates are very small for practical purposes, and the charging dynamo of very little use. As you do not say what current it gives or the E.M.F., I cannot advise you upon the best method of arranging the cells during charging. The formation of the plates occupies several weeks, and the capacity for receiving charge depends upon the weight of reduced lead in them. It does not appear that you have carried the formation of the plates sufficiently far. You had better examine the cells and see to what depth they are converted into spongy lead. This may be ascertained by cutting a plate or two with a knife. You will probably find that the spongy lead only just covers the surface. If this is the case, you must continue the process of formation until the whole depth is reduced. This must be effected by charging the cells with at least one ampère of current per pair of plates. When the charging ceases to be useful the cells will give off torrents of gas, and if continued the liquid will commence to heat. They must now be slowly discharged through a resistance—a lamp, for instance; after which, connect again to the dynamo and pass in current, but in the reverse direction to that previously, and again discharge. This process of continued charge and discharge must be carried on until the whole of the plates are capable of receiving a full charge. The object of the continual reversal of the charge is simply to reduce the metallic lead to a porous state. After formation, the current must always be passed in from one direction.—C. D. R.

[60348.]—**Testing Gold.**—The test stone is a black slate-like stone of close texture. The studs or needles are bits of gold wire, made up of all the alloys of gold supposed to be required to be tested. The manner of using the studs and stone is as follows: The suspected piece of gold is rubbed on the stone until it leaves its mark thereon; then a test stud is rubbed on the stone by the side of the first mark, and the two marks compared. These rubbings are repeated until the rubbing of the suspected gold and a selected stud exactly coincide in tint. We can then determine that the suspected gold is nearly the same quality as that of the stud selected. It is largely in use by Indian traders.—G. E.

[60359.]—**Freezing Meat.**—I understand the apparatus is simply a steam-engine driving a fan which causes a powerful draught of air to blow perpetually through the chamber where the meat is kept, and thus by constant evaporation keeps the air at freezing point.—E. CONRY.

[60359.]—**Freezing Meat.**—This is effected on board ship by utilising the fact that compressed air is reduced in temperature on expansion. A steam-engine is used to compress the air in high-pressure cylinder, and is again forced into the chambers containing the carcases. In expanding it becomes reduced in temperature, and in its passage through the chambers extracts the heat from the meat until the carcases become cold enough to freeze; the whole principle of the operation can be demonstrated by blowing upon the back of the hand; if we simply breathe gently, we shall find that a feeling of warmth is imparted to the part breathed upon. If, now, we blow forcibly, we shall find the air proceeding from the lips is colder. Previous to issuing from the mouth it is compressed between the cheeks, and on expansion is reduced in temperature, and coming in contact with a warm body extracts the heat from it, and in doing so a feeling of cold is produced.—C. D. R.

[60362.]—**Cold Compressed Air.**—I am much

obliged to "S. G." and E. Conry for their information. They will find my address in Addresses, if they will kindly communicate.—DOCTOR MEDICINÆ.

[60362.]—**Cold Compressed Air.**—Machinery for producing cold air is, or can be, made in any desired size; a special apartment is not absolutely necessary, but is advisable. Power is requisite; but that may be steam, gas, or a hot-air engine, and a good supply of water is a sine quâ non, for the whole thing depends on compressing air and extracting the heat from it, so that when it is allowed to expand it will seize upon heat wherever it comes in contact with it—in other words, will be very cold. For dairy purposes, I should think the cold-air process scarcely suitable, though it may do well enough if it is desired merely to keep the milk and cream cool.—SAML. RAY.

[60363.]—**Cold Compressed Air.**—See reply to 60359.—C. D. R.

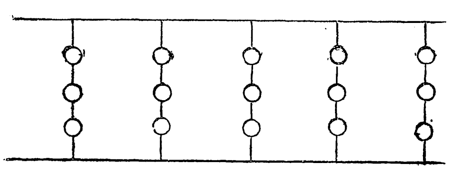
[60364.] — **Beach's Developer.** — TO MR. BOTTONE.—Make up two solutions, No. 1 and No. 2, in the following manner:—(1) Pyro. solution.—Warm distilled water, 2oz.; pure sulphite of soda, 2oz. Dissolve, and when cold add sulphurous acid, 2oz.; pyrogallic acid, ½oz.; mix, and keep in a well-stoppered stock bottle. (2) Potash Solution.—A. Water, 4oz.; pure carbonate of potash, 3oz. B. Water, 3oz.; sulphite of soda, 2oz. After each salt has been dissolved in its own water, A and B are mixed together. To develop an 8½ by 6½, take water 3oz.; No. 1, 4 drachms; No. 2, 3 drachms. If the image is slow in coming out, add more of No. 2. If it comes out too quickly, increase the dose of No. 1 and lessen that of No. 2.—S. BOTTONE.

[60365.]—**Printing.**—It is not easy to understand what "Pica" means by a "dwell" on the type, for all platen machines must, of necessity, have more or less of a "dwell," as the motion of the platen is reciprocatory. It is sufficient if the impression can be said to be perfect, whether it takes one-hundredth of a second or of a minute to produce it. Obviously, the longer the "dwell," within limits, the better the work—that is, some machines which have the merest touch-and-go action can scarcely be expected to do the best work.—A PRACTICAL PRINTER.

[60367.]—**Dry Meters.**—I have had very little experience with dry meters, and what little I have had has not been at all pleasant; the clicking noise which exists more or less in all gas meters will not increase his gas bill, as he appears to think. The objection to a dry meter is that the flexible diaphragms sometimes get hard, and when this happens, the behaviour of a dry meter is usually more curious than satisfactory.—THOS. FLETCHER.

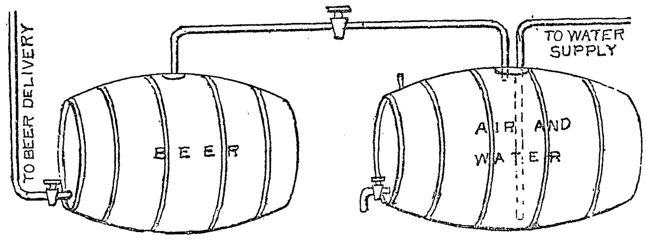
[60368.]—**Exploding Spirit Lamp.**—It does not matter whether the lamp is hot or cold; alcohol gives off vapour at ordinary temperatures, and forms an explosive mixture with air in the chamber of the lamp. The only cure is to make the burner fit better into its socket, so that flame cannot find its way into the reservoir. I have a lamp which frequently exploded until I stopped the air-hole up with a piece of match stick.—PAUL WARD.

[60370.] — **Dynamo.** — TO MR. BOTTONE.—There is nothing the matter with your dynamo; but your lamps are of too low resistance. You can,



however, remedy matters by running five or six sets of the said 14 volt 10c.p. lamps, of three in parallel, as shown above.—S. BOTTONE.

[60369.]—**δ Cygni.**—I see H. Atkinson asks about δ Cygni. He may rest assured Mr. Sadler's figures are not far out. I have seen the *comes* to δ easily very often this year, and on showing it to another person he estimated the distance as little under two seconds. I see it widely apart, and I am sure if Mr. Perry's measure was correct I should never see the *comes* to so bright a principal star. Is not 0·8″ a misprint for 1·8″? I have seen one or two *comes* to double stars which I think are hitherto unnoticed. Near ε Lyræ there is a pair of stars *f.* a little N., similar in position and distance to ε. Close to the S. star of the two is a faint double about 4″. Near P XVII. 200 Herculis are two pairs, one 10′ S. 20′ *p.* 20″ 110° ±, the other 10′ *p.* 9″ and 10″ 20″ 200°; β Cygni has a faint *comes* at 20″, 30° from the smaller star, and the star rather more than 1′ N., a little *p.* forming the apex of an isosceles triangle with β, has also a *comes* about as distant. Σ 2491 has a faint *comes* at 25″ 160° ±.



Star 1° *n.p.* from P XXIII., 101 Cassiopeiæ is double 6″ and 9″ 6″ 70° ±. There is a star on Proctor's maps betwixt P XX. 452 and ν Cygni; 2′ from this star at angle of 140° is a pair 8½—9½ 4″ 30° ±. I think T Cassiopeiæ must be at a maximum at present. On August 28th it was bright and very red. It has a *comes* 1′ distant at 340° and a fainter 10°.—EDWIN HOLMES.

[60370.]—**Dynamo.**—"Trouble" should have stated the E.M.F. his dynamo was made to work at. Probably it is higher than the 14 volts his 10 c.p. lamps take, so that he is running his machine slower than intended. From the facts he gives the machine seems rather to be simply shunt-wound than compound-wound. I suppose "Trouble" knows that if the external resistance of a shunt machine be lowered beyond a certain point the current rapidly drops. It appears likely that the addition of the two extra lamps lowers the resistance enough to do this. Try connecting the six lamps up in three parallels of two in series, or some such combination, to increase the external resistance, and run the machine faster if necessary.—MERE S.

[60373.]—**Battery Zinc.**—TO MR. BOTTONE.—The reason why the bottom of the zincs gets less acted on than the tops is because the zinc salts formed by the action of the acid on the zinc are heavier than the original acid, and falling to the lower part of the vessel as fast as formed, protect the lower end of the zinc from further action. Agitation, the use of a deeper cell, or occasional lifting the zincs will remedy this.—S. BOTTONE.

[60373.]—**Battery Zinc.**—Evidently from some cause the electrical action goes on chiefly at the middle of the plates—probably, I should think, either from the liquid having sunk to that point, or from the top and bottom having got coated with hard sulphate of zinc, while the middle is comparatively clean. It is usually the water line and edges of a zinc plate that wear away. If you get all the zincs properly amalgamated, and keep the plates the same distance from the carbon at all points, they ought to wear away evenly.—E. CONRY.

[60374.]—**Solder for Platinum.**—I have done it with a spirits of salt flux and solder, which I believe was the ordinary sort, using for convenience a blowpipe flame.—E. CONRY.

[60374.] — **Solder for Platinum.** — Ordinary plumber's solder adheres perfectly to platinum; so does silver solder. But all solders are apt to permeate the platinum, and render it readily oxidisable; for this reason it is better to rivet or screw the platinum tips on the screws or springs of electrical contacts.—S. BOTTONE.

[60374.] — **Solder for Platinum.**—Drill the end of the screw, and fit the platinum wire in the hole. Tin the inside of hole with soft solder, and tin the end of wire; heat them and put them together. The platinum sometimes requires a little persuasion to take the solder; but with soldering fluid it can be done. In cheap French work no solder is used.—OS.

[60374.]—**Solder for Platinum.**—For small work and light currents soft solder will do; but for hard work and heavy currents, such, for instance, as the platinum studs in contact breakers of induction coils, the cylindrical block of platinum is silver-soldered on to the brass screw, a small recess having been turned in its (the screw's) tip to hold the platinum central whilst heating. — PAUL WARD.

[60375.]—**Lifting Power of Engine.**—The area is, of course, in favour of the single 36in. cylinder, and it would lift most dead weight if crank were vertical; but the two 24in. cylinders would be able to start where the other would stick, and would lift most dead weight with the same amount of expansion.—T. C., Bristol.

[60375.]—**Lifting Power of Engine.**—If I understand your question rightly, all the practical factors which determine the power of engines are equal, except area of piston, and in the one case there is 24 × 2 = 48 acting sq. inches to 36in. in the other, so that the power of the engines ought to bear the ratio of 48 : 46. Really, however, it would not be quite so much—more like 44 : 46.—E. CONRY.

[60377.] — **Breaking Strain on Cables.**—ERRATUM.—The word "depressing" should be "depression."—SAILOR.

[60378.] — **Beer-raising Apparatus.**—I inclose sketch of arrangement whereby "Vino" can utilise his water-pressure for raising his beer. Let him take an empty barrel and connect his water supply (as shown), letting his pipe go to the bottom of his barrel and connect his beer barrel by means of a tube with a stopcock in it to his empty barrel; on turning on his water supply the air in his water barrel will be compressed sufficiently to force the beer up the 12ft. pipe. At a suitable time, say, every morning, he can turn off the cock between the two barrels, take out the vent-peg of his water barrel, and drain off what water has been used to compress the air in it, and start afresh; of course, he will have the sense neither to let his water barrel get so full as to send water into his beer, nor to burst his water barrel by excess of pressure from his water supply. This is, I think, about the simplest device he can have recourse to.—PAUL WARD.

[60381.]—**L.B. and S.C. Locos.**—Nos. 208 to 213 are alike in dimensions; 214 to 219 have slightly larger boilers and fireboxes, in other respects they are the same; 326 to 350 are all alike, with the exception of Grosvenor, 326, which has 4in. larger driving wheels—6ft. 10in., I think. Lancing and Worthing have been, or are about to be, sold or broken up, as there are some new tanks bearing the names. The Cavendish, I believe, is in the shops. I do not know the dimensions of Caen.—RICHMOND-PORTSMOUTH.

[60382.]—**Balance.**—Assuming the weight to be same side as goods to be weighed, it would have no effect until after the pointer of scale had begun to move, when the process of weighing is really completed; but the effect of the weight being below the knife edges of balance would be to lose part of its power of balancing when scale descended any distance, and so tend to return the beam to a horizontal position.—T. C., Bristol.

[60383.]—**Resistance of Battery.**—Why not make up two similar cells, with plates same size, acting surface and distance from each other, and couple them up against each other? You will thus get rid of all currents, and the resistance of one cell will be half that of the pair as joined up.—E. CONRY.

[60384.]—**Dead Black Lacquer.**—Ivory black ground up with a solution of shellac in methylated spirit is the ordinary dead black lacquer generally used. A better result is obtained by using a mixture of equal parts gum thus and gum sandarac instead of shellac. The proportions vary with the work for which the lacquer is required, and can easily be got at by experiment. The finish of the surface depends on the care with which the ivory black is ground up smooth with the spirit solution.—998.

[60386.]—**Letters on Brass.**—When I have cut these I have heated the plate and filled in with sealing wax, and dressed off smooth when cold.—T. C., Bristol.

[60386.]—**Letters on Brass.**—TO MR. S. BOTTONE.—I should make a thick paste by rubbing up the colours (ivory black for the black, and Chinese red for the red) and a small quantity of good copal varnish on a slab and muller until quite smooth; adding sufficient colouring matter to make a stiff paste.—S. BOTTONE.

[60388.]—**Wimshurst's Influence Machine.**—In reply to the questions by "Influence," I assume that the glass discs are 30in. in diameter. 1. The glasses should not exceed ⅛in. in thickness; smaller glasses should be proportionally less thickness. 2. The bosses should each be from 5 to 6in. in length. The end next the glass should be about 3¼in. diameter, the driving pulley about 2in. diameter in the V-groove. 3. A fair average size for the sectors would be 5½in. in length, the broad end 1in., the narrow end ¼in, 14 or 16 sectors on each glass. 4. The driving wheels ought to be about 10in. diameter. 5. The holes may be bored in the glasses by means of a suitably arranged revolving tube and emery and water; but many of the glass-cutters will cut out the hole when they cut the glass; it takes very little time. If the sharp edges of the glass are rubbed lightly with a file, it is

all that is necessary. 6. The spindles should be of steel, $\frac{9}{16}$ths, or $\frac{1}{2}$in. in diameter. 7. Whether 30in. discs are worth the trouble must be answered by "Influence," for the length of spark depends upon the distances given between each of the parts for the purpose of insulation. Long sparks cannot be obtained from small plates and the correspondingly small distances. Thirty inch plates, suitably mounted, will give thirteen or more inches length of spark. Quantity of electricity depends chiefly upon the velocity at which the plates are driven.—J. W

[60389.]—**Apparatus for Ringing Hand-bells.**—(1) I should think a large edition of the ordinary musical-box mechanism would do—a revolving drum, set with little spikes, meeting the ends of long elastic metal teeth, and twanging them as the drum revolves. If you had large, long elastic teeth, carrying a little metal button, you arrange them to strike the bells and then rebound. (2) You could copy the apparatus which rings the chimes in the clock-tower of "Old London" at the Exhibition; it is perfect of its kind, especially for arrangements where a blow of some force is required. If you like, I can give you a sketch of it.—E. CONRY.

[60391.]—**Inspector.**—Second in elementary is very much elementary indeed. The science and art exams. will not assist you in above appointments. In fact, the companies have a preference (which is well-nigh exclusive) for marine engineers possessing a chief's certificate, and I think they are quite right. In the first place they have to study hard and pass certain—not elementary—exams. by the Board of Trade, and are practical engineers. In addition, they have charge of the boilers in the boat, and are all-round men as a rule.—T. C., Bristol.

[60393.]—**Straight Wires.**—These can be obtained at any metal shop.—C. D. R.

[60393.]—**Straight Wires.**—I think there must be a special machine for preparing the wires for the brushes of dynamo machines; but when I want to so prepare wires in the way you mention, as for a pair of brushes, I do it by fixing one end in a vice, pulling the other out hard, and then cutting off with the pliers to desired length. It is not so long an operation as it might seem to be.—E. CONRY.

[60394.]—**Pocket Magneto Machine.**—To MR. BOTTONE.—What do you mean by a "pocket magneto machine"? I know of no machine having magnets less than 6in. long to be of any use whatever, and these can hardly be called pocket machines. If this is what you want, write again, and I will send in drawings and description.—S. BOTTONE.

[60395.]—**Water Motor.**—If you want simplicity and non-liability to get out of order, you must have a turbine, as a good one will work for years with care, and will not cost one penny in repair. I cannot help you as to the size of turbine as you do not state what fall you have or what quantity of water you have per minute, as these are the two main points of water power. If "F. E. A." will advertise his address, I will help him further.—MILL-MAN.

[60396.]—**Electric Lighting.**—Details of a dynamo suitable for you have been given by Mr. Eaves, and also by "Xero," in these pages. The construction of secondary cells is a long process. See my reply to 60346 this week. You are debarred from using any but Planté cells, owing to the patent rights held by the E. P. and S. Co.—C. D. R.

[60396.]—**Electric Lighting.**—In my book, "The Dynamo, How Made and How Used," you will find full constructive details for a machine such as you require. Some differences, however, must be made—viz., firstly, the machine should be three times the size of the one therein described; secondly, the armature should be laminated, or built up of punchings, instead of being solid.—S. BOTTONE.

[60396.]—**Electric Lighting.**—I am afraid you will not find any work giving what you want. What volts do your lamps take, and can you tell what current is required to light a single one? The latter would be advantageous, and information of the former is indispensable. If you will furnish this, and also say for how many hours each night you would want the light, perhaps I can help you.—E. CONRY.

[60397.]—**Engine.**—The boiler named, with a good draught, is only just large enough, or, I might say, barely enough. Better have one 14ft. by 5ft.—T. C., Bristol.

[60398.]—**Photography.**—Your proposed studio is not long enough (15ft.) for cabinet work. You will require at least 20ft., and if you use the lens mostly in use by first-class photographers (Dallmeyer's 3 A patent) you will require 24ft. Don't put windows in it, but make all your north side and roof of glass, and then you can use screens to modify the light as you desire. Seven feet in height is too low; why not make it 8ft. at the north side, rising to 12ft.?—B.SC., Plymouth.

[60401.]—**Violin Belly** should be $\frac{1}{8}$in. thick all over; or you may graduate it from $\frac{1}{6}$th at centre to $\frac{1}{10}$th at edge.—T. LISLE.

[60401.]—**To A., Liverpool.**—I don't know what is your motive for making a violin belly of cedar wood. I never heard of such, and would prefer a piece of nice grained deal or American pine, but not soft. I would think it would give a deal of unnecessary trouble to work the bass bar out of the solid. I give the thicknesses of a fine old violin in my possession as accurate as I can measure with callipers through *f* holes. Thickness under bridge is $\frac{3}{16}$in. Do. at inside edge upon bass side $\frac{1}{8}$in. bare. Do. on treble do. $\frac{1}{16}$in. full. Do. all round outside of the sides is $\frac{3}{8}$in.—A., Liverpool.

[60402.]—**Violin D String.**—Your violin is probably too thin in the wood, or the ratio between the upper and lower air chambers is not correct. Consult an expert.—T. LISLE.

[60402.]—**Violin D String.**—Of what sort is defect? Examine nut and bridge to see if string is stopped clean and sudden like other strings. If string buzzes on finger-board your bridge is too low, and you must get new one. Look if bridge stands well on both feet, and not on edge of one foot.—WEALD.

[60402.]—**Violin D String.**—It is one of the characteristics of a first-class violin that all tones produced by it are equal, and it mostly happens that an inferior violin is tubby upon its third string. This can often be greatly improved by trying a thicker or thinner string, and at the same time moving the soundpost slightly backwards or forwards, which can be done with a thin 1in. chisel or table knife; but it is essential that said post shall be exactly in a line with the centre of the treble foot of bridge, that it be so loosely up that if all the strings are taken off it would almost fall down, and, lastly, that the E string ought not to be, as is often the case, outside of the vertical line from centre of foot, so that there would be a strain to tilt the bridge over were the other strings slacked up.—A., Liverpool.

60403.]—**Revolving Cylinder.**—I should suggest working them with strong flat coil springs like those of a clock, and if you have any difficulty about making them go slow enough, you could wind on one axis, or on the cylinder itself, a cord sustaining a weight, by increasing which you could regulate the turn of the cylinder to any degree of slowness. I fear, however, you will have some little difficulty about getting it to work as slowly as you want without the aid of clockwork, or very special springs.—E. CONRY.

[60406.]—**Photographic Exposures.**—I would advise "N. Y., Plymouth," to get the "Systematic Exposure Note-Book" (Cartwright and Rattray, Manchester, 1s.), where he will find tables to suit all his queries. (1) and (2), he is right. (3), multiply 1 or 2 by 6 for August. Six o'clock is too late for photography in September.—B.SC., Plymouth.

[60409.]—**Boiler.**—If for practical work, buy one of the many 2 h.p. boilers always in stock, and do not go to the expense of a copper one. You could buy two of above for one of copper, and the difference in steaming is—well, let me say, a fancy. T. C., Bristol.

[60410.]—**Electro-Motor for Boat.**—I think it will scarcely be a "model" electro-motor that "Rochdale" requires. A boat of 3ft. in length will require a fairly powerful motor. I saw one working at an electrical exhibition (at Barrow-in-Furness) in connection with the School of Science and Art. If I remember rightly, it was about 4ft. long, and was sailing in a long tank. Mr. E. Thornton is the maker, and perhaps we might ask him to give us a description in "Ours," so that many of us who have tried and been unsuccessful may know how to proceed. This boat was fitted with apparatus for regulation to various speeds, and also motion for reversing. I believe the speed this small boat has attained is eight miles an hour, and to continue without recharging for six hours. Now this is just what many of us would like. Hope for Mr. Thornton's particulars that I may try my hand.—ANOTHER ROCHDALE.

[60410 and 60411.]—**Electro-Motor and Engine.**—If "Rochdale" can refer to p. 570, Vol. XLI., of the ENGLISH MECHANIC, he will find description and illustrations which I sent in, which will, if carefully followed, enable him to construct satisfactory motor and engine. If he cannot refer, and he will notify, I will repeat information.—S. BOTTONE.

[60411.]—**Engine.**—What sort of electromagnetic engine do you want? A little pump, or mill, or what—or will anything do that shows electricity turning a wheel?—E. CONRY.

[60412.]—**Steam.**—Area of 16in. cyl. = 201in., and of 27in. cyl. = 572in. Ratio of cyls. is $\frac{572 \cdot 2}{201}$, or 2·84 to 1, and if cut off at $\frac{1}{2}$ stroke in h.p. cyl., expansion will be $2 \cdot 84 \times 2 = 5 \cdot 68$ times. The terminal pressure at 50lb. boiler pressure will be $\frac{50 + 15}{5 \cdot 68}$, say 11lb. above a vacuum. At 65lb. it would require to be expanded $\frac{65 + 15}{11}$, say seven times to produce same final pressure, or at $\frac{5}{7}$ of $\frac{1}{2} = \frac{5}{14}$ of stroke in h.p. cyl. The reason of the saving in using h.p. steam is that the latent heat is proportionally less, but the sensible heat greater, the work obtained being represented by the fall of sensible heat obtainable, in working, from boiler to condenser or atmosphere; say in your case from 312° to 100° at 65lb. and condensing.—T. C., Bristol.

[60413.]—**Steam Valve.**—No difficulty in arranging this. Simply a piston weighted to lift at 30lb., say, and connected by a lever to an equilibrium valve to admit steam into the other boilers. No demand for such a thing commercially, as most would use a simple wheel valve, and adjust it as required by hand.—T. C., Bristol.

[60414.]—**Overhead Wires.**—You must obtain permission from the local authorities to cross the streets with an overhead wire, and also from the various owners of lands and houses over which the wires will run. In a majority of cases a rent will be charged for all houses where an insulator is fixed for the purpose of supporting the wire. You will be required to show good cause for erecting the line, and be prepared for a refusal.—C. D. R.

[60414.]—**Overhead Wires.**—Get permission to put up telegraph posts or insulators where necessary from the various householders on whose houses you require to put up the supports, and then run your wire as quietly as possible, without asking permission of anybody else, unless you happen to be in a very small country town, where everybody knows everybody else's business, and there is a fussy vestry to interfere with everybody all round; in which case it would be of no use attempting secrecy, and you would have to propitiate the "powers that be," and get their sanction.—E. CONRY.

[60414.]—**Overhead Wires.**—You must first obtain permission from the owners of houses where you wish to attach the wires. The local boards or parish authorities have no power or control over the overhead wires when carried across streets or highways; but owners of private property (or occupiers) can object to wires passing over their houses or gardens, and can institute proceedings if persisted in. Take care that your instruments are not an infringement of existing Bell, Blake, and Edison patents, or a local telephone company may trace out your line, see the instruments, and bring an action against you or your friend.—ARMATURE.

[60415.]—**Brazing.**—If only required air-tight solder would do; but if it must be brazed file a few notches in plug, which must not fit tight. Use powdered borax as a flux, and drop in some brass cuttings; raise to a red heat, and remove as soon as a blue flame appears in tube.—T. C., Bristol.

[60417.]—**Fish-Plates.**—Yes, they work loose by the vibration, and there are plenty of notions for preventing it, such as split spring washers, nuts with thread part bent, lock nuts, &c. Not possible to say if any railway company would adopt a thing, even if you gave it to them. The patent specifications on railway plant would repay reading, and give you some idea of the number of patents granted for railway matters, and how few are taken up.—T. C., Bristol.

[60419.]—**Clark's Cell** will give a constant E.M.F. of 1·457 volts. Hence, comparison with this gives ready means of measurement. In this cell the positive element is pure mercury, which is covered by a paste, formed by boiling sulphate of mercury in a saturated solution of zinc sulphate. The negative element consists in zinc which has been purified by distillation. It rests on the paste. Contact is made with the mercury by means of a platinum wire, which passes through a glass tube fixed to the interior of the vessel, and which plunges below the surface of the mercury; or, better still, through a little glass tube blown in the side of the vessel, and opening close to the bottom of it (See "The Electrician's Pocket Book," p. 62).—S. BOTTONE.

[60420.]—**Steam Whistle.**—The bell is not indispensable, as it is only used to increase and deepen the volume of the sound. Steam, blowing out against any sharp edge, will produce a loud screech, and if applied to an ordinary metal whistle in the same way as the breath, will produce a similar, only louder, effect.—E. CONRY.

[60421.]—**Carriages.**—It is quite impossible for a pistol thrown from a carriage window to fall on the step board, and if it did, the motion would soon shake it off.—KENTISH TOWN.

[60422.]—**Protection of Life.**—The offices of

the International Association for the Protection of Human Life are at Victoria Mansions, Westminster, S.W., and if your correspondent "Inquirer" will communicate with the secretary, he will doubtless be furnished with the information for which he asks. I may add that I am a member of the Executive Council of the Association.—CLEMENT E. STRETTON.

[60430.]—**Gravity Daniell Battery.**—Several causes have been at work to produce the effects you name. 1. The acid must be too strong to produce evolution of gas. 2. The zinc was probably not properly amalgamated, otherwise gas would not be evolved except on the closing of the circuit. 3. The sulphate of copper solution has been agitated and got mixed with the acid solution, hence the flocculent deposit on the zincs; or, 4. The zinc dips too deeply into the jar, and thus reaches the copper solution. I should strongly recommend the ordinary porous-cell form in preference to the gravity.—S. BOTTONE.

[60430.]—**Gravity Daniell Battery.**—Your solutions are mixing. The black deposit on the zinc is reduced copper, and takes place at all times when the sulphate solution reaches the zinc. You had better empty the cells, and recharge them, using plain water for the zinc; it will take up acid from the copper solution. When hydrogen is evolved it shows that the solution is too strong in acid; a portion, therefore, should be drawn off with a syringe, and pure water added to dilute the remaining portion. Daniell cells consume almost as much zinc on open circuit as on closed.—C. D. R.

[60430.]—**Gravity Daniell Battery.**—Your trouble comes from sulphate of copper reaching zinc. The local action deposits copper in dirty black form, perhaps really copper-hydrogen alloy, and then local action is increased. Open circuit merely encourages the evil; best chance is to let current run free, especially at first, with low resistance. Keep solution on copper plate well nourished with crystals. Clean your zincs now, and start again; fill up cells quietly. When not in use do not break circuit, but connect with high resistance, such as lead pencil, cutting two notches through the cedar for connection.—WEALD.

[60430.]—**Gravity Daniell Battery.**—Your cells are short-circuiting themselves inside—that is, there is some electrical communication between the zinc and copper plates, which ought not to exist. Probably it is caused by the metal strap or wire connected to the bottom plate not being properly insulated from the liquids through which it passes. Perhaps, also, the liquids have become mixed. Have you got sawdust or sand inside the cell, as that is one of the best ways to prevent the fluids mixing? Remake the cells, carefully insulating the metal strap, and using sand or sawdust, and you will not find any trouble. The ordinary form of gravity Daniell cell is as good as any for working an electric pen.—E. CONRY.

[60434.]—**Crank Movement.**—There must be a dead point if the motion of piston is reversed, or how could it reverse? This dead point is theoretically a mathematical point only; but practically it is an inch or two in good engines, and if you have ever tried to oil the crank-pin when running at, say, 100 revolutions a minute, you will know how short an interval it represents. Of course, a direct rotary motion is best, if we can get it without too much complication: but if any reciprocating motion is used to obtain it we had better stick to the crank, I think.—T. C., Bristol.

[60435.]—**B.A. Degree, Dublin University.**—If "Scholastic" would advertise his address in the "E. M.," I would be happy to send him a small calendar. University calendars and their supplements, containing the papers set during each year, can be had from Messrs. Hodges and Figgis, Grafton-street, Dublin, price 4s. each.—T. C. D.

[60435.]—**B.A. Degree, Dublin University.**—The regular examination for this is in December; there is also a special examination for the same in June. The subjects are astronomy, ethics, English composition, and any two of the following—viz., mathematical physics, experimental science, natural science, and classics or languages; the last-mentioned meaning any two out of Greek, Latin, French, and German. The questions for the ordinary examination are not published. "Scholastic" had better procure the Dublin University "Calendar," published by Hodges and Figgis, Dublin, and Longmans, London. Price 4s.—DUBLINIENSIS.

[60436.] — **Telegraph Connection.** — To "E. M."—Do you want the arrangement in duplicate so as to ring from both ends like an ordinary telegraph, or from your own end only? Your words strictly apply to the latter arrangement only.—E. CONRY.

[60437.]—**Zinc Stencil Plates.** — They are made for the trade by a punching machine; but you can cut them out with a mallet and chisel on a block of hard wood, carefully drawing the outline of the letter first, and finishing off with a smooth flat file, if necessary.—E. CONRY.

[60437.]—**Zinc Stencil Plates.**—Make a mixture of Burgundy pitch and beeswax and rub it on the slightly-warmed surface of the zinc. Black Japan varnish will do nearly as well if time is allowed for it to dry thoroughly. Rub the under side with tallow, scratch the outlines of the parts to be cut out deeply and cleanly, and cover the scratches with hydrochloric (muriatic) acid. If done with moderate care the acid will cut out the pattern as cleanly as if done with a chisel or graver.—998.

[60438.]—**Photography.**—The fault in enamelling is in taking the print off the glass *before* mounting; it must be partially mounted on cardboard first. In burnishing, probably your photos. were not sufficiently dry.—B.SC., Plymouth.

[60440.]—**Frogs.**—The best arrangement for keeping frogs is a large rectangular fern-case, the bottom of which is covered to a depth of about 6in. with peat moss. At one end place an enamelled iron pie-dish, sufficiently large to reach from side to side, and let the edge of the dish be on a level with the surface of the moss. In the centre of the dish build a small rockery of stones, &c., for the frogs to climb on. If you intend keeping green tree-frogs as well as the common or garden animals, you must plant a small bush of some kind (myrtle is the best and prettiest) at the end opposite the pie-dish, on which the frogs will bask in the sun. For the tree-frogs flies are the best diet, and the others will thrive well on worms, beetles, or any small insects. Of course, you may put any ferns, bits of bark, or other ornamentation into the case, and if this be tastefully done, the result will be a very ornamental vivarium. I may add that a few green Jersey lizards will add greatly to the appearance of the whole concern. — H. W. EDWARDS.

[60444.]—**Turning Vulcanite or Ebonite.**—Small sharp lathe tools (hand lathe tools, unless the work is very large), three-corner bevel and bird's-beak (i.e., pointed-nosed, more or less) of various sizes, with one or two very narrow, square-nosed tools for cutting with the side edge. A pretty fast speed, a light cut, and no lubricant; an ordinary carpenter's gouge ground down to a rounded nose is also very useful for this.—E. CONRY.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

59926. A "Wonderful Lamp" and Battery, p. 447.
59942. Progressive Loss in Rate of Watch, 447.
59943. Inter.B.Sc. (Lond.), 447.
59946. G.E. Locos., 447.
59973. Hindhead Hills, 448.

60125. The Steam Yacht *Rosalind*, p. 539.
60127. Subscription Sales, 539.
60144. Railway Locomotives, 540.
60145. Picture-Frame Gilding, 540.
60146. Brass Tubes, 540.
60151. Doubling Chenille, 540.
60172. Testing Steel Wire, 540.

IN the *Archives de Geneve*, Professor Brun has published an interesting study on the so-called lightning holes to be found in the High Alps. He and other investigators have found them at heights of from 3,348 to 4,000 mètres, or between 11,000ft. and 13,000ft. above the sea level. Usually they are found on summits. Sometimes the rocky mass, which it is supposed has been vitrified in the passage of the electric fluid, presents the appearance of small scattered pearls, sometimes of a series of semi-spherical cavities only a few millimetrés in diameter. Sometimes there are vitrified rays going out from a central point to a distance of four or five inches. Sometimes a block detached from the mass appears as if bored through by a cannon-ball, the hollowed passage being quite vitrified. The thickness of this vitrified coating or stratum never exceeds a millimètre, and is sometimes not more than the quarter of that depth. The varying colours which it presents depend on the qualities and composition of the rock. The same may be said as to its transparency. On the Rungfischhorn the glass thus formed by the lightning is black, owing to the quantity of actinolith which the rock contains. It is brown on La Ruinette, the rock consisting of feldspar mixed with gneiss containing chloride of iron. Under the microscope these lightning holes display many interior cavities, which must be attributed to the presence of water in the rock at the moment of melting by the electric discharge. This vitrified material has no influence on polarised light.

QUERIES.

[60445.]—**G.W.R. Engines.** — Will some correspondent kindly give dimensions of 3202 class, saying for which work they are used, and how many there are?—G.

[60446.]—**Bisulphide of Carbon.**—Will Mr. Grey, or some other competent chemical friend of "Ours," kindly say how many cubic feet of sulphurous acid gas are given off in burning five fluid ounces of the above? Also, what quantity of bichloride of mercury would it be necessary to vaporise to saturate 1,000 cubic feet of air?—IGNORAMUS.

[60447.]—**To Mr. Bottone.**—I am making a dynamo from dimensions given by you in "E. M." of April 23rd. What size should the iron ring for armature be (you give $4\frac{3}{4}$in., which is size over wire)? I intend using No. 18 double c.c. wire. What distance should there be between sections on armature? I propose using an iron ring with grooves turned on the outside.—MCP. M. V.

[60448.]—**Legal.**—Will our legal adviser kindly reply to the following queries? (1) If a married woman having an income under £100 in her own right can claim exemption from income tax (her husband is, of course, liable for his own property). (2) Is a wife's private property liable for any unpaid debts of her husband's at his decease?—THE BARD.

[60449.]—**Music.**—(1) I should like very much to read some good book, English or German, on harmony, "Harmonielehre." (2) Is there any work in existence which "explains" Beethoven's music—his sonatas, symphonies, and concertos? Would some kind friend of music give me some information on these two points? I should be greatly obliged.—MUSIKFREUND.

[60450.]—**Electric Power for Tramcars.**—(1) It is required to work five tramcars upon a line $1\frac{1}{4}$ mile in length, the total electrical power being 200 ampères at 300 volts, the cars on an average being equidistant. Assuming the generating station to be at one end, please state the economic sectional area of the conductors for various sections of the line. (2) Five cars, weighing two tons each, carrying 20 passengers, have to be taken up a gradient of 1 in 15 at a speed of five miles an hour. What is the necessary mechanical H.P. required and allowing for the loss in conversion, leakage, and transmission? What is the electrical H.P. required?—BLACKPOD.

[60451.]—**Pocket Accumulator.**—Will some of our practical electricians kindly inform me how to make a pocket accumulator for a 4c.p. lamp? Also a simple electric motor?—A. W.

[60452.]—**Loco. Question.**—Does the height of a loco. boiler make it run more rough? Should the boiler be kept low down to get steady running?—KENTISH TOWN.

[60453.]—**North British Engines.** — Wanted, dimensions of the new 590 class of N.B. express engines.—ANTI-VAC.

[60454.]—**Wind Motor for Electric Lighting.**—I have lately constructed a wind motor on a somewhat novel principle. Its power in an ordinary breeze is about on a par with an ordinary windmill presenting the same surface to the wind. As the wind increases in force the speed and power of the motor increases in proportion, without any check, except by the work it performs; but the machinery driven by the motor runs at one uniform speed, however much the motor may vary in speed. It requires no attention under any pressure of wind, except to keep it well oiled. My idea was to make a motor that would drive a dynamo to charge accumulators, and do its work automatically, without requiring the presence of an attendant. The motor is left free to start whenever there is sufficient wind to drive it, and when it attains sufficient speed to drive the dynamo safely, the dynamo is started automatically, and not before. When started, the dynamo will run at one uniform speed under any increase in the pressure of wind, and consequent increase in the speed of the motor; but when the wind decreases in force, so that the motor will not drive the dynamo at a sufficient speed to charge the accumulators, the dynamo is stopped automatically, and the same mechanism will break the contact between the dynamo and the accumulators. I should be glad to have the opinions of practical electricians as to the value of such a motor for lighting country houses, &c. I may add that the motor presents none of the objectionable features of an ordinary windmill.—J. G. GWYNT.

[60455.]—**Chemical.**—Could anyone kindly furnish me with a formula by which I could prepare paper, and make a medium in the form of a pencil (not brush) to use upon said paper, which would raise a palpable and permanent mark upon the same? Colour no object.—W. R. S. R. N.

[60456.]—**Balm of Columbia.**—What is the composition of this preparation for the hair?—SALUS.

[60457.]—**Winding Gramme Armature.**—To MESSRS. BOTTONE, EAVES, AND OTHERS.—Will you be so kind as to give an amateur the following instructions as to winding a Gramme armature—that is, the proper way of coiling the wires, so that the coils shall be evenly wound and the two ends of every coil to come on the outside, and to prevent self-induction between the coils?—AMATEUR.

[60458.]—**Old Oak.** — In consequence of wet flower vases having remained for some time on old polished oak furniture, the colour of the oak has in such places been removed. Can anyone suggest a means of polishing or staining such marks, or in any way restoring the colour of the oak?—IGNORANCE.

[60459.]—**Crane Chain.**—Find the maximum stress in a crane chain 30ft. long, which, when raising 25 tons, has to sustain the sudden impulse due to the dropping of the load through 9in. What statical load would be required to produce an equal stress in the chain?—X. Y.

[60460.]—**Telegraph Circuit.**—I have charge of a telegraph circuit of some eight or ten miles long. Six miles of the line wire is carried by the posts that belong to the railway. This same circuit is used for speaking purposes; but owing to the great amount of induction from other wires it is very difficult to hear each other. I would be very thankful for some instructions as to lessen the induction.—AMATEUR.

[60461.]—**Starch in Yeast.**—Would Mr. Grey, or some other chemical reader, kindly give information as to the best method of ascertaining the amount of starch in yeast when mixed with that substance?—ATOM.

[60462.]—**Testing Lightning Conductors.**—Would Mr. Bottone, or other electric contributor, oblige me with how to test a copper lightning conductor on a 60ft. chimney? I am wishful to do it myself; have battery and galvanometer. Can it be done without ladders, &c.?—CHIMNEY.

[60463.]—**Lantern Slides.**—I have a few slides (photos.) which, when looked down upon, have a greenish sort of tint. I think they are made by the "Wet Collod. Proc." Am I right? Is there any special preparation or mode of treatment for giving slides the above mentioned tint? What is it? Can it be used with any process or plates?—B.

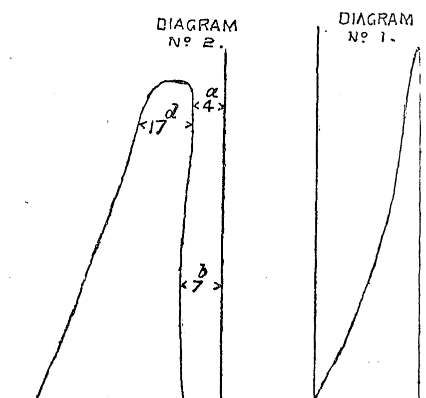
[60464.]—**Coopering.**—Will someone please instruct me through your paper on coopering? I wish to commence in a little way of making small tubs and casks; some knowledge of carpentering.—SOBER.

[60465.]—**Sewing Machine.**—Lockstitch refuses to pick up lower thread; upper thread will work about ten stitches, then seems to catch, and gets cut by needle. Have taken machine to pieces, and cleaned and examined it; but cannot see the fault. Can any reader enlighten me?—F. W. S.

[60466.]—**Emery Wheel.**—Can any of our readers tell me how I can put a good coat of emery on to my wheel that will not get soft when exposed to rain? I have tried all sorts of glue; but when exposed to rain it becomes soft, and dirties any article that I may be grinding on it.—TRAVELLING CUTTER.

[60467.]—**Falke Torpedo Boat.**—Can any reader supply me with the following information about the Falke (the Austrian) torpedo boat? I want to make a model of above boat on $\frac{5}{8}$in. or $\frac{1}{2}$in. scale. I require the position of the two funnels, the conning tower, and the two ventilators behind; also the position of the conning tower in front of the funnels, and, if possible, the length of the turtle deck from the bows, and the distance from the bows of the widest part of the vessel. Please give the height, diam., &c., of the funnels, ventilators, &c.—the size they are in the boat itself. Also give diam. and pitch of propeller.—ISLE OF DOGS.

[60468.]—**Action of Steam**—To "T. C., BRISTOL."—Thanks for your taking notice of my query (60294). The diagrams were taken with the indicator; but I have drawn other two diagrams, not to scale, but so that you will be able to see what I want better. Diagram No. 1;



between the lines of counter pressure and atmospheric line there are 4lb. at A, 7lb. at B, and 17lb. at C. You say the 4lb. at A go to the $2\frac{1}{2}$lb. at E on diagram No. 2. Now where does the 7lb. at B, the 17lb. at C, and the 17lb. at D go to on diagram No. 1? From the atmospheric line to the steam line on diagram No. 1 is 50lb., and not 17lb., as you read it in reply 60294. The 17lb. at D is between the steam line and the line of counter pressure.—YOUNG ENGINEMAN.

[60469.]—**Hygrometric.**—Would one of the readers of the "E. M." kindly give rule for calculating the weight of moist air, say 1,728 cubic inches of moist air at 15° C. and 59° Fahr.; dew point, 5° C. and 41° Fahr.? Also rule for correction of the barometric height for millimètres and centigrade scale?—POSTULATA.

[60470.]—**Malt.**—Could you inform me how to take the bitter and colour from malt after being boiled with hops? I have an idea that animal charcoal will do it; but how to use it, so that it does not get mixed with the malt, is what I want to get at.—THOMAS PEARSON.

[60471.]—**Electric Clock.**—Can any of "ours" give me full particulars and sketch of electric clocks in new schools, Oxford?—W. J.

[60472.]—**Chuck for 3in. Lathe.**—Will any of "ours" kindly give us sketch and full working drawings of a three or four-jaw chuck for 3in. lathe? The patterns is our difficulty for castings. If we can get them out are of opinion could manage other part. Any information will greatly oblige—W. J.

[60473.]—**Resistance Coil or Switch.**—Will someone oblige with particulars for making switch or resistance coil for working strength of battery power of small plating bath for fixing in front shop?—E. T.

[60474.]—**Shirt Collar Studs.**—Can any reader tell me how the metal covering is put on to some of these, and with what tool?—MOSES.

[60475.]—**Gelatine Moulds for Plaster Casting.**—Would some reader kindly give a little information as to the correct method of making gelatine moulds for plaster casting? I have been using good gelatine with as much alum as it will take up; but the gelatine moulds break very readily: they do not seem at all tough enough.—BARIUM.

[60476.]—**Dynamo.**—Would Mr. Bottone kindly give directions for winding and connecting the machine described by him in No. 1100? I have the armature wound with $3\frac{1}{2}$lb. No. 18, and 15lb. No. 20 to put on fields. Also say what number of 20c.p. lamps I would require, and their voltage. Would 2,000 do for speed?—D. B. S.

[60477.]—**Saccharin.**—Would some of our kind correspondents be good enough to answer a few questions in reference to the above? I have read the notices in reference to the above, No. 1115, p. 500, and No. 1116, p. 522, and think that (price there quoted excepted) it could be used to great advantage in my business. Please give address of German Co., or of any English manufacturer of the article in question. What is the present price quoted per pound? Is it soluble in water?—SUGAR BABY.

[60478.]—**Setting out Curves.**—Can any reader give me a hand in this? I want to know how to do it sufficiently for railway contractor's work, and for the present to avoid all theoretical business over the job, that I can go into at my leisure after I know enough for practical purposes. I have Baker's "Engineering Surveying," but that goes into trigonometry. Must I learn this for a start? I have a theodolite, and can set out an angle. What books had I better get for self teaching on this and kindred subjects?—CURVIST.

[60479.]—**Engineering Formula.**—

$$1.—H = \frac{D^2 \times \sqrt{P} \times R \times S}{8500}$$

$$2.—H = \frac{2 \times A \times (P - 16) \times 7 \times R \times S}{C \times 8}$$

I shall be greatly obliged if any mathematical correspondent will kindly transpose the above formulæ. In No. 1 I want the values of D, P, R, and S; No. 2, the values of A, P, R, and S respectively.—ENGINEERING, MANCHESTER.

[60480.]—**Conic Sections.**—In Hunter's book on this subject, there occurs in the early part of the chapter on the ellipse the following:—

$$e = \frac{2a - e\,.\,DA'}{2a + DA'} \quad \therefore a = ae + e\,.\,DA'.$$

Can any of the correspondens of the "E. M." inform me how the value of a is obtained from the first equation?—E. W.

[60481.]—**Polarised Light.**—I am desirous of learning if any improvement has been made in the production of artificial tourmalines (Herapathite) since the papers published by Dr. Herapath, I think, in 1852. Further, why are natural tourmalines so costly? Is it that only occasionally the tourmaline possesses the property of polarising? It cannot be that the working of the mineral presents any particular difficulty. I find that plates but little exceeding $\frac{1}{4}$in. in diam. are charged from £2 to £3 each, £5 being asked for a plate not exceeding $\frac{1}{2}$in. in diam. I am told that some polarising appliances (selenite objects, for example) are much cheaper in Paris than in London. Is it so with respect to tourmalines?—E. W.

[60482.]—**Problem—Carbon in Steel.**—In Eggertz's test for carbon in steel two tenths of a gramme of the steel are taken for testing. Supposing a steel to contain 0·50 to 1·00 per cent. of carbon, what amount of error in weiging the 0·20 grammes of steel would produce a difference of 0·01 per cent. (1-100 per cent.) of carbon, or, in other words, would make a 0·75 per cent. into 0·76, and, consequently, is a very sensitive and accurate balance essentially necessary for the test or not?—ALDEBARAN.

[60483.]—**Electro-Motor.**—I wish to make an electro-motor to be worked by a battery of 12-18 bichromate cells. I require about $\frac{1}{8}$ to $\frac{1}{6}$ H.P., and, if possible, the weight of motor not to exceed 30lb. Would Mr. Eaves, or Mr. Bottone, kindly give me a rough description, dimensions, size and quantity of wire, &c., and best method of winding? I have good appliances for making it, and have made two or three smaller motors before.—MOTOR.

[60484.]—**Twilight.**—Respecting this phenomenon, will "F.R.A.S.," or others of our authorities, kindly inform me how the calculations are made to fix its duration at all times of the year? Whitaker gives the hour it ends for the first of each month; how is this arrived at? We are told that twilight lasts so long as the sun is less than 18° below the horizon. But a degree varies in length with the latitude of a place; and as it is the place, say London, and not the sun, which rotates out of sunlight into twilight and night, slower and through less space as it is more distant from the equator, is the band of twilight, or 18°, narrower in miles at London than at the Equator, or would it be correct, on a diagram of a hemisphere of the earth showing the sun over the Equator (in March) illuminating the upper half for day, leaving the lower half shaded for night, to draw a line parallel to the line dividing day from night (coincident, at this date, with the earth's axis) 18 equatorial degrees wide right across from south to north, or should the width of this twilight band vary from the equator north or south in accordance with the varying lengths of a degree?—because, if not, it would, at London, indicate more than 18°, though of the same width as at the Equator? I am living close to the Equator where twilight is proverbially short; yet it seems to me, theoretically, it should (at shortest) last 72 minutes from sunset to the last streak of light on the western horizon.—LAUKA.

[60485.]—**Waterproofing Double Textures.**—Could any of your readers give the writer any hints about waterproofing double textures? I can make the solution right enough; but on the slightest pressure to make the two cloths adhere, the solution inclines to come through and stain the fabric outside, and, of course, it looks unsightly. The commercial double texture solution appears quite black, as if it was mixed with earthy matter. I have tried it mixed with silicate, magnesia, soot, tar, pitch, &c.; but any of these mixtures seem to destroy the adhesive power of the rubber. The melted pitch, for instance, when mixed with the indiarubber solution, hardens almost immediately, and renders the solution useless.—WATERPROOF.

[60486.]—**Oscillating Engines.**—Will any kind reader who has had experience in Mill's style of oscillating cylinders state whether I can use them for a steamboat to drive a screw of 3in. dia. at a high speed? I have had considerable trouble with the old style of flat faces, working on a block, as they seem to me to waste steam very much. I think of using a pair, $\frac{5}{8}$in. by $1\frac{1}{4}$in., on the diagonal system, only one crank, and at a pressure of 40lb. steam. Will any reader give me some particulars as to working, and if suitable for high speed, and how the steam is admitted to the cylinders?—ENGINE PUP.

[60487.]—**Dynamo.**—Will Mr. Bottone, or some other electrician, kindly say whether a dynamo giving, say, 25 volts and 12 ampères would light 12 incandescent lamps, taking, say, 25 volts and one ampère each, or should the dynamo give 300 volts and 12 ampères to light the lamps? Also, about how many volts and ampères must a dynamo be making to give an unpleasant shock to any person touching the terminals or the leads?—J. H.

[60488.]—**Medical Battery.**—I am constructing a medical battery of several dozen of Leclanché cells. I wish to know if a canvas bag would answer instead of the usual porous pot, and what disadvantages there would be attending it? I have looked through all my back numbers since 1875, and can see no mention of any other diaphragm but the porous pot. Not having a long purse, if the canvas bag will answer it would be a great help to me. At the local chemists I find peroxide of manganese is 1s. 2d. for 7lb. I find electricians want from 8d. to 1s. per pound. Is there any difference in the quality, and would the first-mentioned do for a Leclanché?—CARPENTER.

[60489.]—**Electric Lighting.**—To S. BOTTONE.—I wish to light up four rooms of 10 candle-power each for about six hours a night. I want to light them by storage batteries, and to charge them from a 70 candle-power dynamo driven from a lathe. How many cells should I want, and how long would it take to charge them? I intend using E.P.S. cells.—VOLT.

[60490.]—**Book-keeping.**—I shall feel obliged if any reader will kindly inform me which is the best and simplest method of keeping books in a small engineering firm—whether single or double entry is to be preferred, and what books are really requisite. Information as to the simplest work on book-keeping, dealing, if possible, with the engineering section, would oblige. I am about to commence business on my own account, and would like to know the best system for a place employing, say, 20 hands.—LEDGER.

[60491.]—**Time.**—I have three regulators, all compensated, but cannot get them to run together. Will anyone kindly tell me if there is a simple method of getting true time by the observation of a star passing a given point two or three times a week, so that I could find which of my clocks is going right?—CHRONOS.

[60492.]—**Mechanical.**—Many thanks to "T. C., Bristol," for answers to my past queries. Would he kindly give a rule in figures for finding in wheel works when the same two teeth come into contact again? A wheel of 44 teeth, pinion 28; how many turns will each wheel make to bring the same two teeth together that were in contact when starting? Rules for any wheels will oblige—NOVICE.

[60493.]—**Sewing-Machine Cams.**—Would someone inform me what kind of machine is in use for cutting sewing machine cams, as I am ignorant as to how they are cut?—W. G. PAYNE.

[60494.]—**L. B. and S. C. Locos.**—Can anyone tell the principal dimensions and what letters denote the classes of the following: Goodwood, Norwood, Reigate, Sutherland, Genoa, Silverdale, Chambery, Gipsyhill, 424, 411? Also how many engines are stationed at Battersea and New Cross?—RICHMOND-PORTSMOUTH.

[60495.]—**Britannia Developer.**—Would "B.Sc.," or some of your photographic readers, kindly assist a fellow being driven almost to desperation by the following? I am using pyro. developer with Marion and Co.'s Britannia plates. I have adhered strictly to the formula in mixing. I have used half a gross of plates with various exposures, and I can get nothing except a hazy image. Would some kind reader tell me the cause? "E. Y.," No. 1,069, p. 68, was in the very same predicament; perhaps he can now assist me.—TERRANOVA.

[60496.]—**Telephone Fixing.**—Under the heading "Answers to Correspondents" you say "two wires are better, as earth return is not satisfactory with telephones." As with earth return the paths for the current would be farther apart in most cases than when two wires are used, and, therefore, induction would be less; how can that be so? and is it not entirely opposed to Mr. W. H. Preece's experiments as detailed in his paper "Induction in Telegraph Wires"?—ZINCI SULPHAS.

[60497.]—**Acoustic Telephones.**—I wish to fix one of these for my own use, but find great difficulty in getting the sound to travel round the insulators, of which I cannot do with less than four. I can hear the sound of the voice, but am unable to tell what is said. A musical note is conveyed perfectly. Can any of your readers assist me?—ZINCI SULPHAS.

[60498.]—**Induction Coil.**—I have made one according to directions set forth in "Dyer's" book, and get $\frac{1}{2}$in. spark. I find, no matter which way the primary current flows (I have fitted a commutator), I can obtain the static spark from that end only of the secondary which is farthest from the core. Why are not the ends of sec., from which static spark is obtained, reversed when prim. current and polarity of core are reversed? Is it a fault in construction?—ZINCI SULPHAS.

[60499.]—**Waterworks Pressure.**—Can any obliging fellow reader give the usual working pressure of town's water, giving an example or two, say Glasgow, Manchester, Liverpool, Sheffield, Birmingham, or London? Expressed as pounds per sq. in. preferred, but feet head of water, or inches of mercury will do.—NIAGARA.

[60500.]—**Coil**.—Can any kind reader inform me how to wind a street coil, 9 by 4? I want to have six different powers. What size wire to use, and if c.c. will do?—ONE IN A FOG.

[60501.]—**Inks**.—Will any kind reader inform me what colour I ought to get if I dissolve 3½ of nigrosine in 10oz. of warm water, and state what action sulphuric acid has upon it? Also if some reader will inform me how to make black ink, like Draper's?—NEMO.

[60502.]—**Lattice Girder**.—Should be greatly obliged for dimensions of a lattice girder, 12ft. span, to carry a concentrated load of 5 tons, and method of calculating the strength. Should be glad of recommendations for course of study for calculating strength of materials and structures.—SELF TAUGHT.

[60503.]—**Photography**.—(1) what kind of lens is considered best for both cabinets and c.d.v. portraits? I mean, what diam. and length of focus? (2) What is the quickest time that a portrait can be taken in with a lens described, as of ordinary intensity, by noted makers (in studio)? (3) Will the cheapest dry plates, advertised at 1s. per doz. (¼-plate) produce first-class portraits with a good lens?—H. WALKER.

[60504.]—**Watch Jewelling**.—Would any reader be kind enough to say how watch jewels are set in their places? I see some of them are only stones bored through, and others have collars of brass round them.—IGNORAMUS.

[60505.]—**Salt and Lime in Water**.—How can I precipitate salt and lime in water before putting it into boiler? They stop up the exhaust pipe and small steam pipes.—T. P.

USEFUL AND SCIENTIFIC NOTES.

Primitive Man.—Two Liége *savants*, MM. Marcel de Puydt and Maximilian Lohest, have announced a recent discovery, which may be of scientific importance. In a cave at Spy, a few miles from Namur, known as the Biche aux Roches, they found in the sandstone two human skulls of extraordinary thickness, resembling the celebrated skull found in the Neanderthal, near Elberfeld. They have the same very projecting eyebrows, and the same low sloping forehead of a decidedly simian character. The finders suggest that these are types of the skulls of the primitive race who dwelt on the Sambre. Other things were discovered in the cave by MM. de Puydt and Lohest, among them some thousands of flints very carefully dressed on one side; also some specimens of jasper and agate, minerals not found anywhere in the neighbourhood, ivory breast pins, several red ear pendants, and some necklets of pearls of curious designs. It was noticed that there were no representations of animals. All were found in the sandstone, three layers of which were plainly discernible. It was visible that the remains of flints, &c., deposited in each layer indicated different stages of skill in workmanship. The lowest stratum was by far the poorest in the number of the objects found and in the quality of their workmanship. But it was here that the skulls were found, so that from a scientific point of view it is most important. A drawing has been carefully made of the geological section of the cave, so as to mark precisely the point where the skulls were found.

FROM a paper on "Secondary Electrolysis," by E. Semmola (*Compt. Rend.*) it appears that if a small ribbon of platinum is immersed in a voltameter containing acidulated water, in such a way that its ends are opposite the electrodes of the voltameter, and a powerful current is passed through the latter, hydrogen and oxygen are evolved not only from the electrodes but also from the ribbon. This secondary electrolysis varies greatly with different conditions, and ceases altogether when the current is not strong; but if oxidisable metals are used instead of platinum, it becomes much more energetic. The phenomena are well seen with amalgamated zinc, which is not attacked by acidulated water except when the current passes. When the circuit containing the voltameter is closed, hydrogen is given off from one half only—the negative half—of the zinc, whilst oxygen is absorbed by the other half. If several pieces of zinc are immersed in the water in the voltameter, hydrogen is given off from each of them. This secondary electrolysis is due to a current derived from the immersed zinc.

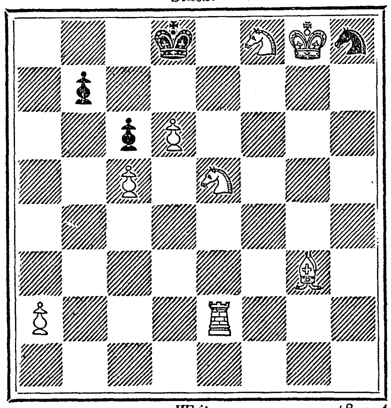
THE unique example of a town undergoing direct transition from oil lighting to electric illumination without passing through the intermediate stage of gas lighting is presented by the little town of Tivoli, near Rome. Upon the occasion of the inauguration a large number of invited guests from the town and from Rome was received by the municipality and citizens. The guests included the representatives of England, Spain, Austria, and other nations, and after the city had been illuminated a grand banquet was partaken of in honour of the occasion, and was followed by a musical entertainment in the town-hall. The success of the lighting is complete. Arrangements are being made for private lighting in Tivoli and for transmitting 2,000 horse-power from Tivoli to Rome for lighting purposes in the latter city.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MX.—BY J. P. TAYLOR.

Black.



White. [8 + 4

White to play and mate in two moves.

SOLUTION TO 1008.

White.	*Black.*
1. Q Q R 7.	1. Anything.
2. Q, R, Kt, or P mates.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,008, by Link, G. A. A. Walker, A. Bolus, A. Dean, Avon, A Beginner, "——," I. M. B., J. A. M., and J. Mackenzie; to 1,007, by A. Bolus, Link, J. Thompson, and Isca.

E. BONREW.—In your attempt at 1,007, 2. R-K sq. is not mate, as Q covers. In 1,008, you have not given Black his best defence, as 1. ——— Q Kt-Q 2 prevents mate next move.

A. BOLUS.—We had not forgotten; our remark was meant to refer more to two-movers.

BLACK PAWN AND T. H. BILLINGTON.—Thanks for problems.

J. A. M.—In your attempt at 1,009, we think you have overlooked the defence, 1. ——— B-R 4.

A BEGINNER.—We did not intend to convey that yours was considered a *correct* solution; but only that you received some marks for good attempt.

J. M.—The marks refer to a Solution Tourney now going on.

RECEIVED, with thanks, *The Wanderer*, *Chess Player's Chronicle*, and *Cassell's Saturday Magazine*.

THE German Secretary of State has published statistics on the periodicals of the world, from which it appears that there are 34,000, with a distribution of 592,000,000 copies; 19,000 are published in Europe, 12,000 in North America, 775 in Asia, 809 in South America; 16,500 are in English, 7,800 in German, 3850 in French, and 1,000 in Spanish.

THE largest body of fresh water on the globe is Lake Superior, 400 miles long, 160 wide at its greatest breadth, and having an area of 32,000 square miles. Its mean depth is 900ft., and its greatest depth is said to be about 200 fathoms, or 1,200ft. Its surface is about 635ft. above the sea level.

Carbon, or Transfer Paper.—To make transfer paper, mix lamp black with cold lard to the consistency of thick paste: apply to common printing paper (not sized or letter paper) with a rag, and with a piece of flannel rub off all that will come off. For red use powdered Venetian red; for green, chrome green; for blue, Prussian blue. To use transfer paper place the sheet between the sketch to be copied and the paper on which it is to be copied, with the coloured side next to the clean paper. Trace the lines of the copy with a dull pointed instrument, and the design will be accurately transferred on the lower sheet.

Preserving Wood.—The prevention of decay in wood is said to be effectively accomplished by exhausting the air from the pores and filling them with a guttapercha solution, a substance which preserves the wood alike from moisture, water, and the action of the sun. The solution is made by mixing two-thirds of guttapercha to one-third paraffin, this mixture being then heated to liquefy the guttapercha, when it is readily introduced into the pores of the wood, the effect of the guttapercha being, when it becomes cool, to harden the pores.

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Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

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Advertisements *must* reach the office by 1 p.m. on Wednesday, to insure insertion in the following Friday's number.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 22, and unacknowledged elsewhere:—

W. A. HUNTER.—C. H. Wingfield.—Orderic Vital.—T. H. Nassau.—T. Casson.—Chas. Penruddocke.—Valve Gear.—W. Roper.—G. D. Seaton.—Goods Fireman.—R. E. F.—E. Conry.—F. P. Otto.—R. S.—E. R. Dale.—Lt.-Col. Campbell.—Mill.—Arthur Mee.

OILMAN. (Illustrations have been published in some of the pictorial papers, but we really do not see how you can make a model, as there are merely erections over the bore-holes with pipes leading to the refining stills.)—SIDNEY AUSTIN. (Make a chloride of silver battery, or one of those mentioned in recent numbers. See indices under head "Battery.")—A LOVER OF THE MECHANIC. (There is the *Journal of Gas Lighting*, published at 11, Bolt-court, Fleet-street, E.C., weekly, price 6d. We do not know whether there is such an association.)—G. J. (Try Allen and Co., Waterloo-place, W. 2. Perhaps Harcourt's "Harbours and Docks," published by H. Frowde, Amen-corner, E.C., will suit; or Wiggins's "Embanking Lands from the Sea," published by Lockwood and Co., Stationers'-hall-court, E.C. 3. Has been

frequently illustrated, and is described in every manual. 4. See "A Catechism of the Steam Engine," by Bourne, and other textbooks.)—PRACTICAL. (See Mr. P. J. Davies's book on "Plumbing," and the back volumes; also the list issued by Mr. Fletcher, Thynne-street, Warrington. You should look in the indices of the Patent records. The stamp duty is not recoverable.)—J. D. B. (Lacquer is inferior work. Blueing was described in No. 1114, p. 489; but the address should be No. 48.)—ENGLISH BARLEY. (Malt is made by damping barley, and when it begins to germinate, drying it in suitable kilns. See any cyclopædia.)—AN OLD READER. (There are no works of the kind. You will find full instructions in back volumes, but as a rule the numbers containing the articles are out of print.)—DARWEN. (The question is of no interest to any one: it simply shows that 6 × 6 is more than 5·5 × 6·5.)—NICKEL. (For articles on nickel-plating, see pp. 96, 117, 139, Vol. XXXIX., and the indices generally. Watt's "Electro-Metallurgy," eighth edition, Crosby Lockwood and Co., Stationers' Hall-court, E.C., price 3s., contains information on the subject.)—G. H. H. (The various methods of gilding frames have been frequently described; see No. 870, for instance. 2. Send to any of our tool-makers who advertise for one of their lists, and you will find sets priced according to the number of pieces, with illustrations of the various tools.)—JUMBO. (You will find it altogether more profitable to purchase the oxygen in iron bottles or in bags from those who make it for the theatres, as it is rather risky for a novice to make it in such quantities as you would require. See illustrations of gas tanks given in some recent volumes, and endeavour to examine some of the burners in use. You want a mixture of oxygen and coal-gas impinging on a cylinder of lime, but the gases must not mix until they reach the cylinder. Aniline dyes for leather in No. for July 16, p. 431.)—LUCIFER. 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(Continued on page vi.)

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 1, 1886.

NOTES ON THE CHAMBER ORGAN.—V.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

IN considering the question of the stops most suitable for the Pedal department of the Chamber Organ, the chief difficulty which presents itself is the space they demand for their accommodation. It is this difficulty of finding adequate floor space and height which has, in the generality of cases, prevented the introduction of open stops of 16ft. speaking length, and has caused the almost universal adoption of covered registers of 16ft. tone. It is quite obvious that in rooms of the ordinary size it is impossible to place the lower octave of a 16ft. open Pedal stop, unless some arrangement has been specially made for its reception. If the pipes are of wood, and they are almost certain to be so, all those beyond, say, 10ft. in length may be mitred, and the four or five lower ones may be laid horizontally behind the organ, or in a recess constructed to receive them or partitioned off from an adjoining room. In the latter case, an opening must be made in the wall behind the organ to allow the sound free egress. If a recess or shallow chamber can be formed in the manner hinted at, or, what is better, planned along with the music room or drawing-room, all difficulty in connection with the appointment of an adequate Pedal organ disappears. To further economise room, the C C C and D D D pipes can be made, by a simple arrangement of pneumatic valves, to serve as C C C sharp and D D D sharp also. I have adopted this system in connection with the open Principale, 16ft. in my own organ. There can be no question as to the immense value of an open 16ft. stop in the Pedal department; for its pure, quiet, and dignified tone imparts a grandeur otherwise unattainable in a small instrument; while it supplies a perfect groundwork on which all varieties of manual combinations may rest, enriched, but otherwise undisturbed. The best scales for the C C C pipe are 11in. by 9in., or 10in. by 8in. Except on higher pressures than that previously recommended, pipes of a smaller scale will be too slow of speech and too weak in tone. The stop must be voiced to yield a pure, prime tone of unobtrusive character, which will support rather than overweigh the rest of the organ. At the same time it must be sufficiently clear and self-assertive to render independent pedal passages with distinctness, even when used alone. While the larger pipes of this stop will have to be stowed away behind the organ, and, if possible, out of sight, the chief part of the remaining pipes may be ranged in view, and utilised as an important feature in the general design of the instrument. Whatever the disposition may be, it must be borne in mind that it is imperative that every pipe be placed immediately over or close to its wind. This important consideration will always influence the placing of the pipes.

The stop almost invariably introduced in small organs is of the *Bourdon* or *Lieblich Gedact* species, of 16ft. tone. The chief peculiarity in the speech of such a stop is its tendency to give the second harmonic upper partial tone in addition to the prime tone. This is most observable in stops of small scale, so much so as to earn for them the name "Quintaten." * When there is no open stop of 16ft., it is desirable that the *Bourdon* should be of medium scale, and voiced to yield the prime tone as pure as possible. But when there is also an open register, the stopped register of 16ft. tone may with advantage be a Quintaten in character. When skilfully voiced, it forms an effective stop in imitation of the orchestral double-bass, and materially enriches the full tone of the Pedal organ.

In all instances where space permits it is advisable to introduce an independent open stop of 8ft. This may be a soft-toned Gamba, a *Dulciana*, a Violoncello, or a flute-toned wood register. When space and expense are important considerations, the 8ft. stop may be obtained by adding an octave of pipes to the 16ft. stop, and inserting an Octave coupler. This is an expedient frequently resorted to in small instruments.

A reed stop is a most desirable addition to the Pedal department of a Chamber Organ; but its introduction is attended with certain difficulties. If it is a *striking reed*, of the ordinary construction, it is almost impossible to get it sufficiently refined and quiet in tone. Of course, it must be of 16ft. pitch, and accordingly the vibrations of the larger tongues are accompanied by a rough, disagreeable noise, impossible to be suppressed or even reduced by distance in an ordinary apartment. If it is a *free reed*, such as I have alluded to in the preceding article, it unfortunately demands considerable space for its accommodation. Perhaps it will be as well to explain the last remark. Although the tubes of a free reed of 16ft. tone are not larger in diameter, and are considerably shorter than the corresponding tubes of a striking reed of similar type, the boots are altogether different affairs, being, comparatively speaking, immense. For instance, the wooden boot of the CCC pipe of the Euphonium stop measures about 5in. by 4½in. in cross section, and about 4ft. 3in. in length. The metal tube, of the usual inverted conical shape, is about 10ft. in length; this, as well as all the other larger tubes, can be mitred in any convenient fashion, and generally with advantage to the tone. The tone of the free reed Euphonium, when properly voiced, is of singular purity and roundness; and while the lower notes have a characteristic reedy quality, they are entirely free from the buzz inherent in striking reeds. Such a stop is of great value for melodic use; and if an additional octave is added and an octave-coupler inserted, its value in this respect will be more than doubled. In scheming the Pedal department of a Chamber Organ, every endeavour should be made to provide a stop or stops suitable for solo or melodic playing altogether independent of the manuals.

Having thus hastily touched on the question of the speaking stops most suitable for the Chamber-Organ, I have now to consider the apportionment of such stops in the different departments of the instrument, and the means to be adopted to secure them adequate powers of expression.

Great Organ.—Expressive.

The department of the Chamber Organ which, for the sake of distinction, I call the Great organ, is, under the treatment I propose, by far the most extensive and important one in the instrument. Here should be congregated the chief organ-toned registers, namely, the Principal, 8ft.; Octave, 4ft.; Super-Octave, 2ft.; Mixture, &c., and two or three of the more important reed stops, and a proportion of the chief solo flue stops. To these must be added two or three soft-toned stops suitable for combination and accompaniment. The full tone of this department should be characterised by depth and richness, while its leading combinations are replete with variety of tonal effects. Every endeavour should be made, in the selection of the stops, in the adjustment of their scales, and in voicing, to render it an impossibility to draw an imperfect or unpleasant combination. When the total number of manual speaking stops is about fifteen, it is advisable to place about two-thirds of the number in the Great department, the remaining third being apportioned to the Choir department.

I now come to the all-important question, how to impart the maximum power of expression to all the stops of the Great organ *save one*. The only stop I propose leaving beyond the control of the Expression levers, and, accordingly, outside the swell-boxes, is the Principal, 8ft. The pipes of this important stop should be employed to form the "towers" and other features in the external design. Such salient positions secure for the stop perfect freedom of speech and predominance of tone, placing it at once in the prominent place it is entitled to hold in the general tonal scheme. The remaining stops of this department should be about equally divided, and inclosed in *two independent swell-boxes*. Special attention is directed to this apportionment; for, to the best of my knowledge, I am the first who has suggested the advisability of dividing any *one department* of an organ into *two distinct expressive portions*, while both can be played together or separately on *one clavier*. This arrangement has been followed in the appointment of my own Chamber Organ, and I venture to think with results of the highest value. This is one of the most important steps, in my opinion, towards rendering the organ more flexible in the matter of *expression*, and an instrument better suited for the satisfactory interpretation of the inspirations of great composers. For the production of complex orchestral effects, subtil *nuances*, and a greatly increased range of crescendo and diminuendo, no method, so far as is known to me, can equal the one here suggested.

I must now give some further details respecting this arrangement, so that it can be thoroughly understood, and its peculiar advantages realised by the reader. Let it be supposed that the Great organ comprises ten speaking stops, to be apportioned as above directed; five of these will be placed in what may be designated, for convenient recognition, the *back swell-box*, and four in the *front swell-box*. The Principal, 8ft., will be placed outside the latter swell-box, while it derives wind from the inclosed wind-chest. Five stops are thus apportioned to each of the two divisions of the Great organ. The pallets of both wind-chests must be connected by one train of mechanism with the single clavier devoted to the Great department. This arrangement, however, would be of little use, at least, in one of its important offices, unless means were provided for instantaneously connecting or disconnecting, at the will of the player, either of the divisions to or from the keys. This is secured by simple pneumatic ventils which control the wind separately supplied to each division. The ventils are controlled by small buttons or "pistons" placed immediately under the Great organ clavier.

The selection of the stops to be placed in the different swell-boxes is a matter deserving careful consideration, for much depends on their proper apportionment. This apportionment may, on first thoughts, appear a very simple affair; the most obvious arrangement seeming to point to the grouping of the foundation and mutation stops in one swell, and the solo and accompanimental registers in the others. Such a mode of procedure would, however, result in much disappointment and a serious narrowing of the offices of the twin swells. Indeed, the diametrically opposite course must be followed. If the chief foundation stop (Principal, 8ft.) is connected, as suggested, with the windchest of the front swell, the Octave and Mixture should be in the back swell, and the

* This term is almost invariably incorrectly written "Quintaton." The word is derived from *quintam tenentes*, and should accordingly be rendered Quintaten.

Super-octave (whatever its character may be) should be in the front swell. The solo and accompanimental registers must be about equally divided, care being taken to secure as great a contrast of tone as possible in the two divisions. Thus, if a solo Flute is placed in one division, let a Clarinet be opposed to it in the other. Again, as the Principal, 8ft. is connected with the front swell, place the most powerful reed (the Trumpet) in the back swell. Again, contrast a string-toned stop with a flute-toned one, and so on.

Before going further it may be advisable to put the reader in possession of one or two facts connected with the twin swells. In the first place, it may be pointed out that while the back swell contains about one-half of the stops apportioned to the Great organ only, the front swell should be made sufficiently large to contain all the stops apportioned to the Choir organ as well as the remainder of the Great organ registers. By this arrangement, the back swell-box will contain, say, one-third, while the front swell-box will contain about two-thirds of the entire list of manual stops. In the second place, each swell has an independent Expression lever, of the "balanced" form, placed side by side, in the position previously recommended. So placed, they can be moved one after the other or both together with *one foot;* or in different directions at the same moment with *both feet*, when the Pedal organ is silent. This absolute control over both the Expression levers is essential to the full utility of the twin swells. It will now be seen why I have refrained from applying the usual term Swell organ to any manual department. The entire instrument may, under the arrangement here proposed, be correctly designated a Swell organ.

It may be questioned why the Choir organ should not have an independent swell-box and an accompanying Expression lever? On first thoughts it may appear advisable, seeing that the Great organ has two swell-boxes, for the Choir stops to be inclosed in a third and distinct one; but the additional space required for such an arrangement, the increased number of mechanical parts, and the inconvenience of operating on three Expression levers, are not repaid by the very slight advantage gained by the third independent swell. In an organ of the moderate size contemplated in these Notes, I hardly think the third swell would be found to present a single advantage over the simpler arrangement proposed. Supposing the three swells are adopted, it will be necessary to have a simple mechanical device provided whereby the Expression lever of the Choir may, at will, be firmly linked with one or other of the levers belonging to the Great organ. This is necessary to enable the left foot of the player to open every swell-box of the instrument simultaneously, by simply placing it across the space between the two Great organ levers, and, accordingly, with half the sole on each lever. The combined use of all the Expression levers will only be resorted to in the production of a grand crescendo, with the claviers coupled. Thus united, the entire manual departments may be said to form *one magnificent Swell organ.*

Leaving the Choir department for future consideration, let us see what effects are possible through the agency of the twin swells of the Great organ. A few illustrations must here suffice, for space is too restricted to admit of any branch of my subject being more than briefly touched upon.

1. Suppose all the Great stops are drawn, and the wind is admitted to both the back and front divisions; with both the swells closed the effect will be that of a Principal, 8ft. (*Open Diapason*), at its full value, with a richly-toned, but subdued, background, to which the closed swells impart the effects of distance and restrained power. Now, the slightest touch of the foot on either of the Expression levers materially enriches the combination to the ear, by bringing one half of the background, if I may continue to use the phrase, nearer and more prominent. Leaving the lever thus first touched where it has been placed, the foot may be shifted to the other lever, and sufficient pressure used to open its swell rather more than in the previous case, and, accordingly, bring the tones of the inclosed stops still more prominently forward. Marked differences of tonal effect are thus produced. The mode of proceeding may be carried on step by step, until the full Great peals forth at its maximum strength. Numerous tonal effects may be produced by skilful management of the twin levers before the full power is reached.

II. Suppose the Principal, 8ft., Flute, 4ft., and Super-octave, 2ft., are drawn in the front division, and the Trumpet, 8ft., Octave, 4ft., and Mixture are drawn in the back division, and the wind admitted to the front division only, to begin with. With a closed swell the effect will be that of a full-toned unison in combination with a very soft Octave and Super-octave. Let the tone be brightened by a partial opening of the swell, and then, at a favourable moment, let the pneumatic button be touched, and the wind admitted to the back division. Instantly the ear is arrested by the addition of a mysterious and distant chorus effect, filling up and enriching the more prominent combination.

The front swell may now be fully opened, for the harmonic series is practically complete, and the back swell operated upon at the will of the player. The wind of the front division may be cut off at any desired moment, leaving the Trumpet, Octave, and Mixture at the disposal of the organist and under perfect control. I cannot help feeling how poorly words, however concise, convey any idea of the complex and charming effects hinted at here; they must be heard to be fully realised.

III. Suppose the Clarinet and a string-toned stop are drawn in one division, and a flute-toned combination (say, Orchestral Flute and Piccolo) in the other, and the wind admitted into both divisions. While the organist is engaged in playing a florid composition, he can, with one foot only, bring a hundred *nuances* to enrich his performance, now subduing the flute tones and swelling the reed and string tones, and *vice versâ.* And when he can spare both feet from the Pedal keys, he can, by placing them on the twin levers, produce marvellous orchestral effects, replete with light and shade, and unusual crossings of diversified tones.

The above simple illustrations must suffice to show what is gained by the division of the Great organ speaking stops, and the inclosure of both divisions in independent swell-boxes. If the reader is an organist and a musician, in the true sense of the word, he will have no difficulty in realising what such a treatment is capable of doing in the sphere of expression; and how, by its aid, musical ideas may be intelligently rendered which are at present obscured by the limited power of expression in the ordinary instruments of the organ builders.

(*To be continued.*)

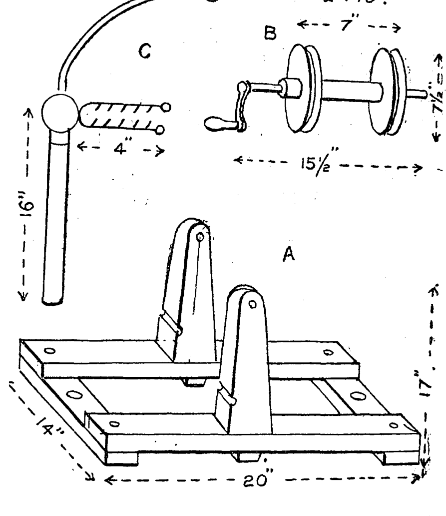
ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—XI.*

By S. R. BOTTONE.

IT is with considerable diffidence that the author ventures to place before the readers to the ENGLISH MECHANIC the following instructions concerning the construction of the Wimshurst machine, since the machine has been so fully and ably described in these pages by the inventor himself. However, to render this series of papers complete, a brief sketch of the mode of making two simple forms will be given.

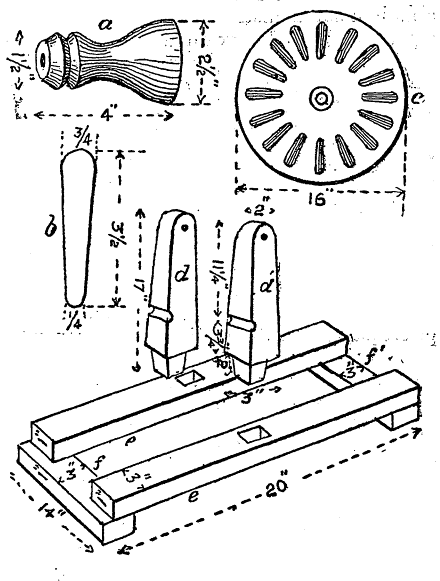
§ 34. *The Wimshurst Influence Machine.*—The portions that first demand our attention are the *plates.* These should be of glass—good window-glass—as flat as can be got, and not too green in colour (as it is apt to be poor in insulating power) is to be preferred. This is to be cut into two discs, each 16in. in diameter. The thickness of these discs should not exceed 1-16th of an inch. As in the Carré and Bertsch machines, it will be actually better *not* to have holes drilled in the plates, but to fasten the bosses to the plates as described at § 20.

FIG. 13.



These bosses consist in two circular pieces of mahogany or other well-seasoned wood, not less than 4in. in length. (It is a great mistake to have these too short, as then the glass discs come too near the standards, and much electricity leaks away.) It is best to turn these up in the lathe, of the form and dimensions shown in Fig. 18*a*. While in the lathe, a perfectly central hole nearly ½in. in diameter must be bored in the small end of the boss (as shown in

FIG. 18.



the cut), reaching *nearly*, but not quite, to the thick end of the boss. This hole must be bushed for its whole length with ½in. brass tubing, and some stout steel wire which just enters the brass tube, selected and straightened out, to serve as spindles on which the bosses are to turn. Mr. Wimshurst, in his directions, says: "I must impress upon those who make a machine that they cannot give too much care in selecting the tubes to fit properly, or the steel wire; it will save trouble throughout the making, and the machine, when made, will work more smoothly." The centre of the glass plates having been obtained as described in § 20, the bosses are attached to the plates

precisely as described therein. When quite set and dry, the plates should be varnished, in a warm dry room, on both sides with good shellac varnish, and the varnish dried by the fire.

§ 35. As shellac varnish is in constant requisition for insulating electrical apparatus, I give Mr. Wimshurst's recipe for the preparation and preservation of this useful compound. Take a large, wide-mouthed bottle—say, a pickle bottle—fit to it a soft wooden bung, bore a hole through this bung, and in this hole tightly fix the handle of a rather large brush (the brush end being in the bottle); then about half-fill the bottle with good shellac, cover the shellac with methylated spirits, and shake the bottle occasionally. In about 24 hours it will be ready for use. By this means the brush is always clean and serviceable.

§ 36. While the varnish is drying on the glass discs the operator may strike out on a piece of paper a circle of the same diameter as the discs, and, by means of the compasses, divide the circle into sixteen equal parts, drawing radial lines at each division, from centre to circumference. This divided circle will, if placed on a flat table under the glass discs, enable the operator to fasten down the tinfoil "sectors" or segments, at equal distances from each other.

§ 37. These sectors consist in wedge-shaped strips of tinfoil, slightly rounded at the top and bottom, as shown at *b* (Fig. 18), 3½in. in length by ¾in. wide at top, diminishing to ¼in. wide at bottom. These sectors are easily attached to the glass plates by placing these latter in turns upon the paper circle (§ 36), and, having rubbed a little *thick* shellac varnish over *one* surface of the tinfoil sector, placing it (shellac side downwards) on to the glass plate, just over one of the lines, care being taken to leave about ½in. of clear glass between the periphery of the disc and the circle of sectors. The line showing this distance had better be struck out with the compasses on the paper, as the perfect regularity of the circle of sectors adds much to the neat appearance of the machine. One disc, mounted on its boss, and fitted with sectors, is shown at Fig. 18, *c*. When the sectors are firmly stuck down to the glass, and the varnish quite dry, it will be well to run a brush charged with varnish round the inner and outer extremities of the tinfoil sectors. These rings of varnish may extend ½in. inwards, but not more. They serve to increase the adherence of the sectors to the glass, and also to insulate slightly the extremities. On the centre of each disc, exactly opposite the bosses, must now be fastened with hot marine glue or Prout's elastic glue, a small ebonite washer, punched out of sheet ebonite 1-32in. thick. These washers are to prevent the rotating glass discs from actually touching during rotation.

§ 38. *The stand* next demands our attention. It should be made of mahogany, walnut, or some other well-seasoned wood. Six pieces will be required—viz., two pieces 20in. long by 3in. wide and 1in. thick; two pieces 14in. long by 3in. wide, and two uprights 17in. in height 3in. square. These two latter must be cut round the lower end to form a square tenon 2in. long by 2in. square section, and two of these sides must be made to slope away 2in., this forming the top end, which must be rounded, as shown at Fig. 18 *d d'*. A hole of exactly the diameter of the steel spindle on which the plates are to run must be drilled through each standard, at about an inch from the top, care being taken that these two holes come exactly opposite each other and at the same *height* in the standards, otherwise the plates will not run opposite each other. At about 3¾in. from the tenon, and on the same side of each standard, a long semi-cylindrical slot is cut, about ½in deep; this serves for the spindle of the driving-wheels to run in. All these pieces are shown in Fig. 18, where *d d'* are the uprights, *e e'* the long cross pieces, and *f f'* the lower pieces of the stand; these pieces must be planed up so as to fit accurately; mortice holes cut in the centre of the 20in. strips to take the tenons of the uprights. The whole is then joined together so as to make a strong frame, with glue and screws; the long strips being screwed *over* the 14in. pieces at each extremity so as to form a square 14in. by 20in. As the two short pieces are placed *below* the larger ones, and as the uprights are morticed into these, it is necessary to make the ends of the uprights project 1in. through the holes, so as to afford a support to the centre of the frame. With a spokeshave, or similar tool, the sharp edges should be taken off the frame, so as to prevent dispersion of electricity. The frame and standard being put together, as shown at Fig. 19 *a*, it will be well to cut out the holes in the centre of the shorter pieces of the frames, which holes are to receive the glass rods or jars (as the case may be) which support the conductors and combs. These holes may be begun with a centre-bit, and should be 2in. in diameter if jars are to be used, or 1in. if glass rods only are to be employed.

§ 39. As the glass discs, when mounted, must rotate in contrary directions, it is necessary to have two driving wheels on a spindle wherewith to drive them, and to connect one driver with one boss (§ 34) by means of a straight band, while the other transmits its motion by means of a crossed band. These driving-wheels may be turned out of any suitable wood, 7½in. in diameter; they should have a centre-bit hole, 1¼in. in diameter, put through the centre; a length of some good hard wood should then be turned up to make the spindle, on which the two wheels must be tightly fitted and glued. Care must be taken that the edges of the wheels, when glued to the wooden spindle, should come exactly opposite the V groove in the bosses (§ 34) when the glass discs are in their places. These wheels must have a groove turned in their edges, to take the driving band.

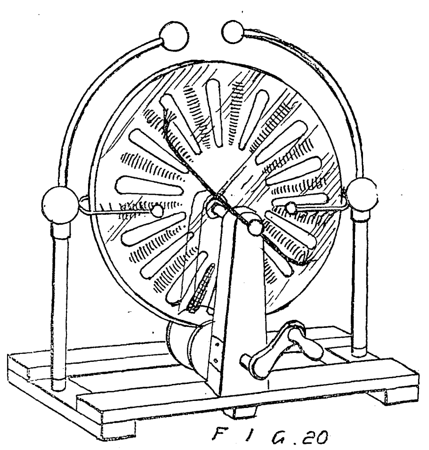


FIG. 20

The length of the wooden spindle must be such as to just *not* reach from standard to standard, say 7¾in. A central hole, about ½in. in diameter, is now made through the entire length of this wooden spindle, and through this wooden spindle is driven an iron rod 15½in. in length, ½in. diameter, projecting 3in. at one end, and 4in. at the other. At the longest end this rod is squared up to take a driving handle. If the wooden spindle does not fit quite tight upon the metal rod, it will be better to drill a hole through wood and iron and drive in a metal pin. The driving spindle is placed in the two semi-cylindrical slots cut in the sides of the standards (§ 38), and is kept in its place by means of two small rounded cleats screwed thereto. These driving wheels, with their spindles, &c., are represented at Fig. 19 *b*.

§ 40. The next step is to mount the combs and conductors on to the glass pillars, which are to insulate them. These pillars, of which two are required, should be 1in. in diameter and 15in. in length. Good white glass that becomes readily electrical on friction should be chosen. They must be fitted with brass collars 1in. long, at the upper extremities, and to these collars are soldered brass balls 2in. in diameter. At the upper portion of these balls is drilled a hole ¼in. in diameter, into which are fitted, but not *fixed*, brass rods ¼in. thick, about 16in. long. These rods are bent into quadrants, and terminate in brass balls. It must be noted that the two brass balls terminating these rods must be of different sizes to obtain the best effects. In the sized instrument under consideration, one should be ⅝in. and the other 1¼in. in diameter, and nicely polished. By not having the rods as fixtures in the top of the glass pillars, it is easy to exchange the rods if the direction of the flow of the current in the machine is reversed, either accidentally or intentionally. The combs, which must be screwed to the centre of each 2in. ball that terminates the glass pillars, consist in ¼in. brass rods 12in. long, terminating in brass balls about ½in. diameter, and bent into the shape of a horseshoe, so as to embrace both the plates. In the interior of the horseshoe are soldered, or otherwise affixed, four or five ½in. brass points. The whole arrangement of the glass pillar, with its collecting comb, large ball, movable end, and terminating ball, is shown at Fig. 19*c*.

§ 41. The plates can now be mounted on the standards. To this end, each plate in turn is held with its boss against the small hole at the top of the standard, on the steel rod, which was chosen as running freely in the bushing of the boss (§ 34) pushed through this hole and into the hole in the boss as far as it will go. The rod is then cut off, leaving an inch projecting on the outside of the standard. With a file, a nick is cut in this steel rod at about the centre of the portion that is to remain in the standard, then a round-headed screw is driven into the top of the standard to enter this nick and keep the steel rod quite firm and immovable. To the projecting ends of the steel rods are affixed the bent rods carrying the brushes. These rods are technically known as the "neutralising rods." They are made from ¼in. brass rod, about 17in. in length. A hole ⅜in. deep and about ⅛in. wide, is drilled at the two extremities of each of these rods. A little tuft of about a dozen short lengths of the fine wire used by the gilt ball manufacturers, is made into a brush by binding at the bottom end with a little of the same wire; this same end is pushed in the holes in brass rod, and wedged firmly into its place by means of a little wooden wedge. There are two such rods; and each rod must have a brush at each end. A short length of brass tubing, fitting tightly on to the projecting pieces of the steel spindles carrying the plates, is now procured, and cut into two pieces 1½in. long. With a round file, a slot (sufficiently deep to take the brass neutralising rods just finished) is produced in these pieces, and each rod having been placed in this slot, at its centre, is soldered thereto. At the same point, to give a finish, and prevent dissipation of electricity, is also soldered a small brass ball. Each rod is then bent slightly in the shape of a bow, so that the "brushes" shall come into contact with the sectors, when the neutralising rods are put in their places on the steel spindle.

The appearance of the complete machine, with the "brushes" in their right position for a right-handed person to drive, is shown at Fig. 20.

ASTRONOMICAL NOTES FOR OCTOBER 1886.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 49 39·13 AM	12 30 13	3 15 50	12 40 34·02
6	11 48 7·92 ,,	12 48 25	5 11 48	13 0 16·78
11	11 46 46·10 ,,	13 6 46	7 6 6	13 19 59·54
16	11 45 36·40 ,,	13 25 19	8 57 58	13 39 42·30
21	11 44 41·50 ,,	13 44 6	10 46 39	13 59 25·07
26	11 44 3·56 ,,	14 3 11	12 31 21	14 19 7·83
31	11 43 44·08 ,,	14 22 35	14 11 14	14 38 50·60

The method of finding the Sidereal Time at Mean Noon at any other Station will be found on p. 353 of Vol. XLII.

Spots and faculæ still diminish, though fine isolated ones occasionally appear.

The Zodiacal light may be seen in the East before Sunrise.

The Moon

Enters her First Quarter at 10h. 33·6m. at night on October 4th, and is Full at 3h. 23·9m. a.m. on the 13th. She will enter her Last Quarter at 2h. 40·8m. o'clock in the afternoon

of the 20th, and be New at 7h. 15·5m. a.m. on the 27th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	3·6	3 9·5 p.m.
6	8·6	7 21·9 „
11	13·6	11 1·7 „
16	18·6	2 4·4 a.m.
21	23·6	6 33·9 „
26	28·6	11 6·3 „
31	4·2	3 35·2 p.m.

The Moon will be in conjunction with Saturn at 7h. a.m. on the 20th; with Jupiter at the same hour on the 26th; with Venus at 1 p.m. on the 26th; with Mercury also at 1 p.m. on the 28th; and lastly with Mars at 10 a.m. on the 30th.

Mercury

Is an Evening Star throughout the Month, but is most indifferently situated for the observer during the whole of it. His angular diameter increases gradually from 4·8″ to 5·4″ between the beginning and End of October.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 41·4	3 20·1	0 0·8 p.m.
6	13 12·1	7 6·0	0 11·8 „
11	13 42·0	10 38·8	0 22·0 „
16	14 11·5	13 55·5	0 31·7 „
21	14 40·7	16 53·4	0 41·2 „
26	15 9·8	19 29·8	0 50·5 „
31	15 38·6	21 42·0	0 59·6 „

The path indicated in the above ephemeris commences in Virgo, and extends to, and terminates in, Libra. On the evening of the 7th Mercury will be rather less than 3° N. of Spica Virginis, and some 2° South of α Libræ on the 22nd. He will be in conjunction with Jupiter at 2 a.m. on the 4th.

Venus

Is a Morning Star during the whole of October, but is also very poorly placed for the observer, and is an insignificant object to boot; her gibbous little disc diminishing in diameter from 10·2″ at the beginning of the month, to 9·8″ by the end of it.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	11 34·2	4 21·5 N.	10 53·8 a.m.
6	11 57·2	1 54·9 „	10 57·0 „
11	12 20·0	0 33·7 S.	11 0·2 „
16	12 43·0	3 2·7 „	11 3·4 „
21	13 6·0	5 30·8 „	11 6·7 „
26	13 29·3	7 56·2 „	11 10·3 „
31	13 52·8	10 17·4 „	11 14·1 „

Beginning on the actual confines of Leo and Virgo, this path is practically entirely performed in the last-named Constellation. Venus will be very close to η Virginis on the morning of the 10th, and on the 14th some 2° South of γ Virginis. She will be 3½° north of Spica on the 23rd. She will be in conjunction with Uranus at Noon on the 14th, and with Jupiter at 9 p.m. on the 22nd.

Mars and Jupiter

Have both left us for the season.

Saturn

In the sense of his Southing is a Morning Star; but he rises at about a quarter to Eleven at night at the beginning of October, and before 9 a.m. at the end of it. He is in quadrature with the Sun at 3 p.m. on the 15th. His equatorial diameter increases imperceptibly from 16·2″ on the 1st to 17·1″ on the 31st. But little change will be noted in the opening of his rings, and he still presents an all-repaying

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
6	B.A.C. 7097	6	10 33 p.m.	Dark	115	142	11 42 p.m.	Bright	278	312
8	e^2 Aquarii	5½	†10 29 „	S.S.E.	23	39				
12	*f* Piscium	5½	11 58 „	Dark	38	40	12 15 „	Bright	13	19
14	μ Ceti	4	§6 11 „	Bright	84	46	7 1 „	Dark	311	272
16	θ^2 Tauri	4½	‡6 52 „	Bright	132	98	7 36 „	Dark	253	216
16	θ^1 Tauri	4½	‡7 1 „	Bright	162	127	7 27 „	Dark	223	186
16	80 Tauri	6	7 25 „	Bright	61	24	8 4 „	Dark	325	287
16	81 Tauri	5½	7 36 „	Bright	68	32	8 20 „	Dark	318	279
16	B.A.C. 1391	5	†8 5 „	N. by W.	193	155				
16	85 Tauri	6	8 5 „	Bright	92	53	8 59 „	Dark	295	255
16	α Tauri	1	†10 37 „	N. by W.	195	155				
17	111 Tauri	5½	‡7 24 „	Bright	101	69	8 14 „	Dark	276	240
17	117 Tauri	6	9 9 „	Bright	18	339	9 17 „	Dark	2	322
22	B.A.C. 3538	6½	‡12 53 „	Bright	24	348	1 23 a.m.	Dark	311	274
23	44 Leonis	6	2 6 a.m.	Bright	23	344	2 38 „	Dark	310	271
23	B.A.C. 3562	6½	2 14 „	Bright	26	347	2 49 „	Dark	307	268

† Near approaches. § Star rising. ‡ Stars below the horizon.

Greenwich Mean Time of the Greatest Eastern Elongations of the Five Inner Satellites of Saturn.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
3	Tethys	5·3 a.m.	16	Enceladus	2·5 a.m.	26	Mimas	3·5 a.m.
5	Tethys	2·6 „	17	Rhea	4·1 „	26	Rhea	5·1 „
5	Enceladus	3·5 „	18	Dione	5·5 „	27	Enceladus	1·7 „
6	Tethys	11·9 p.m.	18	Tethys	7·8 „	27	Mimas	2·1 „
7	Dione	6·7 a.m.	20	Tethys	5·1 „	27	Mimas	12·7 p.m.
8	Rhea	3·2 „	20	Enceladus	5·2 „	28	Mimas	11·3 „
9	Enceladus	6·1 „	20	Dione	11·2 p.m.	29	Dione	4·3 a.m.
9	Dione	12·4 p.m.	22	Tethys	2·4 a.m.	29	Mimas	10·0 p.m.
10	Mimas	2·9 a.m.	22	Enceladus	11·0 p.m.	31	Dione	10·0 „
11	Mimas	1·5 „	23	Tethys	11·7 „	31	Enceladus	4·3 a.m.
11	Enceladus	11·9 p.m.	25	Mimas	4·9 a.m.			

spectacle to the observer provided with sufficient optical power.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 32·7	21 25·4	6 53·0 a.m.
6	7 33·9	21 23·1	6 34·5 „
11	7 34·9	21 21·2	6 15·9 „
16	7 35·7	21 19·6	5 57·0 „
21	7 36·4	21 18·5	5 38·0 „
26	7 36·8	21 17·8	5 18·8 „
31	7 37·1	21 17·6	4 59·4 „

It will be seen from the above ephemeris that the very short arc described by Saturn during October lies in Gemini. Regarding the planet as stationary (which we may do for our present purpose) he may be said to lie very approximately at the right angle of a right-angled triangle, whereof δ and κ Geminorum are at the extremities of the hypothenuse.

Neptune,

Although, as far as his passage over the Meridian is concerned, a Morning Star, yet is visible during a considerable part of the ordinary working hours of the amateur's night; in fact, towards the end of the month he rises before 5h. 30m. p.m.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 42·9	17 55·5	3 3·8 a.m.
6	3 42·6	17 54·1	2 43·8 „
11	3 42·2	17 52·6	2 23·8 „
16	3 41·8	17 51·1	2 3·8 „
21	3 41·3	17 49·4	1 43·6 „
26	3 40·8	17 47·6	1 23·4 „
31	3 40·2	17 45·4	12 59·2 p.m.

The short retrograde arc thus described by Neptune lies some 6° or so to the South of the Pleiades, in a perfectly barren region of the sky.

Uranus

Is now invisible for the purposes of the Observer.

Shooting Stars

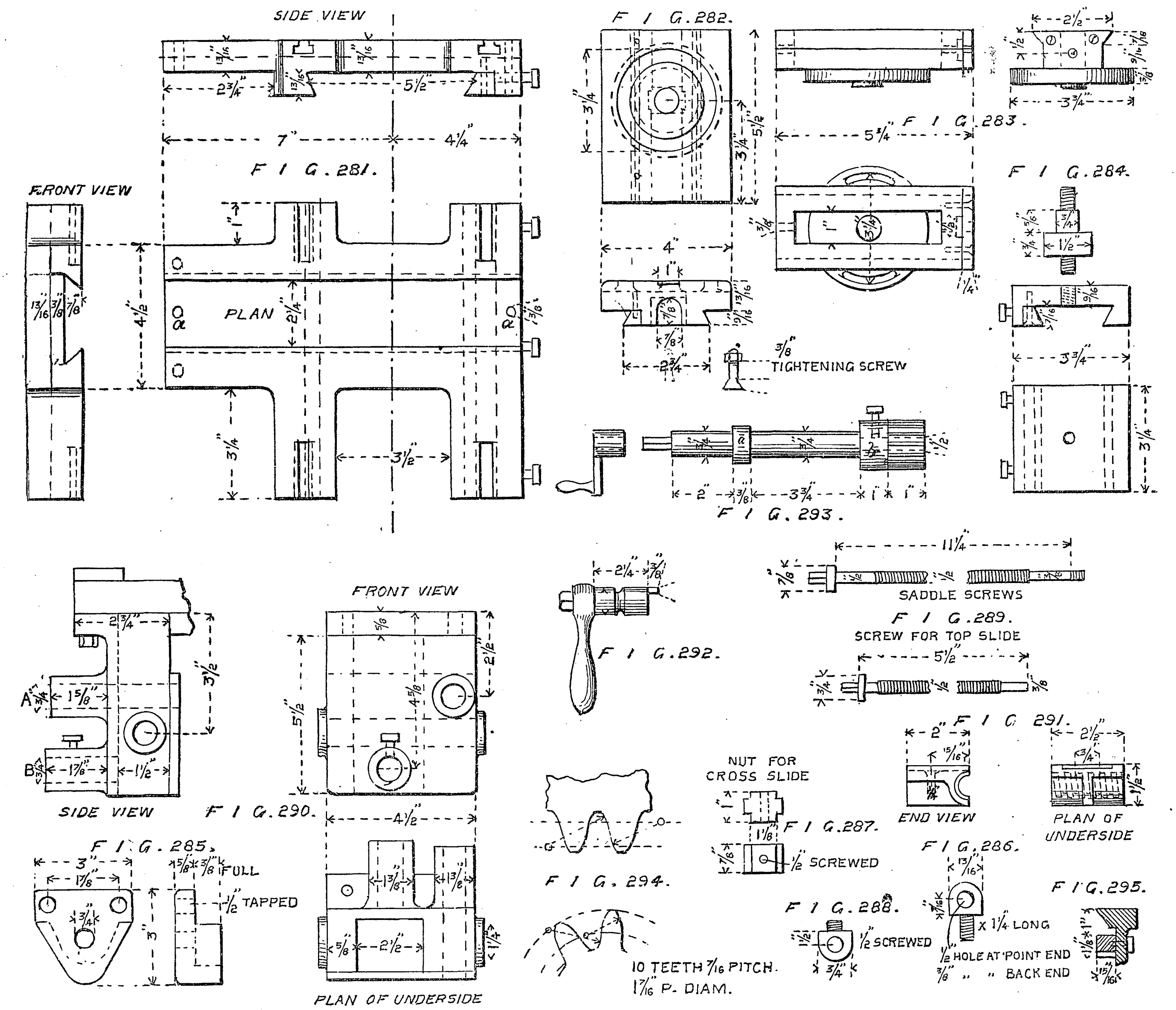
May be watched for from the 1st to the 6th; and again from the 18th to the 21st, inclusive, with the best chance of rewarding the Observer.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the Night of October 1st, 1886.

Star.	Souths.
	h. m. s.
δ Aquilæ	6 38 7·59 p.m.
Altair	7 3 31·81 „
α^2 Capricorni	7 29 58·21 „
α Cygni...	7 55 42·95 „
α Cephei	8 33 56·29 „
α Aquarii	9 17 52·77 „
Fomalhaut	10 9 9·84 „
Markab...	10 16 52·66 „
ι Piscium	10 51 47·22 „
α Andromedæ...	11 20 7·48 „
α Cassiopeiæ	11 51 36·56 „
β Andromedæ...	12 20 49·18 „
Polaris	12 35 49·12 „
η Piscium	12 42 46·95 „

The method of finding the Greenwich Mean Time of Southing of either of the Stars in the above list for any other night in October; as also that of determining the local instant of its Transit at any other station, will be found on p. 355 of Vol. XLII. It must, however, be reiterated that the rules there given are not rigidly accurate as applied to Polaris, or any close circumpolar star; though they will probably be found quite sufficiently so in practice.

RECENT experiments by Professors J. J. Thomson and Threlfall have brought them to the conclusion that, just as ozone is formed by the passage of electric sparks through oxygen, so an allotropic modification of nitrogen is formed by sparking in nitrogen.



THE AMATEUR WORKSHOP.—XXVI.

Self-acting Lathes.—(*Continued.*)

THE annexed figures represent in detail the slide-rest shown in the general views (Figs. 263, 264, 265, page 546 of Vol. XLIII.) And since in those views the principal parts are seen in their relative positions, I have in these, to render the construction as clear as possible, taken the rest apart, and dimensioned almost every item of detail separately, so that there can be no mixing up of dimensions and views in a structure necessarily somewhat intricate. Keeping those general views at hand, there will be no difficulty in assigning to each matter of detail its proper place.

There is no unnecessary work about this rest; on the contrary, it is as simple as one of this type can be, though of course, a compound slide and screw-cutting rest cannot be a very simple affair in itself. It consists of saddle (Fig. 281), cross slide (Fig. 282), middle slide (Fig. 283), top slide (Fig. 284), tool-holder (Fig. 285), while the remaining figures embrace the apron and its parts, and the various minor details, as screws, rack-and-pinion arrangements, &c. Let us take these in succession.

The saddle (Fig. 281) consists of a plain plate having vee'd edges above for the guidance of the cross slide, and one vee'd edge below to embrace the front edge of the bed, and also a rectangular strip at the back to receive the loose adjustment strip with its set, and clamping screws. The main plate can either be prepared from solid stuff, or narrow cross strips can be halved together. Upon this plate come the remaining parts. The space within which the cross slide travels can be cored out, as being the best job, in which case the main plate will be $\frac{13}{16}$in. thick (see end and front views), or can be made to deliver in the pattern, when the main plate will be only $\frac{3}{8}$in. thick (see front view). (Note that throughout I quote finished dimensions, that is taking no account of pattern allowances for fitting.) Strips are nailed on the bottom (which should be top in moulding), the one being the rectangular piece which carries the loose vee strip, the other a piece which is similarly rectangular in the pattern, but which forms a backing for the vee strip skewered against and cast with it. The shouldered underside becomes the base for the attachment of the apron shown in Fig. 290, and the holes in the apron flange and in the saddle, therefore, are marked one from the other. Four prints are nailed on the top next the ends to carry T-shaped cores, whose section is seen in side view, to receive both for miscellaneous attachments of work to the saddle. The $\frac{3}{8}$in. holes at *a a* are for the bearings of the leading or traverse screw, the bearings being shown in Fig. 286.

The cross slide (Fig. 282) is preferably cored on the under face, the core embracing the arch for the traversing screw, and the square recess for the nut. The top ring recess for the circular slewing motion is also cored out to $\frac{5}{16}$in. deep. The vee which is cast with the slide is loosely skewered on.

The middle slide (Fig. 283) is cored out and the strips cast on, being skewered to the sides of the main body of the pattern. (See end view.) A circular flange is made fast to the body, and curved prints and cores provided for the swivelling motion, the clamping studs passing through these slots. There is also a central stud to insure steadiness, turned to fit the recess in Fig. 282.

The upper slide (Fig. 284) is a plain pattern having a parallel edge on one side to form the backing for the strip, and a vee on the other, the latter loose as in the other cases. The tool-holder (Fig. 285) is of the triangular pattern, and requires no detailed description.

In the fitting of these various sliding portions there is, of course, no difficulty where surface plates, squares, and accurate planing machines and angle plates are available, since the parts are machined independently of one another with the aid of templets, and when brought together require nothing but a trifle of easing and scraping. But it is different in the case of amateur work, and the obvious way to proceed with such a saddle as this would be, bearing in mind the principles already laid down and previously discussed, to fit and check it in the first place independently with scribing blocks and calipers, and finally upon its own bed. This is a laborious task in a saddle of this description having large surfaces, and hence I should advocate having the flat surfaces, not only of the saddle, but of all the slides, at least planed to a parallel thickness, by which the labour of filing would be reduced to the mere fitting of the edges, strips, and screws. Proceeding in this way the saddle as being the basis of operations would be first fitted to the bed with its loose strip. The latter should be of wrought iron, and screwed as shown, and the fit of the saddle should be such that there should be no difference in the degree of tightness or slackness of the sliding fit when the saddle is thrust along by hand. If there is a difference the bed is not of equal parallelism throughout, and if the bed is parallel and the slides are not parallel, there will be tightness at one end and slackness at the other in any position of the rest.

After the saddle is fitted thus, the next most important portion of the work is the groove which guides the transverse slide, and this should be marked by direct measurement from a face plate, care being taken in the first place to be assured that the plate itself runs true,

and that the headstock is in a condition of perfect parallelism according to the method to be presently described. At the same time it will be proper to check the transverse edges by means of a long and true square carried over and parallel with the edges of the bearers themselves. Assuming the transverse edges once got true, there can be comparatively slight difficulty experienced with the fitting of the others. The edges of the cross traverse slide can be fitted to the grooves on the saddle, the fast and loose vees being first marked off on their ends symmetrical or central with the circular groove and stud. The circular groove for the nut must be skimmed round in the lathe and the stud turned.

The fitting of the top slide (Fig. 283) is a repetition only of the work previously done, and since it is revolved and rendered adjustable at any angle by means of the circular groove, the edges of the slides are not regarded in reference to other edges, as was the case with the saddle. The upper plate (Fig. 284) which carries the tool-holder, and the latter also (Fig. 285) are very plain, and dimensions being given for screws (Fig. 289), vee's, and central stud, no further details are necessary.

It will be desirable to try the parallelism of each successive sliding piece directly from the bed itself with scribing block, since although each separate piece may show fairly true for thickness alone, yet on the whole a slight discrepancy may be apparent.

The centres of the holes for the traversing screws will not be marked off until the various bearings and nuts are fitted in place,—viz., Fig. 286 for the saddle, Fig. 287 for the cross slide, Fig. 288 for the top slide. These being all in place, the centres of the holes in the lug bearings (Fig. 286) and in the ends of the slide (Fig. 283), will be scribed off and drilled, preferably with a small drill first of all, being, say, $\frac{1}{32}$in. or $\frac{1}{16}$in. smaller than the sizes of the actual holes, and afterwards the faces of the nuts in the slides will be brought opposite to these, and scribed off therefrom, moving the slide with its attached nut first to one end, then to the other. Supposing a slight variation to exist in the centrality of the end holes, it will be apparent on marking off and drilling the central nuts; and the difference in the holes can then, having them under size, be easily adjusted by filing to one side, and finally finishing with another drill, or with a broach to the exact size. The diameters of the holes are given in each case. The central nuts are screwed either with an angular or with a square thread, as is most convenient, square threads being cut by the lathe makers on account of their more durable wearing surfaces.

Before going farther, and while on the subject of fitting the slides, let us anticipate a little, and suppose the rack and pinion in place, and see how we may check the accuracy of our lathe parts with a view to final adjustments.

When checking the truth of a lathe there are three points to be attended to—the parallelism of the headstock mandrel with the bed cheeks, the exact right angles therewith of the transverse groove in the saddle which guides the slide for surfacing, and, lastly, the parallelism or alignment of both headstock and poppet in relation to the bed cheeks. In the business of setting and checking, the base of operation is of course the vee'd-edges of the lathe bearers. To those the saddle is fitted with as fair an approximation to accuracy as can be obtained by direct measurement, and the headstock is similarly set with its screws. Now sliding the saddle bodily along with a boring-tool clamped in the tool-box, bore out a bush attached to a chuck on the headstock mandrel, taking a very light cut so that there shall be no possible forcing or springing of the tool. The hole will probably not be parallel when tried carefully with calipers. Assuming that the rest fits truly to the bed, the inference is obvious that the headstock mandrel is not set parallel: hence adjust its set screws until by repeated trials we find that the headstock is in such a position that a hole can be bored perfectly parallel, or a pin turned similarly; then, and not until then, can we be sure that the axis of the headstock is in perfect alignment with the axis of the bed. Then, as regards surfacing, we have presumably taken all reasonable precautions to get our vees for cross traverse at exact right angles with the bed slides, according to the directions just now given; but the probability also is that they are not quite so—in fact, not sufficiently accurate for the requirements of good work. Therefore we must try for surfacing by putting a face-plate, known to be true, on the mandrel thread, or by turning a plate of metal true, and then running the cross-slide over the centre, try the turned face to see if the tool or any other point set in the tool-box touches the turned face on the far side precisely as on the side towards the front. Supposing there is not exact correspondence, the only way to remove this source of inaccuracy is to readjust the edges of the saddle vees by filing or scraping the required parts, with consequent resetting of screws, until the vees for cross-travel carry the cross-slide over with a practically perfect approximation to the conditions requisite for true surfacing. Lastly, though we have a true headstock, and true rest for boring, turning, and surfacing, we are not sure now that the headstock and poppet are perfectly in line in relation to the axis of the bed—in fact, we may presume that they are not, spite of all our previous care in lining out. Take, therefore, a round bar, the longest convenient, place it between centres, and turn down a short bit at each end, say an inch inward to the same precise diameters. Shift the saddle of the rest to each turned end in succession, and test by means of a gauged thickness bit of metal interposed between the turned diameters and a tool point or any similar bit of metal clamped in the tool-box. If the space between the turned part and the point is exactly the same at each end, the position of the slides on the saddle meanwhile remaining unaltered, the saddle and the slides being racked bodily from one turned end to the other of the rod without interfering with their relative positions, well and good. If the interspace is not exactly the same at each end, the headstock must be set over in a perfectly parallel position with that which has already been imparted to it by the set screws, and to the precise amount of the difference in the spacing at each end of the rod as gauged by the thickness piece. This can be done by scribing lines with dividers at a little distance away from the edge of the headstock upon the bed, and using these lines as a guide for parallel adjustment.

With this we may consider the essential work of the upper portion of the rest (polish excepted) finished, and devote our attention to the apron and its parts. There are numerous forms of apron and clasp-nut made; but I shall content myself with describing one alone, and that not the most common form. This is convenient, compact, and easier to make than the ordinary double nut with cam plate, and is quite as good for a lathe of small size.

The main casting of the apron is shown in Fig. 290. It is bolted to the underside of the saddle by means of the return flange, is furnished with a groove to take the sliding-clasp nut, a plate being screwed against the face of the groove to retain the slide in place, and two bosses A for the pinion spindle Fig. 293 and B for the eccentric spindle (Fig. 292) for actuating the slide. This casting delivers itself very well, so that its pattern is precisely like the casting, plus the allowances. It should be fitted and screwed in place previously to machining, and the groove scribed with due regard to parallelism and square setting while so screwed up. The sliding nut (Fig. 291) is afterwards fitted to this groove, the labour of fitting being diminished by the use of narrow chipping strips. The screw will be cut in the lathe while the nut is yet solid—that is, the nut will be screwed in an entire circular hole just as though it were a common nut, and then the one half slotted away and discarded, leaving the half-clasp nut as shown in the figure. Or if the slotting presents any difficulty, cast the top half which is to serve the temporary object, as a separate piece, and fit, and solder or "sweat" it on the other, bore and cut the threads, and afterwards separate the halves by the application of warmth. The oblong, round-ended slot is to be cut to the dimensions and in the position shown, to take the eccentric-pin on the spindle (Fig. 292), by which the nut is thrown into and out of gear. This spindle, it will be observed, is prevented from slipping endways by the pin fitting into its circumferential groove (Fig. 290).

The spindle of the rack pinion is dimensioned in Fig. 293, and is maintained endways by the collar *a* at the front and the boss and set pin *b*, which forms an integral part of the pinion, at the inner end. For notes on the making of spur pinions see Vol. XLI. p. 160; information relative to racks will be found on the same page also. Two teeth each for this particular rack and pinion are drawn to full size in Fig. 294, and the section of the rack in Fig. 295. It is 2′ 5″ long, reaching to the gap at one end, and 4″ inwards from the end of the bed at the other, and is preferably cast in two lengths. Its position relatively to the bed in the other direction is shown in the transverse view, and also its mode of attachment by means of stud bolts put in from the inside of the bed.

HOW TO MAKE VARIOUS COLOURS.*

Being frequently asked by young aspirants for fame, in the ranks of the carriage painter, for formulas, by which they could be guided in making certain colours, I have concluded that others might be interested in such matters, and will therefore give here a few of the most popular recipes employed for producing various colours. It must be understood, in the first instance, that all the colours we see on carriages are not simply pigments or pigments mixed and applied as paint. The application of certain colours over certain grounds will produce colours not to be obtained in any other way. The term glazing is applied to this method of painting.

Brown.

Brown, according to scientific authority, is a warm, broken colour having red for its prominent ingredient, and possessing a slight yellowish tinge. Now we make what is called brown with red and black, or red and blue; but it is not really a brown. It is a dark red, and to make a brown we must add a little yellow. Mix Indian red, Tuscan red, or Pompeian red (all the same pigments) with black, to make a colour as light or as dark as you desire, then add a little chrome yellow. To make a richer brown take English vermilion and ivory black, and tinge with yellow. A richer brown, known as japan brown, is made by mixing any deep red with black japan until the required shade is produced. Another and still richer brown is made by mixing carriage-part lake and ivory black and a few drops of yellow. Carmine and such colours as lake, rose pink, &c., give a sort of maroon colour of various shades, according to the amount of black or blue mixed with them. Chocolate brown is a very handsome colour—the colour of prepared chocolate cakes. It may be made by adding a little red and black to burnt umber. Mix the umber and grind it, then add the red and black in small quantities until the desired shade is obtained.

Maroon.

A maroon colour is quite different from brown, yet many call it by that name. It is made in several ways, generally with lake and carmine. To make a good maroon colour add a little black to carriage-part lake, and put over a black ground, then glaze with carmine darkened with blue, not very strong. Carriage-part lake is purchased ready prepared.

Carmine.

Carmine, though an expensive pigment, may be used with economy in making lake colours. By preparing the ground with red, darkened to various shades, then glazing with carmine, we can make a handsome lake colour, and one that will not fade so readily as the real lake. German vermilion (sold at 35 cents per pound) mixed with white lead makes one of the best foundations for a carmine job. Next lay on the German vermilion darkened with a little carriage-part lake, after which colour-and-varnish with carmine, to which is added a little of the vermilion.

Green.

The handsome bottle greens, seen on carriages, are mostly "glazed colours." A ground is made of Dutch pink and black, then a glazing of yellow lake is put on, which gives that rich "depth" so much admired. Rich greens for express work are generally made by adding Prussian blue to Milori green. Chrome green may also be used for such work, but it is not so rich.

Grounds.

All delicate or expensive colours are put on a ground as near the colour of the finish as is possible to make with inexpensive pigments. This lessens the danger of patches and streaks occurring, and reduces the quantity required to make a solid covering. Most lakes have a ground of drop black, tinted with Indian red to the desired shade. For

* By F. B. Gardner, in the *Blacksmith and Wheelwright.*

purple lake, use a ground of Prussian blue with a little white added. For vermilion use a pink, made by adding red to white lead. For green use lead colour. It may sound strange to many, but I have demonstrated in a number of cases that ultramarine blue laid over a lemon yellow ground will be far more brilliant and durable than when put over any other ground. Why this is so I am unable to tell. This goes to show that the ground has an effect upon colours to a greater degree than is generally supposed, and the painter should take pains to get his foundation and groundwork as near perfect as possible. The ground for laying colour over is best when mixed to dry with an egg-shell gloss, not flat or dead, as some are in the habit of making it; then it will require no sandpapering, nor rubbing, which might destroy its evenness.

A PRACTICAL USE FOR LEIDENFROST'S DROPS.

WATER, placed upon a red hot metallic plate, springs into the form of a drop, and evaporates without coming in contact with the plate, as is known to all. It is equally well known that by using a concave vessel the drop continually rotates. To Bohlig belongs the credit of suggesting the practical use of the Leidenfrost experiment, more especially in water analysis for determining the solid residue of natural water. Where hitherto this determination has been effected by evaporating the water to dryness without boiling, in a platinum dish on a sand or water bath, and afterwards weighing the already tared dish, Bohlig proceeds as follows:—He brings a shallow platinum dish to a bright red heat over a gas lamp, measures out 50c.c. of the water to be analysed, and by means of a pipette lets single drops of it fall into the capsule, where they gather into a fluid globule, or spheroid, which begins to rotate. The evaporation proceeds quietly, without any spurting, and new quantities of water are added drop by drop, so that the spheroid always preserves a suitable and comparatively unvarying size. The operation can be carried out successfully with little practice, and is extremely elegant and precise. It is only necessary to be sure that the vessel is kept at a red heat, and that too many drops are not added, nor in too rapid succession, as otherwise the sudden cooling would cause a spurting of the fluid. Too rapid a rotation of the globule is prevented by letting the next drops, when it is time to add them, fall in a direction opposite to that of its rotation, so as to keep its movement in check. When the 50c.cm. of water are in the capsule, the operation is soon ended, the globule rapidly grows smaller, darker in colour, until it resembles a pea, the rotation slackens, and eventually ceases. The flame is then removed. The globule of residue lies perfectly loose on the capsule, without showing any adhesion. Thus there is obtained the solid residue of 50c.c. of water, which has been evaporated without contact with the sides of a vessel, without loss, and without contaminating mixture, in the shape of a little globule, which is exposed for a good while to a temperature of 180° C., until dry, and then is rolled directly upon the scale pan of a chemical balance, and weighed within ½ milligramme. The advantages of Bohlig's method may be thus summarised. The residue is in the shape of a little bead, with so small a superficies that, even if it contains chloride of calcium or chloride of magnesium, the absorption of water from the air is almost nothing, especially as the time of exposure is soon over, on account of the small weight to be weighed. Moreover, there is nothing to prevent the weighing of the globule in an air-tight, closed tube, well-dried beforehand. It is unquestionable that this new method can be adopted for the evaporation of all sorts of fluids to dryness, without loss, and for a large class of cases, if one includes different modifications of the method. For example, the platinum may be replaced with equal or greater advantage by silver, copper, or even pure nickel, and the method is not limited merely to solutions in water. There is no true contact of the fluid to be evaporated with the sides of the vessel, so that no chemical action can affect them. Hence aqua regia, sulphur compounds, &c., can be treated in red hot silver vessels without the latter being at all attacked.—*Rundschau für Pharmacie.*

Edison's Carbon for Transmitters.—Edison has recently devised a modification of the carbon button in his transmitter, which is said to greatly increase the efficacy of the instrument. He takes a textile or woven fabric, preferably that known as "veiling"; he forces lampblack or powdered carbon into the meshes under a strong pressure, and then carbonises it. Or, instead of this, he employs a disc of thin paper perforated with a large number of very fine holes, and treats it in the same way.

SCIENTIFIC NEWS.

WE learn from the American papers that the Lick Observatory, with its big telescope, will be in full activity in the latter part of next year, unless some unforeseen delay should occur. A correspondent informs us that the extra crown lens, which it was intended to use with the 36in. refractor for photographic purposes, has been cracked in the grinding; but we will hope that the Messrs. Clark will overcome that disaster. The amount bequeathed to the observatory was 700,000 dollars, and only about 200,000 dollars will remain as the nucleus of an endowment. Every effort has been made to keep current expenses low; but that sum will not be sufficient to support a staff capable of utilising the various instruments to the fullest extent. To quote the words of Prof. Holden, the Americans do not mean to jealously "guard the immense scientific opportunity for ourselves, for California, or even for the United States. The real gift of Mr. Lick was to the world. We mean to put the large telescope at the disposition of the world by inviting its most distinguished astronomers to visit us, one at a time; and to give to them the use of the instrument during certain specific hours of the twenty-four. Each day there will be certain hours set apart when the observatory staff will relinquish the use of the equatoreal to distinguished specialists who will come from the United States and from Europe to solve or to attack some one of the many unsolved problems of astronomy. In this way we hope to make the gift of Mr. Lick one which is truly a gift to science, and not merely a gift to California and to its University."

In a paper by Dr. B. A. Gould, read at the meeting of the American Association, held recently at Buffalo, N.Y., the author gives an interesting account of his photographic work at Cordoba. The only Northern stars photographed were the Pleiades and Præsepe, and it is notable that on all the Pleiades' plates all Bessel's stars within the limit of the field are found, with one exception, a 9½ mag., whilst others down to the 11th mag. are clearly depicted. Dr. Gould has frequently photographed about 70 of the southern clusters, and more than a hundred double stars.

The death is announced of Alessandro Dorna, director of the University Observatory, Turin. He was in his sixty-second year.

Prof. Cohn has lately delivered a lecture on "The Action of the Electric Light upon the Eye," in which he stated that it sometimes induced inflammation. Arc lights should be surrounded by a globe of ground glass, or even opal, notwithstanding the loss. He quoted the conclusions of Voit and Ranke, of Munich, that the light from an Edison incandescent lamp is seven times brighter than that of an Argand gas-burner, and therefore excites the retina more. On the other hand, if the electric light is weak, books and work are apt to be held too close to the eyes—a fertile cause of myopia. Prof. Junge, of Zurich, informed Prof. Cohn that the local reading society had given up the use of the incandescent lamps, as the illumination was too weak, and to have increased it sufficiently would have made the cost double that of gas. So far as the eyesight is concerned, the incandescent lamp is to be preferred to the arc light, but in either case the light should be steady and strong.

It is stated that a resident of Sydney has brought under the notice of the Governor an electrical machine-gun which is said to be capable of firing 120 rounds "every few seconds," from any position and in any direction. It is stated to have the further advantage of being easily portable.

At the Fourth Semi-Annual Convention of the National Electric Light Association, held recently at Detroit, Michigan, an exhibition of novelties was organised, and amongst them was an incandescent lamp of 400 candle-power, which was stated to need only 425 watts—a very economical lamp of the kind if it answers the test.

A "transportable electric lighthouse" has been lately invented by M. Beduwe, a builder in Liége. The idea is to furnish the light in any place on short notice; and it is thought the apparatus might prove useful in public works, cases of accident, gatherings in public places, fêtes, &c. The constituent parts are (1) a telescopic system of copper tubes bearing the light; (2) a three-cylinder steam-engine to drive either a Gramme machine, or a suction and force pump; (3) a vertical boiler on the tubular system; and (4) a reservoir for water. The whole is mounted on a four-wheeled carriage. The light is raised by hydraulic means.

A Mr. F. Rohart has recently presented a note to the French Society of Agriculture in which he briefly describes a method of utilising wool grease. He has not given a full account, but states that the wool grease, having first been melted down, is treated with "a certain sulphur compound," with which it enters into combination. The substance thus produced is a true chemical compound, and contains in combination at least 100 times its volume of hydrogen sulphide. If it be now treated with an alkali, it is immediately saponified, even in the cold. The soap thus produced smells neither of the grease nor of the hydrogen sulphide, and the conversion takes place with great rapidity. It is, however, essentially a cheap soap, and is not adapted for toilet purposes. This should, if true, prove good news in America, where in New England and the Middle States it is calculated that 40,000,000lb. of the non-drying viscous grease are run into the rivers every year. The subject came up at the Farmers' Convention held recently in Boston, when it was pointed out that the wool grease might be saved, and utilised instead of European degras by the tanners. If M. Rohart can make a soap out of the wool grease, he ought to find plenty of occupation in America.

Mount Lyell, about seventeen miles north-east of Macquarie Harbour, on the west coast of Tasmania, is believed to be extraordinarily rich in gold. Its formation resembles that of the famous Mount Morgan in Queensland, and it is stated that some assays already made have yielded the precious metal at the rate of 164oz., 187oz., and 348oz. to the ton.

The celebrated fossil tree at Clayton, upon which a paper was read by Mr. Adamson at the recent meeting of the British Association, has been purchased by Prof. Williamson, F.R.S., for Owens College, Manchester. It is the most gigantic carboniferous fossil yet discovered.

The Egyptian obelisk, or Cleopatra's Needle, in Central-park, New York, is showing slight signs of disintegration, in spite of the paraffin dressing it received. It is now suggested that ultimately it may be necessary to inclose the stone in a light glass structure.

The Marquis Benzoni, accompanied by Count Savicoux, Major Piano, and a Modenese engineer, Sig. Salmitare, will attempt to penetrate Harrar by way of Assab. They were to start at the beginning of October.

The Canadian salmon, hatched at the South Kensington Aquarium last April, are thriving well, and many of the Indian fish lately imported seem to find their surroundings suitable.

At the Royal Victoria Hall, on Oct. 5, Mr. W. L. Carpenter will lecture on "What may be Done with a New Lantern"; Dr. W. D. Halliburton will discourse on "The Germs of Disease" on the following Tuesday; and on Oct. 19 Prof. Judd will lecture on "A Piece of Pumice-stone."

M. Lecoq de Boisbaudran has communicated to the Paris Academy of Sciences some interesting experiments on the "Fluorescence of the Compounds of Manganese subjected to Electric Effluvium in Vacuum." The fluorescence of some of the compounds of manganese is an extremely sensitive reaction, by means of which imponderable traces of this metal may be detected in natural or artificial substances which might otherwise be supposed to be free from its presence.

M. Ch. V. Zenger has recently brought before the Paris Academy of Sciences some notes on "Phosphorography Applied to the Photography of the Invisible." He has often observed that the bluish-green glow at night on the ice of Mont Blanc would affect a sensitised film, and he therefore concluded that Balmain's luminous paint spread over collodion might also be acted upon. The idea is not novel, but M. Zenger found that in a few seconds a photo-

graphic impression was produced, and that if the plate was removed from the camera and placed in contact with a dry sensitive surface, after the action had continued about an hour the object appeared in all its details as in the ordinary case of photographic impressions. He thus proved that images of objects invisible in the dark may be fixed by simple contact or by the photographic apparatus.

The *Mineralogical Magazine* and *Journal* of the Mineralogical Society, No. 2, contains a paper by Prof. T. G. Bonney on a rare rock from the Val d'Aoste, illustrated by chromolithographs of a couple of microscopic slides: it is a glaucophane-eclogite. Amongst the other papers there is a suggestion for a new classification of the hydrocarbons, and a useful account of the diatomaceous deposits in Skye.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

STELLAR MAGNIFICATION — SPURIOUS STAR-DISCS—STAR-LIGHT.

[26307.]—Whenever the subject of stellar magnification has been discussed in these pages it has generally, in substance, been stated that stars are not susceptible of magnification, as contradistinguished from planets, which, though to the naked eye presenting no characteristics that enable one to distinguish them from the fixed stars, are nevertheless susceptible of magnification. This idea, presented to the mind of the struggling amateur (interminable are his woes!) must appear extraordinary to say the least: it does not appear plausible to him, that a telescope should be endowed with the faculty of distinguishing planets from fixed stars in order that it may magnify only the planets (for stars won't magnify); nor is it comprehensible to his mind that one is expanded into a surface with detail, whilst the other is converted into a spurious disc of a definite size, without detail however; this disc, though round and planetary in appearance, having no reference at all to the ultimate star, which is a point of no dimensions whatever! and which no magnification, however great, can give dimensions! Thus it is said. A very meagre attempt is, as a general thing, made to grease this bolus somewhat thoroughly so that it may go down easily and not grate too harshly; but, though the trusting student resists slightly, he, as a general thing, takes it in, and it glides down softly; but it scarcely ever digests—it never can be clear to his mind that any distant object viewed with a telescope is not magnified in the exact proportion of the focal length of the object-glass to that of the eyepiece. Now, why not acknowledge that this is certainly the case even with the star, that the star is as certainly not a point, that it presents a true surface, that the surface presented is $(500)^2$ times greater with, than without, a telescope magnifying 500 times, that with a sufficiently great magnifying power (would our atmosphere and our instrumental capabilities permit it) the surface of a star would present a disc not unlike that of the sun.

To make this clear to a person who has contended with the various conflicting peculiarities of the images of stars and planets, a few simple considerations will, I think, make them all very plain and perfectly harmonious. It is, of course, utterly hopeless to conceive the distance of the stars or to measure this distance with magnitudes such as those with which our minds are accustomed to measure earthly ones: we have actual figures which, within reasonable approximation, represent this colossal distance; but these figures represent no definite idea of the remoteness of the stars to a mind endeavouring to picture it for contemplation. It is conceivable though that no matter how large a sphere may be, it is possible to place it at so remote a distance that its dimensions may shrink to any assignable smallness. Let us suppose that a solar globe is withdrawn into space until its disc presents to the eye a diameter of 0·00001″, such a disc would, of course, present no sensible area to the unassisted eye. Would it in the telescope? Let us see! Since a telescope increases the angle which an object subtends at the eye, directly in proportion to the magnifying power, a telescope capable of magnifying 500 times on being directed to this object would present a disc having a diameter of $500 \times 0{\cdot}00001'' = 0{\cdot}005''$. It appears then that after having magnified the object or the angle which it subtended in the first place 500 times, it still presents a surface that is not recognisable as such by the eye (leaving for the moment out of consideration the spurious star disc, which is an optical phenomenon inseparable from focal images). Hence, what appeared as a point to the naked eye appears still to be a point in the telescope, notwithstanding that it has really been magnified 500 diameters. There would be no perceptible variation in this result if we increased the magnifying power still further to 1000 diameters, when the diameter of the true disc would be 0·01″, representing an undiscernible area, vanishingly small and comparable only to a point, though in truth it has definite dimensions, for it may readily be seen that if the magnifying power be still further increased to, say, 100,000 diameters, our distant globe would then subtend an angle of 1″ and would be visible in a telescope whose object-glass is of large diameter as a small, a very small, disc; but such a magnifying power being—with our present facilities, and with the obstacles that lie in the way of overcoming the image-annihilating properties of our atmosphere—impossible, we may never hope to see the true disc of a fixed star.

If, now, instead of a star we consider the effect of magnifying power applied to a planet, say Jupiter, which at opposition subtends an angle of 44″, an angle which, though many times greater than that of the star, when received on the background of the sky does not sensibly differ from a point in apparent size, and as far as any impression it will make on the retina is concerned, will not differ in its effects from the impression left there by a star subtending 0·00001″.

I exclude from consideration the tendency to enlarged retinal images from superior brilliancy, and hence assume that the quantity of light from both sources is the same. This would result then in an apparent equality in size of Jupiter and a fixed star giving the same quantity of light, notwithstanding their very considerable difference in angular diameter. Though the difference between these diameters is too small for retinal perception when received with the naked eye, this is, however, not the case when it is assisted by the telescope, for when we magnify 44″ 500 times we obtain an angle of more than six degrees, which will allow ample space for possible detail. We have thus applied the same reasoning to both planet and star, and have obtained consistent, comprehensible results: the planet from a point has expanded to a wide disc six degrees in diameter, the star, however, has remained an apparent point, though we have truly magnified the angle under which it is seen; showing that an object may be so small, or rather subtend so small an angle, that a large multiple of that angle may still be a small quantity.

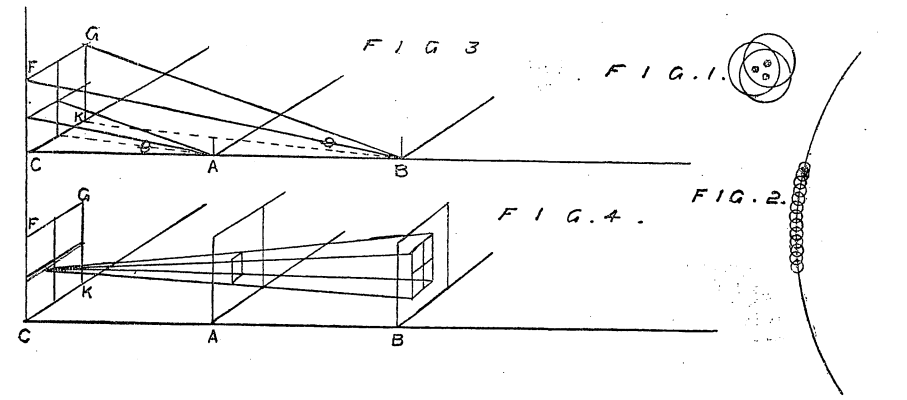
Thus far we have left out of consideration the spurious star disc, which, as is well known, is an inherent property of every image-forming instrument: it is a necessary part of the very nature of light that every point in the object is represented by a minute disc in the image. A star then being as far as dimensions go, when viewed either by the eye or through a telescope, a mere point, will be represented in the image by a disc which the eyepiece may magnify at will, the disc being formed by the o.g. or mirror; the disc then is of determinable dimensions for every o.g. or mirror, depending only on the aperture and decreasing as it increases. If three points be conceived in as close proximity as one can see them in any object, yet distinct and separate, such points being elements of detail of the surface of the object, an image of them formed by an o.g. will consist of three overlapping discs whose centres will be the positions corresponding to the three elementary points (see Fig. 1). It is clear therefore that the spurious disc of every point in an object has a direct tendency to blot out, or at least to modify, the images of neighbouring elementary details, and it follows from this that the smallest possible detail that may be observed in an image must be of the size of the spurious disc; whence it follows that masses of detail cannot possibly be viewed, being of a less size in the object than the focal image of a single point, consequently all detail observed in an image must be formed out of elements of that size, all of them more or less overlapping the discs of numerous elements in the immediate neighbourhood. It thus becomes manifest that the smaller the spurious disc the greater will the image resemble the object, the greater will be the quantity of detail that will be formed in the image, and the greater in general will be its usefulness. Such a decrease in the size of the spurious disc can only result, however, from an increase of aperture or diameter of the image-forming surfaces, and hence the value of large telescopes for the production of images in the greatest possible degree resembling the objects they portray.

A very striking comparison may be useful here to perhaps render the formation of images by aggregation of discs clearer to some. Let it be supposed that an artist is engaged in the production of a mosaic. It will be quite obvious that he will be better enabled to reproduce the original, the smaller the separate pieces are, out of which he purposes to produce the image—and that there are matters of detail in the original, for the production of the image of which his pieces will be too large; and, further, that no matter how small these separate pieces may be, the image can never be identical with the original, since its elements will always be smaller than those of the mosaic can ever be. In the comparison no account is taken of the overlapping feature of the spurious discs.

We have seen that a star disc or the disc formed by any point on a planet's surface is the image of a point which, if it were accurately reproduced, would be in the centre of the spurious disc; this point then is the limit to which a disc would at length diminish if the o.g. were indefinitely increased in diameter. It is manifest therefore that the image of the limb of a planet being formed of discs, the centres of which are the places corresponding to similar points on the limb of the planet, must be too large in diameter by exactly the diameter of the spurious disc, which extends beyond the true boundary of the image by its radius; it becomes necessary, therefore, in making measurements of planetary diameters, or even details, to make allowance for the redundancy in the image in order to obtain the true value sought. (See Fig. 2.)

And now a word or two concerning the brightness of stars. Assuming non-extinguishable properties for the medium filling space beyond our atmosphere, a star shines with undiminished splendour intrinsically, be it ever so remote in the recesses of space; that is to say, for the same angular area of true star disc, the same quantity of light reaches us, as would reach us from the same angular area were the star any distance, however near or remote, say at only a million miles, or only a thousand miles, where its disc would subtend an angle of nearly 180 degrees.

This seems improbable at first sight; but a little consideration will establish this truth firmly. Imagine a plane C A B (see Fig. 3) on which at C there is erected a high and wide surface C F G K; let an observer at A note the extent of surface included within a certain solid angle θ, then having retired to the position B just as far again from the erect surface, let him again note the area included within the same angular space, and it will be observed that having doubled the distance from C, the extent of surface visible in the solid angle will be quadrupled, that is, the areas included within a certain angular subtense are proportional



to the squares of the distances. In the above diagram, supposing the surface C F G K to be a luminous one, we will obtain four times as much light included in the angle θ in the position B as will be obtained in the position A; for, as we recede from A the squares in the diagram, into which the surface C F G K is divided, will contract in apparent size until when we reach B, four squares together with all the light they radiate towards B will be included in the angle θ, which only included one square in the first position; it follows then that the intrinsic brightness of the surface has increased fourfold in doubling the distance. But the quantity of light that will fall on a given surface will also diminish as the square of the distance as we recede from it, as will be seen by inspecting Fig. 4, where a point in the erect surface is shown to radiate in the direction of our observer; clearly the little square in the position A is one fourth of the projected surface at B, and hence the light at B being spread out over four times the area at A will for each element of surface be four times less bright; hence, having increased and diminished the brightness of a source of light, in the same proportion by doubling the distance, its intrinsic brightness cannot have changed at all; it is obvious therefore that the intrinsic brightness of a surface does not change by reason of a change of distance. The observer in moving from A to B has condensed the light of four squares into one, but he has thereby also diminished the brightness of each element of surface, and hence of each square to one fourth its brightness at A, so that the quantity of light entering his angle at B remains exactly the same as that at A.

Applying this result to the stars we learn that viewed from the earth a star is intrinsically as bright to us in the remotest depths of space, there, where the sounding lead of the star-gazer has never penetrated, where its glorious radiations in their almost infinite journey through the endless vistas of space become so enfeebled, that when they reach our earth, a mere mote in the glare of another star, neither eye nor telescope can gather up a pencil whose converging intensity is sufficiently powerful to excite an optic nerve, as it would be were it no further away than the moon—*i.e.*, the same angle including a varying extent of star surface will, however, receive the same quantity of light at all distances; but consider what a small angle we have been dealing with, and the necessarily small quantity of light it represents. I have for illustration assumed the angular diameter of a star to be 0·00001″. May we not, by simply enlarging this disc, produce a sun of no mean splendour, without altering its intrinsic brightness, or even its distance, one particle? Let us try. Our sun is about 32′ = 1920″ in diameter, then $\frac{(1920'')^2}{(0{\cdot}00001'')^2}$ = the number of times the sun's area surpasses that of, say, a star of the first magnitude as seen from the earth, then having ascertained that this equals 36,864,000,000,000,000, we deduce the result that the star, were it recalled from space until its diameter grew to that of the sun (when their discs would be equal in diameter), would be 36,864,000,000,000,000 times as bright as a star of the first magnitude.

Of course, this result is based on the purely arbitrary assumption that a first magnitude star subtends an angle of 0·0001″, the truth of which I can by no means vouch for, though no one can say it is neither greater or less. It is, in fact, one of the great problems of astronomy of the future to determine this quantity, and though our present means of attacking the problem are to all appearances inadequate, there can scarcely be a doubt that the future will develop new means, perhaps a new science to cope with it, and that in time the unknown measure of the unseen, the true star disc, will be determined with accuracy, and lead on to renewed speculations in the vast outer expanse of the ethereal wilderness to which the first magnitude star is but the gateway.

St. Louis, Mo., Aug. 30. **Wm. A. Haren.**

T CASSIOPEIÆ.

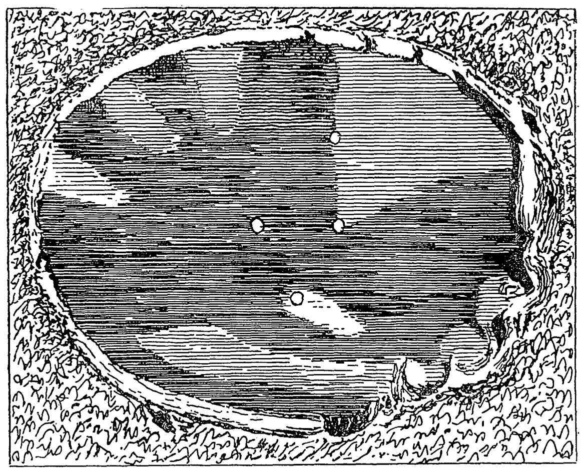
[26308.]—WITH reference to Mr. Holmes's remark about this variable, I may tell him that the star will not be due at a maximum until Dec. 26 of the present year. Observations are, therefore, desirable, as the coming maximum may prove to be a bright one. At the maximum of last year, Mr. Baxendell estimated the magnitude only 7·8.

J. E. Gore.

PLATO.

[26309.]—STARS, double, coloured, and variable, have been for long the rage in your columns. Lunar observations are comparatively unfrequent, save when Mr. Peal expands that most interesting theory of his, or Mr. Elger delights us with one of his splendid drawings.

Time was when views of Plato and its curious interior were frequent; but years have elapsed

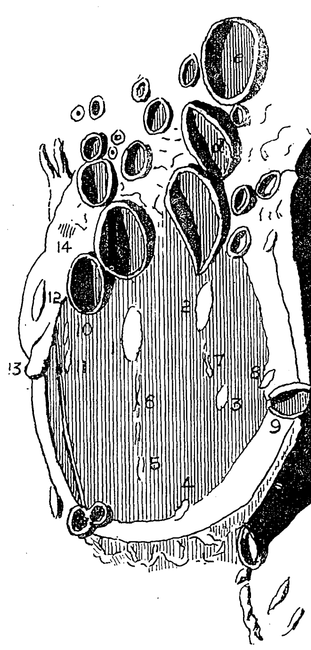


since the last appeared. I therefore take the liberty of sending a sketch of the floor as it appeared to me with an 8½in. Calver mirror on the night of the 17th. Would some observer, blessed with better air and a more accurate pencil than I, tell us what he sees of Plato? I appeal especially to Messrs. Elger and Franks.

Llanelly. **Arthur Mee.**

CLEFT IN CAPUANUS.

[26310.]—THIS important ring-plain contains a few details on its floor which seem to have escaped the attention of observers generally. Neison says it appears level. I observed it on Sept. 8, 1886, for about one hour, when the moon passed across a



gap between two buildings. Though very low, the air was good. The cleft η, along the W. portion of the floor, was very plain. It runs in a N.—S. direction from the foot of peak 13 to the double crater B on the N.W. border. This cleft seems to have been first seen by Mr. E. Stuyvaert, of the Brussels Observatory, on Nov. 29, 1884; 1 is a mound, the largest on the floor, given by Schmidt; 2 another mound, somewhat smaller, but not very difficult; 3 and 5, two other mounds, seen with difficulty. Between 1 and 5, and 2 and 3, are two irregular ridges, 6 and 7, which seem to connect the mounds. Moreover, the plain is not level, as depressions are faintly seen here and there; 4 is generally given as a craterlet—it looked more like a hillock on the present occasion; 8, a hillock; 9, a crater on the E. wall; 10 and 11, two hillocks; 12 and 13, peaks on the W. wall; 14, a slight depression on the S.W. wall. **C. M. Gaudibert.**

STATIC ELECTRICITY.

[26311.]—" A., LIVERPOOL " (26284, p. 85), wishes me to explain some points he refers to in my " Electricity: its Theory, Sources, and Applications." I wish that he, or anyone similarly disposed, would not content himself with merely quoting a few words upon which explanation is desired. With every paragraph numbered in order to facilitate reference, it is very easy to indicate the exact position of the words, instead of leaving me to hunt them out. My writing is generally studded with suggestive sentences, which may be either left to set the reader thinking, or which may be found developed and worked out elsewhere. My chapter on " Static and Frictional Electricity " occupies 77 pages, and I do not know whereabouts the words quoted—" static electricity is understood to mean that produced by frictional means "—may happen to occur. But I am quite sure that this definition is not " laid down " by me anywhere, either as held by myself or suggested to my readers. In § 20 of my second edition, I say distinctly, " Static electricity is, however, a misnomer: it has no existence; all the phenomena are due to static strains, but there is always a gradual loss, called *leakage*, which is, however, the current due to the actual conductivity of all circuits; and every motion set up by so-called 'static' electricity implies a transfer of energy and action occurring in a field of force set up in the form of strains in the particular 'inductive circuit' in which the motions occur."

It is rather hard to take a sentence or two out of a systematic book through which a continuous train of theoretical explanations is worked out, and deal with those sentences apart from the whole train of thought. But this becomes more difficult when the sentences dealt with form no part of the author's own ideas, but are even statements of something which he considers imperfect or erroneous, and then proceeds to correct.

Now " A." quotes me as laying down " that static electricity is only to be found on the external surfaces of bodies," and asks me to explain, on that view, certain experiments which he details. Well, as he does not supply page or section, I refer to the Index, and find " Surfaces and Electric Distribution," p. 62. There, in section 81, I say, " Most electrical works occupy many pages and numerous illustrations to show that *static electricity is formed and exists only on the surfaces of bodies*." I add that Faraday made numerous experiments to prove " that the force is to be found only on *external* surfaces." Then I go on to say that these old theories were destroyed " as soon as it was found that electricity could be placed upon an *internal* surface," which is just what the experiments stated by our friend go to illustrate, but which also has been known to everyone this many a year.

My own statement is: " The static actions of electricity are manifested at surfaces, because these are the boundaries of the field of force in which the electrical charge exists. The law and its reason are obvious—electricity in its static manifestation *must be formed only on surfaces* where the polarised circuit passes from one body to another." In fact, the old theories taught that a charge of electricity was put on the surfaces, as a coat of paint might. The theory (which I was plentifully abused as a heretic for maintaining years ago, but which is now adopted by pretty nearly everyone) is that the (imaginary) electricity is not on the surfaces at all, but in the intervening di-electric, air, glass, &c. If " A." will read pp. 72—75 on " Inclosed Spheres and the Leyden Jar," he will find all his experiments explained, and the whole subject fully worked out; but I may add that he appears to have made a discovery. He says: " I find that if any part of a piece of glass be rubbed, the whole of it is electrified simultaneously." Now, if he means only that the whole surface will manifest some small electrification, no doubt he is right, because the glass surface will conduct slightly; but it is a well-known fact that we can use a rubber to write or make marks, upon a glass surface which are invisible, but if we dust a fine powder on the surface, it will adhere to those marks, and render them visible. Of course, also, if a glass tube is rubbed externally, the inside is electrified (with a charge opposite to that of the external surface): the reason is obvious, on the principles which I have fully explained. **Sigma.**

CONCERNING CHAMBER ORGANS, HARMONIUM PLAYING, AND HOME STUDIES.

[26312.]—I HAVE read the letter by "Country Solicitor," in last week's issue, with not a little interest; and as my name appears therein, in reference to more than one subject, I may be pardoned for essaying a short reply.

It is almost needless to remark that I feel highly gratified at his kind assurances that my "Notes on the Chamber Organ" afford him and others pleasure, and are of "the deepest interest" to him, as he courteously puts it.

Firstly, with reference to his opinion of the Programme I ventured to include in my letter (26103), I can assure "Country Solicitor" that no one of my guests, on the occasion of its performance, complained that so much of the "music of the future" was included therein; and I only wish "Country Solicitor" had been with us on that delightful evening. Does he know the chief numbers from Wagner's pen which were performed —viz., Isolden's Liebestod; Walther's Preisslied; and the Steersman's Song, from the Fliegende Holländer? From his rather slighting remarks I should guess not. If he has amongst his friends a first-rate violinist, I strongly recommend him to obtain copies of the instrumental pieces; but let them not be judged by the way even a good amateur would render them. On the occasion of their performance at my house, the violin was in the able hands of Herr Ernst Schiever, leader of the Richter Orchestra. "Country Solicitor" must be aware of the difficulty of securing variety when one arranges numerous programmes; indeed, one is sometimes so much at a loss for something new, that one wishes one could really get a leaf or two from the veritable *music of the future*. There are vast stores of classical compositions at one's disposal, but few pieces that readily lend themselves to the humble means of rendition at an amateur's disposal. Personally, I always feel there is a danger of grossly misrepresenting or misinterpreting the thoughts of the great composers; and the old saying, "fools rush in where angels fear to tread," comes with unpleasant force to the mind when one is contemplating the performance of a movement from any of the great Symphonies or other complex orchestral works. This consideration has always had great weight with me; and has led me to prefer music specially written for the instruments at my disposal, or such compositions as readily lend themselves to a chamber treatment.

I have read with much interest the programme so kindly given by "Country Solicitor"; and, while one can find no fault with the selection therein displayed, one cannot help feeling disappointed that the true king of instruments—the violin—took no part in its rendition. Now, seeing that the programme I have already given has so greatly offended "Country Solicitor's" musical taste, let me give one other example from my bundle of programmes, in the hopes that it may disabuse his mind of the impression that my mind is lost in admiration of the "music of the future."

"The meaning of song goes deep. Who is there that, in logical words, can express the effect music has on us? A kind of inarticulate, unfathomable speech, which leads us to the edge of the infinite, and lets us for moments gaze into that."—*Carlyle.*

PROGRAMME. PARTE YE FIRSTE.

OVERTURE (A Midsummer Night's Dream) Mendelssohn.
Done on ye Organ alone.

CREATION'S HYMNE... ... ... Beethoven.
For ye Contralto Voyce with ye Organ.

FANTASIE ... (Hungarian Airs) ... ... Liszt.
For ye Pianoforte alone.

DUETTE ... (Marriage of Figaro) ... Mozart.
By ye Pianoforte and Organ.

LARGO ... (Sonata in D major) ... Beethoven.
Played on ye Fiddle, Bass Viol, Pianoforte, and Organ.

AVE MARIA ... ... Gounod.
For ye High Voyce, with Fiddle, Pianoforte, Organ, and ye Horn sparinglye.

PROGRAMME. PARTE YE SECOND.

ITALIAN CONCERTO (F major) ... ... Bach.
Allegro Moderato—Andante—Presto.
On ye Pianoforte alone.

ANDANTE CON VARIAZIONE (Grand Septuor) Beethoven.
Rendered on ye Fiddle, Pianoforte, and Organ.

SONATA YE FORTH ... ... Mendelssohn.
For ye Organ alone.

AVE MARIA ... ... Schubert.
Given on ye Fiddle, Bass Viol, Pianoforte, and Organ.

ANDANTE RELIGIOSO ... ... Lefébure-Wely.
On ye Horn, two Bass Viols, and Organ.

DUO DE CONCERT (Aida) ... ... Verdi.
On ye Pianoforte and Organ.

It will be seen from the heading given that it is also my practice to append to the programmes some quotations having reference to music. The practice is a good one, and I am glad to see that in this respect "Country Solicitor" and myself agree.

I regret to hear that any remarks of mine anent the Chamber Organ, has "struck sorrow into the hearts" of himself and others who may have a limited purse, and, accordingly, cannot afford to purchase a Pipe Organ; but it surely is not my fault that a properly appointed Chamber Organ is so costly an affair. To those who can neither afford to purchase such an instrument nor contrive to make one, I say let them be content with "Country Solicitor's" favourite, the Mustel. Indeed, if "there is as much music in it" as his friend said there was in his church organ of some fifty speaking stops, and more power of expression in it than in a Pipe Organ of any kind, what need is there for any opinions of mine, in favour of the true Chamber Organ, to "strike sorrow into," or even disturb the heart of "Country Solicitor"?

His Mustel must be far superior to my Chamber Organ; yet, strange to relate, I do not envy his instrument. I have never yet seen or heard a Reed Organ which I would care to possess, and I fear the same sentiment will be found in the breasts of all others who love the Pipe Organ, and are fortunate enough to possess good instruments.

I disagree entirely with "Country Solicitor" in the following remarks:—"In even a moderate sized drawing-room a Pipe Organ seems entirely out of place. I even make bold to say that the organ proper is fit only for a cathedral or other building where the 32ft. pedal notes have room to speak." The contrary is really the case so far as the true Chamber Organ is concerned; and I most unhesitatingly affirm that a properly constructed Pipe Organ, schemed on the lines set forth in my "Notes on the Chamber Organ," is in all respects perfectly adapted for a moderate sized drawing-room. Space will not permit me to enlarge on this subject here; but I may just remind "Country Solicitor" that there is no necessity for a Chamber Organ to produce the 32ft. notes. With the 16ft. pitch, the bass is as deep as the lowest bass of the orchestra, and surely that is sufficient for all practical purposes.

Again, I disagree with "Country Solicitor" when he says:—"After all is said and done, even Mr. Audsley must be contrained to admit that even his pet organ is a soulless intrument, devoid of all expression." Where have I acknowledged that the pipe-organ is "a soulless instrument, devoid of all expression"? I have admitted, and do admit, that the organ, as usually made, is *deficient in powers of expression;* and one purpose, as will be clearly seen from the instalment in this issue, of my "Notes on the Chamber Organ," is to show how *increased* and, indeed, *satisfactory powers of expression* may be given to the Pipe Organ. The *portamento*, *sforzando*, and certain subtle *nuances*, or refined effects of light and shade are certainly difficult on the best appointed organ; on the ordinary type of Chamber Organ they are impossible. But, on the other hand, they are still more difficult on Reed Organs which are fitted with a pedal department; for the blowing of such instruments has to be done by hand or by some motor, just as in the case of the Pipe Organ. It is, accordingly, only on the Reed Organs with manuals and no pedal department that the maximum of expression can be obtained. Such one-ply instruments must always be deficient in grandeur, at least they altogether lack the dignity and impressiveness that the Pedal stops impart.

Now the crowning glory of the true Chamber Organ is the magnificence of its bass: this is of untold value in all varieties of *ensemble* music. In short, for all purposes of chamber music the true Organ is unrivalled by any instrument of the Harmonium type. I wish I could let "Country Solicitor" hear the effects produced by my Chamber Organ, either in such a solo as the Overture to "A Midsummer Night's Dream," or in such a concerted piece as the Largo from Beethoven's Sonata in D major; for if he once heard the effects, he would never consider the Pipe Organ "a soulless instrument, devoid of all expression." If he will communicate direct with me, I shall be happy to give him an opportunity of judging whether *his opinion* of the Pipe Organ or *mine* is the correct one. I presume he often pays a visit to London.

I am sorry "Country Solicitor" does not place music on higher ground than as a simple "recreation." I give it credit for being one of the most elevating and refining agents which can be brought into our high-pressure daily life, and within the confines of the home circle. I may be wrong in this, as in many of my other beliefs and opinions; but if I am, I certainly do not desire to be convinced of my error. **G. A. Audsley.**

Devon Nook, Chiswick, W.

[26313.]—THE borrowed Quint of $10\frac{2}{3}$ft. mentioned by your correspondent is not an example to be followed. The fifths are *tempered*, and the acoustic note comes on and off in great waves of sound. That is my experience at St. Mary's, Denbigh, where the experiment was first tried (February, 1884).

The Great Quint is useless and ever offensive in the upper range unless accompanied by an actual 32ft. stop. For the upper range the best way is to borrow from the Bourdon, beginning at the CCC pipe, thus getting the *actual* 32ft. note as at St. Mary's, Denbigh. For the bottom octave 12 truly tuned pipes should be used. This method was advocated in my "Modern Organ," 1883 (invented 1881), and shown in my "Inventions" organ.

Denbigh, 20th Sept. **Thomas Casson.**

SPECIFICATION OF ORGAN, ST. MARY-LE-BOW, LONDON, E.C., BY J. W. WALKER AND SONS.

[26314.]—GREAT ORGAN (COMPASS C C TO A IN ALTO, 58 NOTES).

	Ft.	Pipes.
1. Double open diapason, metal, to tenor C, lowest octave, wood stopped	16	58
2. Open diapason, metal	8	58
3. Horn diapason	8	58
4. Wald flute and stopped bass, wood	8	58
5. Principal, metal	4	58
6. Harmonic flute, metal and wood	4 tone	58
7. Twelfth, metal	$2\frac{2}{3}$	58
9. Mixture (3 ranks), various		174
10. Trumpet	8	58
		696

SWELL ORGAN (COMPASS C C TO A IN ALTO, 58 NOTES).

	Ft.	Pipes.
1. Double diapason, wood	16 tone	58
2. Open diapason, metal	8	58
3. Echo Gamba	8	58
4. Vox Angelica, tenor C, undulating with No. 3	8	46
5. Stopped diapason	8 tone	58
6. Principal, metal	4	58
7. Spitz flute, wood	4 tone	58
8. Fifteenth, metal	2	58
9. Mixture (3 ranks)	various	174
10. Horn "	8	58
11. Oboe "	8	58
12. Clarion "	4	58
		406

CHOIR ORGAN (COMPASS C C TO A IN ALTO, 58 NOTES).

	Ft.	Pipes.
1. Salicional, metal	8	58
2. Dulciana, metal	8	58
3. Lieblich Gedact, wood	8 tone	58
4. Gemshorn, metal	4	58
5. Flute, wood,	4 tone	58
6. Piccolo, wood	2	58
7. Clarionet and bassoon, metal...	8 tone	
		348

PEDAL ORGAN (COMPASS CCC TO G) 32 NOTES.

1 Open diapason, wood	16	32
2 Bourdon	16 tone	32
3 Mixture	12 tone	32
4 Principal	8	32
		128

COUPLERS, &C.

1 Swell to Great	4 Great to Pedal
2 Swell to Pedals	5 Choir to Pedals
3 Swell to Choir	

Three composition pedals to Great; three ditto to Swell; Tremulant to Swell.

SUMMARY.

	Stops.	Pipes.
Great organ	10	696
Swell	12	800
Choir	7	406
Pedal	4	128
Couplers	5	—
Total	38	2030

The case of the organ is of handsome design, with two frontages of gilt speaking pipes, facing south and west. **E. R. Dale, F.S.Sc.**

EARTHQUAKES AND VOLCANOES.

[26315.]—IT is well known that before an earthquake or volcanic eruption takes place there is a strange stillness in the atmosphere, an oppressive something that can be felt, which has led people in all countries and at all times to believe that the volcanic force was the cause of it. Only to-day we find writers accounting for long drought by volcanic agency. They have found that there is a connection between the atmospheric changes and volcanic action, but have mistaken the effect for the cause.

Say, for instance, that the barometer rises $\frac{1}{2}$in.

over an area of 5,000 square miles, the pressure on that area is increased by, in round numbers, 2,130,000,000 tons. If a wave of atmospheric pressure passed over a country in such a way that over the eastern part the barometer were first ½in. lower than in the western half, and then ½in. higher, the effect would be as though a mass of hundreds of millions of tons were shifted from the Western to the Eastern half. If the mercurial column rises 1in., it corresponds to a weight of 650lb. to each square foot, or about 850,000 tons on each square mile of surface. That such a strain must be an important factor in earthquake phenomena must be very evident, but it will not account for volcanic activity. Another agent that may be mentioned is the rise and fall of the tides, which may play a more important part even than the atmospheric pressure. For atmospheric pressure is so distributed that though the weight of air is constantly changing, there are no sharply defined lines, which separate regions of less density from regions of greater density. It is otherwise with the sea along a shore line. Here the sea acts with constantly varying pressure, as its level changes on the seaward side of the shore, while on the landward side of the shore line there are no such variations of pressure. "It has been shown by an American writer that if with a tolerably straight shore line 500 miles in length, and that along this shore line a region of ocean 100 miles broad rises through a height of 3ft. under the combined action of sun and moon raising a tidal wave, and favouring strong winds urging the water shorewards, that 50,000 square miles of sea-water, 3ft. deep, are added as so much dead weight to that part of the earth's crust which underlies the seas along that shore. Each square mile contains about 3,000,000 square yards, or 27,000,000 square feet, the additional weight corresponds, then (as the added layer is 3ft. deep) to 50,000 times 81,000,000 cubic feet of water, each weighing 64½lb., or to 116,000,000,000 tons."

If pressure alone would cause an earthquake, we have in these two forces energy enough to bring about the most stupendous shocks. Pressure alone is not enough; other factors enter into the case, and are all important to the successful effort which terminates in an earthquake.

The question of how earthquakes and volcanoes are caused must be put to nature herself, and in an orderly manner, and must be answered with like order, and I think that we have an amount of information that will from inference enable us to speak with certainty on this point:—

1st. What are the products of volcanoes?
2nd. Where is volcanic action most active?
3rd. When is volcanic action most active?

Taking the questions in order, we find that the products of volcanoes are lavas, which are composed of silicates of alumina, potash, soda, lime, iron, &c., in varying order, forming acidic or basic compounds, as the case may be; the volcano also emits sulphur, water, &c. The energy necessary to melt silicates such as our modern lavas are is very great under ordinary conditions. But when we come to consider that the fusion point would be raised by the pressure, then is the amount great indeed.

It is found that volcanic energy is most active on the coast lines, and that with one or two exceptions all active volcanoes are near the coast.

Volcanic action is most prevalent and active during atmospheric disturbances, and when tidal pressures and atmospheric influences act together it has also been noticed that earthquakes occur in greater numbers during the winter months (or when the earth is nearest to the sun.)

To apply any one factor singly would be unreasonable, seeing that we know the results of volcanic action. For instance, pressure alone gives great heat, but at the same time makes the material acted upon harder to melt. But suppose we apply them as they are, then we get with but a slight effort all the elements necessary for an earthquake or a volcano. Thus the water percolating into the earth finds its way down to great depths, becomes heated, and takes up in solution great quantities of mineral matter. This water sometimes comes to the surface as hot springs, but the greater portion of the deep-seated water is retained under ordinary conditions. The boiling point is raised in proportion to the pressure; it cannot flash into vapour, but is retained in a liquid state, and is under such conditions as makes it a very powerful solvent and agent in bringing the rocks into a state of hydrous-fusion or hydrothermic fusion. On examining a lava stream we find that it is not so much a molten mass as a partially melted rock flowing by means of its contained water; it is in a state of hydrous-fusion only, and not, as is generally supposed, like molten metal. The mud that fell in New Zealand, the mud and water, or ash and water that buried Pompeii, and many other cases show the action that water takes in these convulsions. (That water does find its way into the earth, and is there heated, and carries solutions of minerals, is, or rather was, beautifully shown in the white and pink terraces at Tarawera. The silicious terraces being the product of this volcanic water, it came to the surface with its solutions, there undergoing evaporation, deposited the silica, &c.) The water from the lakes of the Tarawera district found its way into the earth, became heated, dissolved the silica, which is slightly soluble in hot water, and brought it to the surface, evaporation disposed of the water, and left the silicious materials, which, owing to the configuration of the ground, formed terraces, which were coloured by metallic salts. The same action goes on to-day in Iceland, around every geyser, the deposition of what is known as silicious sinter. But the water that we have chiefly to consider does not reach the surface in this condition; it is retained in the earth in the form of a liquid. It cannot flash into steam, the pressure being too great. By a coincidence it happens that the tides are in the spring. This would add a greater strain on the coast line. The energy generated by such strain, acting with the internal water of the rocks, brings them into a state of hydrous-fusion. The forces that caused the spring-tide, acting upon this imprisoned semi-fluid, would draw it in a given direction. Now, if the atmosphere were under such conditions as we have already considered, greater force would be placed upon the mass. If the crust overlying is strong enough to resist this tension, we have no knowledge of volcanic activity. But if a line of weakness anywhere occurs the pressure is at once relieved, the water flashes into vapour, and owing to the great pressure under which it was generated, it will carry everything before it. Such is the evidence of the past and present volcanoes. The ring of Somma was blown out with a crash, and a great amount of water and mud buried Pompeii. The side of Tarawera was served the same way. These old volcanic lines being the lines of weakness in a country, offer the least resistance to the forces at work, and are, therefore, liable to activity under the conditions mentioned at any time.

Where the earth's crust offers sufficient resistance, these forces will not be suspected; but that they are ever active is well shown in what is geologically known as metamorphism. The energy has been expended in rearranging the materials of our rocks, bringing igneous masses into partial fusion, and reconstructing them as gneiss, &c.; turning mud banks into slates, granites, and gneiss, and chalks, limestones, &c., into marbles.

Such is some of the work done by these mighty agents, water and pressure, which, acting over large tracts of country, have given rise to regional metamorphism, which may be taken as a measure of energy distributed over large surfaces with a resisting superincumbent strata. The same forces where the overlying strata are weak and break away give us volcanoes, earthquakes, and contact metamorphism. **P. H. Marrow.**

PERMANENT WAY.

[26316.]—THE following particulars of a new system of permanent way which has lately been brought out in this country (Prussia), and patented throughout the civilised world, may perhaps be of interest to the readers of the ENGLISH MECHANIC.

The perishableness of timber sleepers and their almost utter worthlessness after service, and the lightness and instability of metallic sleepers hitherto in use, as also their probable early deterioration and ultimate valuelessness, except as old iron (after, perhaps, as brief a lifetime as their fellows—the timber sleepers), has given rise to the idea of using old rails, unfit for further service as such, as sleepers for all kinds of permanent way.

It is, of course, a fact patent to everyone, that very large quantities of rails are taken up and replaced by new ones in all our railways, from year to year. How large the quantity may be, I cannot say; but I should think, on the whole system of British railways, scarcely less than 130,000 tons per annum, as they are considered, I think, unfit for further service after serving for the passage of 50,000,000 tons of rolling weight. These rails are generally sold, against public tender, at a very low price as compared with their original cost—perhaps at not more than 40s. per ton on the average.

On the other hand, it is probable that not less than 1,000,000 of new timber or other sleepers are required per annum to replace such as are unfit for further service, and this, of course, at an enormous cost and great inconvenience, not only as regards their bare provision, but in breaking up the old and laying down the new ones.

I am not sufficiently provided with particulars and details as to these matters in order to state other than approximate figures; but it is, I should say, undoubtable that the direct cost per annum in maintenance of sleepers on the lines of the United Kingdom is scarcely less than from £8 to £10 per mile, whilst the loss in value of material (old as compared with new), must be quite as much again, in addition.

Now, if, as is here proposed, the old rails were used as sleepers, it is evident that, whilst the cost of maintenance would unquestionably be very much reduced, the loss in value of material would be almost nil; as, in the first place, such sleepers would have a lifetime of, perhaps, 80 or 100 years, and even then be worth, or nearly so, their original old-iron value; and, secondly, the loss in value of material as now used accruing every twelve to fifteen years, and sometimes very much oftener, in replacing old with new, would practically be all but eliminated.

The 130,000 tons of old rails exchanged from year to year would, in the course of from fifteen to eighteen years, suffice to replace all the transverse timber sleepers at present in use with those of old rails, from which period onwards a positively permanent way would be provided, requiring but very little attendance, and possibly no renewals in the shape of sleepers for, perhaps, fifty, or even one hundred, years to come.

The invention assumes the cutting of the rails into lengths of 7ft. 6½in. for intermediate, and 8ft. 2½in. for joint, sleepers; so that, as a rule, one rail would yield four single lengths, or two compound sleepers.

They would be laid flat on their sides, head to head, forming thus a bearing surface of from 10in. to 11in. in width, according to the depth of the rails. At points corresponding to gauge of line, the heads and flanges would be notched or recessed to within ⅛in. or $\frac{3}{16}$in. of webs, for taking in properly-fitted and bevelled iron packing plates (bevelled to secure cant of one to 20 for the main rails) of about 10¼in. by 8⅝in., and averaging ½in. thick, with raised edges on the two sides parallel to track. On these packing plates (which correspond in the one dimension to the width of the compound sleeper) the main broad flanged rails (or chairs, where these are used) are placed, and the whole secured by four 1in. bolts, a nut passing through both sleeper members, the packing plates, and the clip plates, and thus binding the two members of the sleeper, and all the other parts, permanently and firmly together.

Accidental gauge alterations, or spreading of the rails, is absolutely prevented by the recesses planed out in the sleepers, and by the clip plates abutting, on the one side against the raised edges of the packing plates, and on the other against the rail flanges, suitable forms of clip plates being of course provided for curves.

The joints are of the suspended class; the sleepers being in these instances 2ft. 1⅝in. apart from centre to centre (the intermediates being 3ft. 5¼in. apart), and well fished with strong, angular fish plates reaching from sleeper to sleeper, notched to fit and to abut against them and held by four strong bolts.

The bolt holes are throughout on the one or head side: and the bolts are provided under their heads, with corresponding lugs, so that all turning or movement is avoided.

The weight of such a compound sleeper will ordinarily be about 3cwt. or 1cwt. more than ordinary oak sleepers, and 2cwt. more than the usual light and flimsy metallic transverse sleepers now in use.

There will be no difficulty it is confidently apprehended in packing such sleepers, less, in all probability, than with timber ones, owing to their greater stability and steadiness, and very much less, as a matter of course, than with the light, hollow, and ever-shifting metallic sleepers now employed, and whilst sufficiently heavy to insure perfect repose, there will be elasticity enough for all purposes of traffic and safety of rolling stock.

Although originally in the main intended for single-headed, deep-flanged rails, resting immediately on the foot or packing plates, as described, the same general arrangement, with very slight modifications, is equally adapted for chairs and ordinary double-headed rails, the sleepers made of such being probably even better than with those having very broad flanges.

The cost of preparing the sleeper for the reception of the packing plates is very little—at most, 10d. per compound sleeper, in the matter of cutting, planing, drilling, and fitting, at any of the railway workshops, and when carried out on a large scale would probably not exceed 6d.

The fittings being somewhat heavier than ordinarily—corresponding to the heavier sleeper and intended permanence—would doubtless be a fraction dearer, although perhaps not more so, than in the case of the heavy English lines.

A trial section has been down some six months on one of the State lines of Prussia, and has been reported upon most favourably by the local engineer. He thinks the question of permanent way solved by this invention.

Its general introduction would render our railways independent of foreign wood supplies, and save the country at least £300,000 per annum in the matter of purchasing timber from abroad. On the other hand, the output in the manufacture of metallic sleepers by home industries would be balanced by the increased demand for heavier fittings, and especially by the demand for beams, girders, &c., for building purposes, now largely supplied by merchants and factors in the shape of

old rails, and would then (finding a more lucrative employment) have to be supplanted by new manufactures.

It will be very interesting to learn the opinion of friends of the ENGLISH MECHANIC upon this novelty in permanent way; but I may remark, along with the engineer before mentioned, that it requires to be seen in order to fully appreciate its unquestionable merits.

Rhine, 17th Sept. **S. G.**

LOCOMOTIVES.

[26317.]—I ALSO agree with Mr. Grey, "T. C. S.," "M. R.," and others, that if we are to do any good in locomotive discussion we must know all details about engine, train, coal, water, gradient, and speed.

Will anyone tell me what is the proper heating surface for cylinders 18 by 26 and 7ft. wheels?

In reply to W. D. Thompson, p. 86. no one knows what is to be done with the 1,667 class of 19in. engines. They have gone from London and from Nottingham, as they can't even run those short expresses with two vans and three little bogie coaches.

What they want is a new large boiler; but look at the disgrace of having to rebuild new engines. It is a strange thing to me, and I should like it explained. How is it that no engines can be built now on M. R. equal to Mr. Kirtley's 800 class made 1870.

Will "Kappa" and others who see Midland trains kindly note for our information the Midland *double* engine work? How many pilots a day work to and from London? Is it true that some days every train has two engines, and many of the loads are not more than 12 or 13 coaches? How is this? Why use two engines, when one old 800 would do the work?

Leeds. **Engineer.**

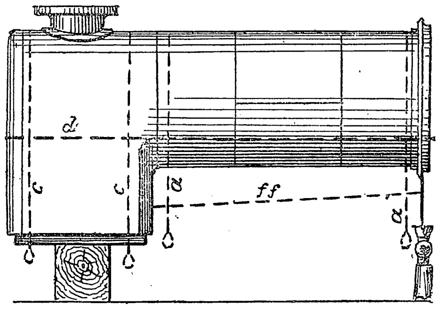
G.W.R. LOCOMOTIVES.

[26318.]—MANY disparaging remarks have been lately made in the "E. M." with regard to these engines. It is stated (Vol. XLIII., p. 528) that "the 2201—2220 class have proved complete failures." I have lately had the opportunity of learning the views of the men about them, and am told that when they first came out they steamed badly, but having been "in shop" are all right now and are doing good work. New and larger boilers with domes are being put to many of the narrow-gauge engines—*e.g.*, the 160 and the Prince Christian (No. 1118) class. Most of the 8ft. singles B.G. have had new boilers within the last few years, and the driver of a N.G. engine, pointing to one of these B.G. singles, said, "Those are splendid engines; there are none that can beat them on an ordinary road." There is a new N.G. four cylindered compound No. 7 with coupled wheels 7ft. in diam., the eccentrics and connecting rods of all the four cylinders working on the same crank axle; the pressure of steam in the high-pressure cylinders is 180lb.; and in the low-pressure cylinders, 90lb. A B.G. compound No. 8 has also lately come out. No. 10 is similar in appearance to No. 9, but the eccentrics are inside. When it is said that the speed of the Dutchman and Zulu to Plymouth and Penzance compare unfavourably with expresses on other lines, it is forgotten that below Newton Abbot it is impossible to run fast; there is scarcely a mile level or straight all the way, and the trains are worked by 8-wheeled saddle tanks, with 5ft. 9in. coupled-wheels, mostly built at the Avonside works—"Noble engines," so the driver of the engine said, "for the work they were built for, but no use for fast running." I do not think the engines are often to blame for unpunctuality, but delays at stations; no extra time is allowed in the time tables for stoppages during the summer months, when traffic is heavy. I asked a signalman at a station where the Dutchman was allowed four minutes if he had ever known it start four minutes after arrival? He answered, "Yes, he had known such a thing to happen; but it was sometimes nearer fourteen than four."

I have recently photographed No. 2203, about which "G." inquires on p. 95. She resembles the 800 coupled class, and as she has no dome and the injector is not fixed as in the more recent engines, I do not think she is new; in fact, on examining the photo with a magnifying glass, I see the date is 1881. The driving-wheels are 6ft. 6in., I cannot give other dimensions. **T. Perkins.**

HOW TO ERECT A LOCOMOTIVE ENGINE.

[26319.]—THIS is the second time I have troubled you with the sketch how to erect a locomotive engine; the last time was about twelve years ago. But as an old apprentice of mine has written me for such information who is now on the other side of our globe, and as he tells me they are about to commence making their own engines, and he has forgotten the way I went about such work, I have told him I would send the required information to the MECHANIC, that it might be useful to other young men as well as himself. The rough sketch I give is of a locomotive boiler as they come from the boiler shop. You first place your boiler in position in sketch with the tube plate resting on a screw jack so that you can set it level. You then get four lines marked *c c* and *a a*; you put one at either end of the boiler, also one at either end of the firebox. You then look at your drawing, and you will see what distance the centre of your cylinders wants to be from the bottom of the boiler, and also the incline they want to be. Then place a line *ff* through each cylinder. Then see that your four lines *c c* and *a a* are equal distance from your cylinder lines; but mind and have your boiler quite level and square with the four lines over the firebox and boiler. When you have done this, pack up your boiler under the barrel; but mind and have an opening through the packing so as to keep your cylinder lines clear, and if on piece work, to save time, it is the best way when you have got your lines *ff* right in every respect, to get two pieces of iron, say $1\frac{1}{2}$ and $\frac{1}{2}$, pointed. Drive them into the floor, one on either side of the boiler; then cramp a straight edge on, then level with the cylinder lines also at the firebox as well, then mark on the straight edge the lines, and you can



then take the lines away, but let the straight edge remain until you have got your cylinders in the required position. Then you look to the frame line marked *d* on your drawing, which will give you the height of foot plate from the cylinder lines, which will give you the position of your brackets for the outside frame—that is, if such is an outside framed engine; if not, it will give you the height of the inside or single-framed engine.

Sheffield. **Ch. H. Nassau.**

CONTINUOUS BRAKES.

[26320.]—IN letter 26297, "L. and Y." has undertaken to answer the ten questions of "Railwayman." The answers given are incomplete, and therefore inaccurate and misleading. No doubt "L. and Y." has based his answers on the brake arrangements in use on *one* railway, possibly the Lancashire and Yorkshire.

Question 1. "Can the engine and tender, &c., be fitted with a complete apparatus for each system?" Answer. "The engines are not provided with a reservoir," &c. Evidently this question was misunderstood. Taking the answer as it stands, it would imply that it is impossible to fit an engine and tender with a complete apparatus for the auto. vacuum brake. In further reply to the question, I would direct your readers to the *Engineer* of Oct. 19, 1885, where a full description of the apparatus fitted to engine and carriages is given, as exhibited at the Inventions. And if a more practical demonstration be asked, I would recommend a visit to Cardiff to see the auto. vacuum brake applied to tank and tender engines in daily use on the Taff Vale Railway. This will also apply to the answer to question 2.

The third question refers to the possibility of shutting off the brake on any carriage when out of order without affecting the rest of the train. It is not the general practice to do so; but it is quite feasible. In fact it is done on the L. and N.W. Ry. The only qualification is that the brake as now used on that railway is a simple vacuum; but were this converted into an automatic brake, which I believe will be the case shortly, the valve to disconnect the cylinder from the train pipe could be used in that event, as well as it is used now.

Question 4. The tap fixed at the end of each carriage in the Westinghouse brake is a constant source of danger. "Railwayman" evidently thinks otherwise; but let me ask him what might happen in the event of a train being made up with the tap at the front being left *closed*, while at the same time the guard in the rear fails to notice the fact from the indicator. The train starts, the driver, trusting that the full brake-power is available, may on any emergency find that he is quite powerless, with the brake acting on the engine and tender only. If shunting is to be facilitated by any such tap between the carriages, it should be made to operate as part of the coupling, so that it should be impossible to forget it in making up a train. One of the most important features of an automatic brake is that it should give warning whenever it is not in working order. What warning can the Westinghouse give when one of these taps is closed? True, the guard in the last van might detect. But guards have many duties to attend to beside looking at the indicator.

Question 7. Perhaps some of your correspondents can say if any difficulty is experienced in taking off the vacuum brake on the long trains, such as the S. Wales express on the G.W. Railway?

Question 8. Perhaps "L. and Y." will give some data to enable us to judge of the correctness of the answer to this question. On the G.W.R. a pump attached to the crosshead maintains the vacuum when the train is running. Why should this pump cause extra consumption of coal more than the Westinghouse pump, which maintains the pressure in the air brake?

In his answer to the tenth question, "L. and Y." very properly suggests certain improvements. No doubt some companies have adopted the vacuum brake in an efficient form. The simple vacuum should be discarded at once. The *leak-off* brake has also proved itself unreliable. **Œdipus.**

RAILWAY SIGNALS.

[26321.]—REFERRING to Mr. Stretton's letter, page 15, I cannot see what cost has to do with where a signal should be placed. Surely Mr. Stretton does not believe that they are put in wrong positions to save posts. I have never considered such a thing, but have always placed signals, after carefully sighting for them, in what I believed to be the best positions.

A "Lancashire Driver" does not apparently know the system adopted with regard to signals by the London and North-Western Railway. On that line, before any new signal is fixed, or the position of any old one altered, representatives of the Signal, Traffic, and Locomotive Departments meet on the ground and decide what shall be done. The particulars are entered on a form supplied for the purpose, and the representative of each department signs it. This is for future reference, and in case of any complaint or dispute arising.

Replying to "Anti-Vac" and "Ajax," my opinion is that the arm should never be allowed to drop right into, or in front of, the post, as the driver might suppose it was out (missing), and treat it as a doubtful signal. An angle of 45° is unsatisfactory, as it appears to be more up than down. I think the clear width of the arm outside the line of the post is the best. I do not see any advantage in the signals in use on the G. N.; in fact, I think they are less distinct than the ordinary semaphore. I have long since condemned all such distant signals as those in use on the Midland. Junctions should have on the facing side as many distant signals as there are home signals—*i.e.*, one for each direction. I agree with a different coloured light for sidings and goods lines. There are some places where distant signals are fixed simply for uniformity, and to mark the distance, and are not intended to be pulled "off." It is an open question whether distant signals are not better fixed in this manner for terminal stations. There are few cases of back lights in line with other signals, but owing to curves it occurs as often where the signals are fixed on the right side as where they are fixed on the wrong side. In the case of four roads, if you put the signals on the left side, which is two roads away, why not put them on the right (when necessary for sight), which is only one road away.

Mr. Stretton says the Binegar accident was due to the line being worked by "crossing orders." "Ajax" says it was due to the bad signalling!

A word or two to "A Lancashire Driver" and "Signalman." Drivers and signalmen do not consider all the conditions to be fulfilled in fixing signals. The drivers' view is the all-important thing; but there are other conditions which must be met (see my last letter, No. 26146, page 577.) I cannot see that it matters to signalmen on which side of the line signals are fixed, and as I have before pointed out, if the Amalgamated Society of Railway Servants have made it one of their *twenty-three requirements*, they have only given room for evil-disposed practical and experienced men to laugh at and ridicule them, as it is impossible to carry it out without rendering a great many signals useless.

A settlement of the colours for signal lights is necessary. Tall signals (with us 40ft. and upwards) are usually fitted with lower arms working simultaneously with the upper arms. It is a rule for home to precede distant signals. It would not, in my opinion, be wise to fix an arbitrary rule that all siding signals should be ground discs. Where there are more sidings than one, the view of disc signals would be sometimes obscured by waggons standing in the sidings.

I do not think eight hours too long a day's work in any signal cabins I have seen yet, and I know one or two where in 18 consecutive hours the lever movements average over four per minute.

Libra.

LAUNCH ENGINES.

[26322.]—IN reference to the latter part of "Ingeniero's" letter, No. 26254, page 63, wherein he states that no benefit can result by placing the cylinders tanden fashion, I may state that one of the great benefits of this type over the simple expansive engine, is that the strains on framing and rods are not so great, consequently a reduction in the diameter of the shafting may be made. The friction of the two cylinders is certainly greater than the one cylinder; but then again you must look at the fact that the friction on slides and journals is greatly reduced, as they may be made much lighter than in the expansive engine. To compare the two engines, take a single-cylinder expansive engine, area of cylinder 804 square inches, rate of expansion 5, steam pressure 80lb., and assume the back pressure to be 4lb., we have $80\,\frac{1 + \text{hyp. log. } 5}{5}$

$= 80\,\frac{1 + 1{\cdot}6}{5} = 80\,\frac{2{\cdot}6}{5} = 41{\cdot}6 - 4 = 37{\cdot}6$lb. = effective mean press. on piston, and the effective initial load on piston $= 80 - 4 \times 804 = 61{,}104$lb.

Now take a tandem compound, ratio of cylinders $3\frac{1}{2}$ to 1, the rate of expansion the same as before. Referring to the l.p. cylinder, we have 37·6lb. as the mean effective pressure. The initial press. in the l.p. and terminal in h.p. will be $80 \times \frac{3{\cdot}5}{5} =$ 56lb., and the effective initial load on the h.p. piston $= 80 - 56 \times \frac{804}{3{\cdot}5} = 5{,}496$lb. Effective initial load on the l.p. piston will be $56 - 4 \times 804 = 41{,}808$lb. It will thus be seen that the total pressure on the crank is 45,024lb. on the compound, and 61,104lb. on the expansive engine.

In actual practice with compound engines there is always a drop in the pressure to the large cylinder, which varies from 5 to 10lb., and, of course, is increased by this amount in the small cylinder. It may safely be put down that there is 20 per cent. less strain on the framing, &c., of the compound. The single-crank compound has been fitted in a large number of vessels in the mercantile marine, and with most successful results, and I have heard it said that they are much steadier in a seaway than the double-crank engine, owing to the fly-wheel, which considerably reduces the racing and consequently enables them to run at a higher speed without much loss of power, also that they are equally as handy as the double crank, on account of them very rarely stopping on the centre.

Engineering, Manchester.

ON SEVERAL OPTICAL MATTERS.

[26323.]—THERE are several matters in the extract from Mr. Madsen's paper on specula-working which seem new, and I trust our experts in this department—Mr. Wassell and Mr. Linscott—will have something to say thereon.

The speculum appears to have been kept uppermost all through the processes, which is rather unusual in so large and heavy a disc of glass as $18\frac{1}{2}$in. diameter. Nothing is said as to whether the glass tool was a plain or facetted tool; apparently it was of the former kind, as no grooves in the grinder are mentioned. To avoid concentric rings, Mr. Madsen advocates a new method of graduation, which I hope "our" experts will try and report upon. If it will render the side motion unnecessary, it will remove some complications from the specula machine.

I am sorry Mr. Madsen's paper was not printed in full, as it would have been very serviceable to many amateur workers; and moreover, we can form no definite judgment of the value and extent of applicability of new methods from so short an account of them.

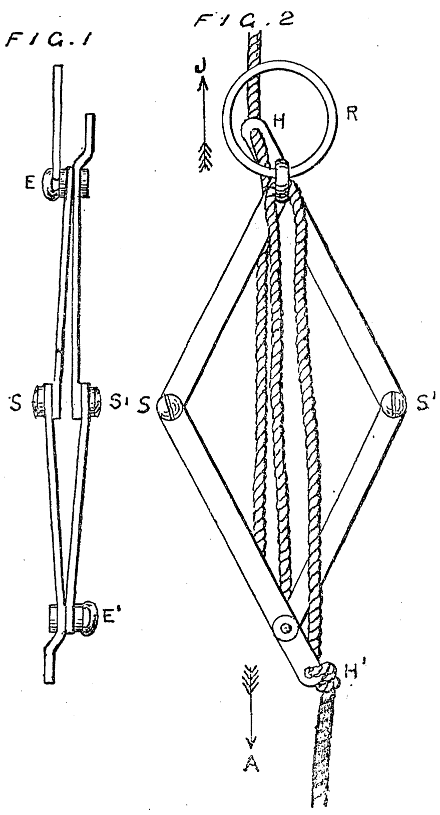
I trust the controversy on English v. Foreign Optical Work will lead to some good result. It is much to be wished that some optical brassworker would give a series of articles showing how to make and fit up the mechanical parts of telescopes, microscopes, and eyepieces in the usual sizes used in the trade.

With reference to *field* glasses, may I ask "Prismatique" what proportions of aperture and focus of o.g. and eye-lenses has it been found possible to achromatise and aplanatise to the best advantage in the two triplet forms figured by him in a letter which appeared some time ago. What is the most serviceable magnifying power for such combinations?

Orderic Vital.

INDICATOR CORD ADJUSTER.

[26324.]—THE mode of connecting the indicator with the reciprocating part of the engine by means of a cord, which has to be disconnected every time the card produced is to be removed, has led to the invention of a disconnecting drum fitted now to all the latest instruments. Those of your readers who, like myself, have to be content with their old instruments, will find the following device of some use in effecting a rapid and safe connection; moreover, they will find themselves suddenly in possession of an advantage hitherto not, to my knowledge, found in any indicator. The sketch (about $\frac{3}{4}$ size) shows a brass frame, the jointed limbs of which are secured by two eyelets E E, and two tightening screws S S; two of the limbs are prolonged above and below the joints E E, and bent as shown in Fig. 1. All joints move firm and smoothly; the eyes and holes where the cord passes through are well rounded. The instrument is reversible; the split ring (R, Fig. 2) being always on the top. Assuming the indicator fixed in position, and the cord fixed to that part of the engine from which the motion is to be taken—say air-pump lever, we lash the cord to the indicator in such a manner that part, or the whole, moves vertically, or nearly so. In marine engines this can usually be done without much trouble. We now reef the vertical part of



cord through H (Fig. 2), and secure it by a knot from thence through the top eyelet to the bottom one, and up again through the hole H, as shown clearly in the annexed. The adjuster being extended to its full limit, it follows that we must have three times the length from E to E, or $10\frac{1}{2}$in. of cord stored up. Taking hold of the instrument by S and S, and opening the limbs we release the cord, the other end of which now must be secured to the hook of the indicator permanently. Placing the forefinger in the ring we resist the down action of the air-pump lever, taking up by this the formerly released cord, and bringing the indicator in action. When once adjusted the indicator and reciprocating part of engine need never be disconnected, except by the mode above explained. The adjuster will remain in any position, in consequence of which two or three diagrams may be taken on the same card by simply placing your finger in the ring, and taking a little more cord up. Where cards have to be frequently taken in all sorts of weather, the adjuster will find, I hope, a place.

Liverpool. **P. F. Otto.**

PHOTOGRAPHIC LENSES.

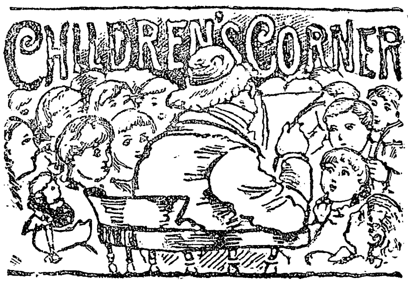
[26325.]—THERE is a manner of using photographic lenses which, though known to some, is not known to all, and which I have not seen mentioned in any handbook. If you have, say, a wide, angled symmetrical of 4in. focus and another of 6in. focus, and if you remove the front combination of the 6in. doublet and replace it by either of the combinations from the 4in. doublet, you get a useful lens of focus intermediate between the two. Theoretically, no doubt, there is a slight distortion of marginal lines; but practically this is so small it may be neglected. I have also found that a similar result may be obtained by removing the back combination of the wide-angled symmetrical of 4in. focus and replacing it by one of the combination of a rapid symmetrical of 6in. focus. It is important that the short focus lens should be in front, or the size of the field is diminished, and when practicable the shorter mount should be used, and it is well that the focal lengths of the two lenses should not differ too much. In the cases I have mentioned, if the chemical focus is displaced at all, it is by so small an amount that a stop of $\frac{f}{23}$ or $\frac{f}{32}$ belonging to the shorter focussed doublet—equivalent to about $\frac{f}{29}$ or $\frac{f}{40}$ on the construction—covers a half plate sharply if the subject is an ordinary landscape.

T. Perkins.

"UNCLE SAM'S" APPEAL.

[26326.]—MAY I ask any of your readers who are willing—especially clergymen, Sunday-school teachers, and others having influence with large bodies of children—to help me?

I am allowed a column in the *Weekly Times and Echo* called the "Children's Corner," in which I endeavour to enlist the children of the readers of that widely-circulated paper into an association for the promotion of kindness to animals and each other. I know, from my own experience, how desirable it is that these lessons should be instilled *very early* into the minds of children, and I think I am doing some little good. Will any readers do what they can to induce children to join, and send me their names and addresses? I send to each child a card of membership, and the children are encouraged from time to time to send me stories about animals and other communications. Here are our rules:—



1. To defend the weak against the strong.
2. To be kind to dumb creatures.
3. To avoid all cruelty to human beings, or to bird, or to beast.
4. To be guilty of no rudeness to the poor.
5. To be friendly to one another.

There is a motto as well—a verse that every child should know:—

"He prayeth best who loveth best
All things both great and small,
For the dear God who loveth us
He made and loveth all."

I will gladly send specimens of the "Membership Card" to anyone interested.

Uncle Sam.

Weekly Times and Echo Office,
332, Strand, London, W.C.

THINGS OLD AND NEW.

[26327.]—I AM not much given to politics; they always appear to me like a game of peg in the ring. If one member sets his top up with evident belief in its spinning powers, another considers it his immediate duty to try to split it, and thereby to insure its destruction. Conservatism says "As you were!" Liberalism says "Right about face!" and so I suppose matters will continually go on to the end—the bitter end—top and bottom sawyer periodically changing places, but ever and always kept apart with a sharp cutting instrument with teeth. Wandering at my own sweet will through a big and flourishing workshop, and passing from lathe to planer, from drilling machine to shaper, I was brought up all-standing by the formidable rival of the last-named appliance, the milling machine, of which there were several at work, quietly executing their appointed tasks with a precision which left nothing to be desired. When these machines first ventured upon the scene of their labours, mechanical conservatism was against them. A milled surface was not supposed worthy of consideration if a planed one could be had. Sterling merit, however, won the race, and the milling machine triumphed. But the matter set me thinking. Why such obstinate conservatism in a machine shop? Why relegate to oblivion any

labour-saving contrivance without a fair trial, simply on the ground that it is a novelty? I must not quote my authority, but I know as a fact that many of the suggested improvements in lathes and appliances discussed and approved in these columns by those specially qualified to judge of their value have been made for sale as suggested, only to lie in the shop unsold and utterly unnoticed.

I am not speaking of questionable stuff, much less of rubbish, but of apparatus well designed and of sterling merits. Of smaller appliances which certainly come under this category there are Noble's expanding mandrels and the J. K. P. chuck, the latter being now made to fit on a flange like the scroll chuck, so as to be readily fitted to any lathe. How many have been sold? Then there is the front slide-lathe, so hotly advocated that one would have expected it to meet with a large demand. It was duly made; but how many were called for? Who knows? Well, I do. I could quote a score of similar cases. Manufacturers could count hundreds to their sorrow. There appears from time to time to be a demand for some modification of an existing machine in order to adapt it for special purposes—*e.g.*, a milling appliance to a lathe. An enterprising manufacturer produces it—advertises it largely; but, behold, it is thrown back upon his hands to cumber the workshop, until possibly it is eventually broken up and any available parts are put to other uses.

We have now before us traversing bushes instead of traversing mandrels, the design of a trained engineer, of whose mechanical knowledge there is little room for question. The lathe is free from some defects connected with the ordinary traversing mandrel, besides having special merits of its own; but the traversing mandrel, which is "*in esse*," will keep out this, which is "*in posse*." The man in possession is an ugly customer always. Given a tool that will do its work well, it becomes a curious question how long it will take to introduce one which will confessedly do it better. One would have imagined that such an improved tool would find a ready sale, and in a very short time outstrip the older one; but experience proves that such is by no means the case. The labour-saving machines of America, of which we are slowly adopting a few, would never have seen the light of day except in the shops of the ingenious inventors, had the latter lived in England. There is indeed very little encouragement here given to inventors, and still less to the few enterprising manufacturers who consent to undertake the risk of introducing novel appliances. Our machine-made watches were written down and ridiculed. But look at the issue of the contest and the profits of the Waltham Watch Co. And who that saw the machines themselves at the Inventories in actual operation could hesitate one moment about the possibility of doing any work, however complicated, by machinery, and doing it thoroughly well. Yet mechanical conservatism would probably induce any English watchmaker to stick to hand work, even if he saw his trade steadily declining and customers going over to the enemy, rather than adopt the new tools and follow the unwelcome lead.

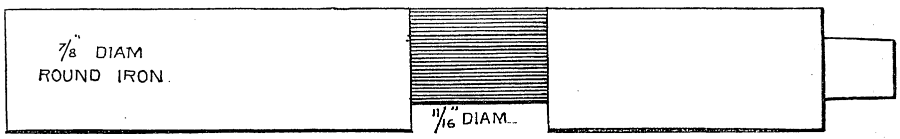
I often wonder what will be the fate of the screwing lathe of Niblett, which I am awaiting his pleasure to introduce. Having one, and being able to speak from practical experience, I can vouch for its merits. Its special advantages over the traversing mandrel are in fact many, its price will be low, and it will be applicable to ordinary lathes; but will it sell? and if not, why not? I had the pleasure of reviewing some time ago a new slide-rest of W. S. Brown. It was a good tool, specially adapted for cutting screws on an ordinary lathe by gearing the main screw with the mandrel or overhead. It was of practical use for all usual work requiring a slide-rest, and was applied to such purposes in the inventor's workshop. I do not feel at liberty to say how many found purchasers, but not enough to encourage invention. I believe the maker has retired from the lathe making business, but I hope the rest in question is not extinct, as I think if it persists in its endeavour to be seen it will yet find a satisfactory future. If not it will have many companions in its compulsory retirement—a goodly society in the main, although it may include some questionable characters. Sometimes I know there is a resuscitation of rejected candidates, and new lamps give place to old ones. But what is the real secret of these rejected addresses? Why are inventions so unconscionably snubbed? It seems to me that pills alone are exempt from this otherwise universal dilemma. Invent a pill and advertise it sufficiently and advisedly and, though its composition is unknown, it will sell abundantly, however worthless, and realise a hundred per cent. profit, and bring many fees to undertakers. In a general way, the survival of the fittest is a very satisfactory arrangement; but what a precious long time it takes to discover the fittest, and when found to introduce it at a profit! Of course, it is a question which is the fittest, and it is matter of experiment, as was the case when I tried at a vegetarian dining-room "fried sole of beetroot," which on trial I did not by any means prefer to fried sole of fish; but then experiment may, and does, prove that such and such novelty is superior to it older rival, and yet it does not find purchasers. Is a mechanical invention like a new book, a hit or a failure, irrespective of it real merit? Yet I feel that I could sell 10,000 copies of "Lilian, a Detective Story," before I could sell 100 of a new drill-stock, although the first would be humbug from beginning to end, and the latter from end to end a really good and serviceable article. I saw the other day the tail of a lathe carrier tied by a bit of string to the pin of the driver chuck. In that very shop were carriers of improved construction and Clements' driver-chuck, yet I suppose that conservative workman will continue to prefer his bit of string. I allow that his work was excellent—I never wish to see better. **O. J. L.**

LATHE WORK.

[26328.]—USING a chisel (with scraping action) to true up some worn roller-skate wheels a few days ago, I found that every now and then a series of ridges, like waves, formed across the wheel's circumference, which it was a deal of trouble to get rid of. The lathe and chuck ran true, and my hand appeared to be steady, so the only reason for this result I could give was that, perhaps, some portions of the wheels were harder than others, and that when the chisel got blunt (as it soon did), only the softer parts were cut. Can any of our friends give me a hint, as I want to do some more? **B. H.**

BENCH HOOK.

[26329.]—NOTICING the American bench hook, I thought it would be of some benefit to some of "ours" to show one that has been used for more than 20 years in a mill in Rochdale. The above is a sketch.



It is simply a piece of round iron turned to ⅞in. diam., and then thrown out of centre and swept to 11/16in. diam. The breadth of sweep depends on breadth of hook, as it has to hold it by being turned round by a box key.

To fix this simple appliance they have only to bore a hole in bench in line with mortise-slot for hook, and then have a box key to raise and lower it just to height. **Mill.**

AUTOMATIC ACTION.

[26330.]—"ANTI-VAC.'S" letter (p. 16). In reference to a statement of mine *re* the above, what I meant by "automatic" was something acting of itself, and not in the charge, nor under the control, of anybody. Signals only act automatically when the wire working them breaks; and brakes only when the connections are severed or damaged, and not when applied in the ordinary manner by the driver or guard. **Libra.**

COPYING DRAWINGS ON A REDUCED (OR ENLARGED) SCALE.

[26331.]—THE following method of copying a drawing on a scale $\frac{b}{a}$ times that of the original, although open to objection in some cases, may be of occasional use to those who do not possess proportional compasses. I have seen no notice of it in books, but the principle on which it is founded is too simple to allow me to suppose there is anything quite new in the process.

Suppose A B to be a line of fixed length, equal to ten units of the measure used in the construction of the figure, and A P, B P lines meeting in P, the lengths of which vary, but bear a constant ratio to each other, A P being equal to $\frac{a}{b}$. B P. The point P will lie on a curve which, in connection with the fixed points A and B, will furnish the draughtsman with the length P B of a line in the new drawing corresponding to the length A P measured from a line in the model.

We have now to determine the curve which is the *locus* of P.

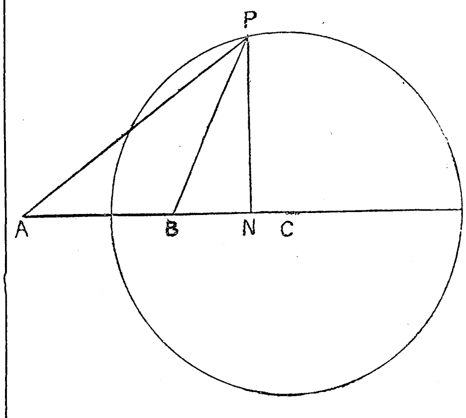
From P draw P N perpendicular to A B (or A B produced), and take B for the origin of co-ordinates. Let B N = x and N P = y.

Then— $$A\,P^2 = \frac{a^2}{b^2} . B\,P^2$$

or $$y^2 + (x + 10)^2 = \frac{a^2}{b^2}(y^2 + x^2).$$

Hence—
$$y^2 + x^2 - \frac{20\,b^2}{a^2 - b^2}x = \frac{100\,b^2}{a^2 - b^2}. \qquad (1)$$

This is the equation to a circle. To determine the position of the centre and the length of the radius, put $y = o$ in equation (1), and find the roots of the resulting quadratic.



Half the sum of these roots gives us B C, the distance from B to the centre C, and half their difference is the radius. B C = $\frac{10\,b^2}{a^2 - b^2}$, and the radius = $\frac{10\,a\,b}{a^2 - b^2}$.

For most ordinary values of a and b, a circle with the position of the points A and B can readily be constructed on a sufficiently large scale to serve for most of the measurements required in copying a drawing. It ought to be on cardboard, and have the points A and B protected by horn centres from the holing of compasses. In most cases, however, it will be found necessary to have a second circle on a smaller scale than that of the first, but which may be derived from the first by the simplest geometry. This will serve for the very short measurements. When the ratio exceeds 2, more than two circles may be required, in order to comprise all the measurements contained in a drawing; and the method becomes less and less satisfactory the greater the difference is between a and b.

The following are the lengths of B C, and of the radius corresponding to several values of the ratio, commencing with the ratio $\frac{\sqrt{3}}{\sqrt{2}}$, which is that used in isometric projection.

Ratio.	Length of B C.	Radius.
$\frac{\sqrt{3}}{\sqrt{2}}$	20·00	24·55
$\frac{3}{2}$	8·00	12·00
$\frac{7}{4}$	4·85	8·48
2	3·33	6·67
$\frac{9}{4}$	2·46	5·54
$\frac{5}{2}$	1·90	4·76

Charing, Kent. **John R. Campbell.**

Pearl Life Assurance Company.—The twenty-second annual general meeting of this company records a year of unexampled increase in the company's business. In taking a retrospect of the income for the past five years it will be found that it has in that time more than doubled—the income from premiums in 1881 being £91,458 13s. 10d., while it is now £195,737 13s. 11½d. 453,898 policies were issued during the past twelve months, representing a new annual premium income of £169,631 14s. 5d. The total income for the past financial year amounted to £199,985 5s. 4½d., and exceeded that of the previous year by £35,878 4s. 3d.

TO get an absolutely clear solution of shellac has long been a desideratum. The *National Druggist* says it may be prepared by first making an alcoholic solution of shellac in the usual way; a little benzole is then added, and the mixture well shaken. In the course of from twenty-four to forty-eight hours the fluid will have separated into two distinct layers, an upper alcoholic stratum perfectly clear, and of a dark red colour, and under it a turbid mixture containing the impurities. The clear solution may be decanted or drawn off.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[59842.]—**Mathematical Probabilities.**—To "ALIOTH AND "R. E. F."—No doubt you are right in the way you look at the subject, but I think I am also right in the way I look at it—i.e., if you throw two dice for an indefinite number of times, 4 and 5 will turn up on an average once in every 18 throws. This must be so, else what becomes of the other 17 combinations. If "a dice be thrown repeatedly," the ace will turn up, on an average, once in six throws. You are, I presume, considering it in this way: Commencing to throw, it is even betting that 3 and 5 are thrown in the first 12 throws; and then, when they are thrown, you start again with the same conditions. To prove my view, I ask the following question. What is the probable number of times 3 and 5 will turn up in 900 throws?—LIBRA.

[59842.]—**Mathematical Probabilities.**—I shall be much obliged to "E. L. G." if he will explain what he means by the opening sentence of his last letter (p. 69). He says that the method given by me is "a needlessly operose way of getting Napierian logs. from common ones. Dividing each common tabular log. by ·434 would give two or three figures of the Napier log." But as this is exactly what I have done, I am at a loss to understand how my method is "needlessly operose." As "Alioth" addressed his queries to me, "E. L. G." had no right to intrude himself unless he had something new to say; but he has only solved one of "Alioth's" queries by guesswork, and he has not given any method by which the table he requires may be calculated. Therefore he has to content himself with trying to pick holes in my method; but as he clearly does not understand this part of the subject, his objections do not count for much. I may tell "Alioth" that my method is accurate enough when it is required to know between which two throws the required probability falls.—R. E. F.

[59926.]—**A Wonderful Lamp and Battery. (U.Q.)**—This query was answered at p. 464, Vol. XLIII., letter 26026, by Prof. F. R. Cheshire.—S. BOTTONE.

[59943.]—**Int. B.Sc. Lond. (U.Q.)**—Information as to Lumbricus Helix and Disternia, especially as regards their dissection, is difficult to get in a connected form, and I know of no book that covers the ground. The mussel is now left out of the syllabus. I do not think that the questions in biology are obtainable apart from the Calendar.—B. B.

[60037.]—**Mounting Sections for the Microscope.**—The query has already been answered twice, but as the following method has yielded very good results in my hands, "Ruse" may, perhaps, not object to a third reply. The slide is painted with a thin layer of a mixture of collodion and oil of cloves, in the proportion of one to four. On this the sections are arranged. The slide is then placed in the drying oven to melt the paraffin and evaporate the oil of cloves. If it be desired to mount the sections in balsam, the melted paraffin is washed away with turpentine, and the cover-glass with the balsam at once applied. But if the preparation is to be put up in glycerine, the slide is washed first in turpentine, then in chloroform, then in alcohol, and then in water. The sections may then be mounted in glycerine, or may first be stained with logwood, carmine, or any other staining fluid. If, after staining, it is desired to mount the preparation in balsam, the slide can be treated in succession with alcohol to dehydrate, oil of bergamot, and balsam. Oil of cloves must not be used, as it dissolves the collodion cement (Schällibaum). This method is taken from Purser's "Manual of Histology" (Longmans, Green, and Co.). It is absolutely necessary to use some method of cementing the sections when a large number have to be mounted together, and even in the case of one section the method is often very useful, when that section consists of several distinct parts—a mesial section of a young triton, for instance.—PLAYFAIR.

[60055.]—**Houseboat.**—To "PONTOON."—With each of the two pontoons the dimensions I mentioned, and 2ft. 6in. wide at greatest beam, flat bottomed and wall-sided, but boat built in their outline fore and aft on the outer sides, and covered in airtight, and carrying a load of fifty stone, they would be submerged about 10½in. On second thoughts, I should give the boat 8ft. beam at centre, from outer edge of one pontoon to outer edge of the other. It will be much more convenient, and it is a very narrow channel that will not take an 8ft. beam. I should suggest carrying the deck as far as possible fore and aft; it will be much more comfortable, and you must not forget two strong crossbeams at each end, with ringbolts, for the tow rope.—E. CONRY.

[60186.]—**Mathematical.**—Neither the fourth, nor third, 6in. ball can move when the box is shut if its dimensions do not exceed 10·242641.—E. L. G.

[60186.]—**Mathematical.**—Mine *re* this last week is wrong. Not feeling satisfied, I got out the drawing-board, and find "E. L. G." is correct, as also my former reply. As "E. L. G." says, the cube will also hold four balls. To hold two balls 6in. diameter I make the size 9·4in.—T. C., Bristol.

[60190.]—**Leclanche for Quantity.**—I have tried a zinc plate 2¼in. wide, instead of the zinc rod; deflection on tangent galvanometer 35½° with the rod, with the plate the deflection was 39°. The resistance was therefore about 12 or 13 per cent. less with the plate.—G. BOWRON.

[60191.]—**Vaporiser.**—If "G. P. P." would say more definitely what it is he wishes to learn, he might possibly obtain an answer.—J. T. M.

[60197.]—**Take a Postage Stamp.**—A number of replies have appeared which mostly refer to post-cards, or stamped envelope and paper. I asserted, and do still, that machines for the supply of postage stamps pure and simple are not in use.—T. C., Bristol.

[60198.]—**Centrifugal Pumps.**—Centrifugal pumps, like others, will only lift the water 28ft.; but they can be made to force it up to heights proportioned to their speed.—A. M.

[60203.]—**Japanning Small Castings.**—If this querist will procure No. 860, he will find on p 36 a useful article on Japan and Japanning. A japanner's stove may take any form, but it is usually made of sheet metal, with closely-fitting door, and a chimney to carry off the vapours. So long as it is dust-proof it may be set in any convenient way, and heated either by gas or coal. The best way is to build a furnace in which the coal can be consumed, and the hot gases can be made to pass around the sides of the stove.—SAML. RAY.

[60209.]—**Colours.**—This querist might be referred to recent letters on "is violet a primary colour?" Much difference of opinion always exists as to what is violet and what purple, and doubtless there is great difference in the colour sensations produced in different eyes, as many persons have not altogether normal colour vision. The spectral violet has not been decomposed, I believe.—S. S. A.

[60219.]—**Cordage.**—There is no kind of cordage which is altogether unaffected by weather, but much may be done by coating it with a thin solution of tar, or if preferred, by carefully coating with boiled oil.—SAML. RAY.

[60220.]—**Flexible Paint.**—Good white lead mixed with boiled oil—no driers—will be found as flexible as anything; but the canvas must be previously damped, just as oilskins are. No paint will stand much rolling up round a broomstick without cracking.—SAML. RAY.

[60224.]—**Tables, &c.**—"Traverse Sailing" might find what he wants in Merrifield's "Nautical Astronomy," Sampson Low and Co.—E. G.

[60230.]—**Ebony.**—If "Wood Broker," who on p. 19 is "amazed and amused" at the replies to this query, will refer to the query itself, it is not unlikely that he will be "amazed" at the magnitude of the blunder he has made. Nevertheless, he is to be thanked for the information he gave, though it is not an answer to the query.—VIDEO.

[60231.]—**Plaster Casts.**—It is not easy to clean plaster casts; but it is perfectly easy to prevent them getting dirty. As soon as cast, or before they become soiled, soak in paraffin wax, and thereupon find a surface which can be readily cleaned from dust, &c.—NUN. DOR.

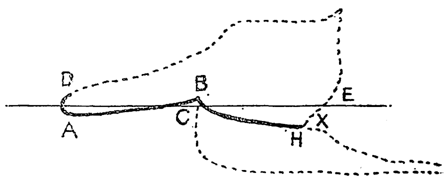
[60238.]—**Transfers.**—Stencils for the sand-blast can be made by soaking thick paper or card-board in boiled oil or copal varnish. A coat of glue will also effect the object.—NUN. DOR.

[60252.]—**Gravity.**—To "G. H. H."—I suspect that I have not been explicit enough. Of course, the earth behind the body will retard it, but not until it has passed the centre. What I should have said, therefore, is that the retardation does not commence until after the body has passed the centre.—RED LIGHT.

[60255.]—**Hydrostatic Pressure.**—In my reply to this (p. 91) it must be understood that the calculation is only applicable to the case of a beam the sectional area of which is small compared to the length, as in the present case, where, from the data given, the diameter will be found about 2in. Having a liking for this sort of problem, I calculated the value of x for a beam with circular section of any radius, but, as it is rather complicated, I do not send it. It is necessary to calculate the exact position of the centres of gravity for both portions of the beam, above and below water, and this requires the integral calculus; a beam of square section can, however, be worked out without the calculus. I can send a sketch of the working with the calculus if desired; it is very neat, like most calculus problems. The W in my reply should have been multiplied by 1·026 for salt water.—M.I.C.E., Bath.

[60268.]—**C. G. S. Units.**—To MR. WM. JOHN GREY, F.C.S.—There is nothing in your rejoinder for me to meet, as it consists practically of recrimination, and I am not fond of the "you're another" style of argument. I simply confirm what I have already said on the subject. Your corrections rest on your own unsupported assertion, for you have not condescended to give a single authority, or even to show how you work out your own statements. I may tell you, however, for whatever worth you may be disposed to attach to an unproved assertion of mine, that the part of the C.G.S. system that I described is, to my own knowledge, practised at this moment in more than one of the large engineering shops in Paris, where the work turned out is unexceptionable. I believe I can see that the cause of our difference of opinion lies in a slight misconception on your part of one of the factors of the C.G.S. system, which, if applied in one direction, produces only a slight variation, but applied in another (the present instance) makes a very serious difference. However, in any case, I do not choose to further prolong this absurd squabble, and if it will gratify you to have the last word you are welcome to it. I am at all times willing, and, indeed, anxious, to learn from any one who can give me correct information; and if a mistake (other than a mere printer's error) appears in anything I write, I shall always receive kindly any correction that is made in a kindly and courteous spirit; but I certainly do not feel inclined to so receive a flat contradiction, incorrect in substance, and rude in expression. When a man starts with the assumption that he is a scientific Pecksniff, and that, therefore, he being immaculate, all who differ from him must of necessity be wrong, it is useless to argue with him, and I must, therefore, decline further discussion with him. Moreover, your action in raking up and dragging into the argument, for the purpose of discrediting me, a reply of mine given long ago on a totally different subject, which you took no exception to at the time, but which you now incorrectly declare to be totally wrong, appears to me to be such a piece of puerile spite that I shall for the future decline all discussion with you upon any subject whatever.—E. CONRY.

[60294.]—**Action of Steam.**—There appears to be something wrong about your low-pressure card, as the initial pressure is greater than in the high-pressure exhaust pipe, from which it takes its steam. I have, therefore, sketched two imaginary diagrams and exaggerated the peculiarities which should theoretically be apparent.



As the l.p. piston is commencing its stroke when the h.p. piston has half finished its exhaust stroke, I have placed the l.p. diagram under the h.p. one in such a position that the end C is immediately under the centre B of the h.p. card. Two other points are to be noted: I have made the scale of the l.p. card the same as that of the h.p. card, and I have turned the l.p. card round so that its steam end is to the left instead of to the right, as in your example. Now let us trace the steam throughout its journey from the boiler to the condenser. The steam is admitted to the h.p. cylinder at E, is cut off, and expands to D. So far there is nothing in a compound engine different to a simple one. (In the figure all the parts of either diagram to which this remark applies are shown dotted. The parts shown in full—i.e., the line D A H—are affected by the special design, as will be seen). At D the exhaust port opens, but instead of exhausting into a condenser or into the open air, the steam has to pass into some form of receiver (such as the pipe between the cylinders), which already has some steam in it of about the pressure at which the steam in l.p. cylinder was cut off in the preceding stroke—i.e., the pressure shown at X. With this steam it mixes, and, of course, loses pressure in doing so very much, as brandy loses strength when mixed with brandy and water. The pressure, therefore, at once drops to A, and the temperature of the steam falls, and the walls of the h.p. cylinder are cooled down in consequence. The h.p. piston now begins its exhaust stroke, moving from A to B and forcing the steam into the receiver while so doing. The pressure ought to rise while

this goes on, as shown on the diagram, where the pressure at B is shown as above the atmospheric line. In consequence of the cooling effect of the sides of the h.p. cylinder (which were reduced in temperature during the exhaust, as noted above), so much steam is condensed that the line A B is generally nearly, or quite, horizontal, or may even slope the other way; however, this is a diagram intended to show what would happen if there were no consideration. At B the steam is admitted to the l.p. piston. As there is a "clearance space" between l.p. piston and slide-valve, which is filled with steam of a lower pressure, this has to mix with the fresh steam and lowers the pressure to C. The h.p. continues to exhaust and the l.p. to appropriate steam till the point H is reached. The steam now occupies a space equal to nearly the whole of the h.p. cylinder, the whole of the receiver, and nearly half the l.p. cylinders; as the same steam at B only occupied a space equal to half the h.p. cylinder and the whole of the receiver its pressure will evidently be reduced, as shown at H. Here the h.p. exhaust closes, and as the h.p. piston continues to move, although it is not in connection with the receiver, the steam is compressed to E in readiness to receive steam for another stroke. I should have said the end I have been considering is not in connection with the receiver, for at the moment that the exhaust from one end of the h.p. cylinder closes, that from the other end opens, and should produce a slight rise at X, where the l.p. steam is shut off; the rest of the course of the steam is the same as in any other engine. Observe that from B to H the diagrams are identical: this is not the case in practice, as there is always a loss from condensation. You will see that the pressure at C cannot be greater than at B, as in your sketch. P.S.—I have just received the copy of the ENGLISH MECHANIC for Sept. 24th, and I see that I have in my reply, which I sent yesterday, mistaken the bottom of the high-pressure diagram for the atmospheric line. My explanation will still hold good; but in my sketch the atmospheric line is higher than in yours.—GLATTON.

[60307.]—**Analysis of Silver Alloys.**—I am sorry that my answer to this query seems to have been rather unpalatable to "G. E."; but it is not my fault that persons cannot learn chemical manipulation from books. Much actual practice is necessary before the requisite dexterity is acquired. It is the same with other things: take rifle shooting, for example. There are plenty of manuals on the subject, written by first-rate men, giving full instructions; but if a recruit imagines that by reading the rules he can go on to the range and rival the splendid shooting of such a man as McVittie, he will find himself grievously disappointed: and similarly "G. E.," if you think that by reading "instructions" you will at once be able to do a delicate quantitative analysis, you will be disappointed also; but please do not blame me. If the Editor likes, I will send the instructions given by Fresenius; but I am not sanguine that they will help you materially.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60310.] — **Field Tubes and Tubulous Boilers.**—The American boiler you refer to is, I think, that known as the Herreshoff boiler. A long pipe was formed into a coil round the sides and over the top of a furnace; water was allowed to trickle into the upper end of the coil from a feed pump, and was drawn off as steam from the bottom of the coil. Sometimes the water had to traverse another coil outside the heating coils first, and in this case the pump fed the bottom of the outer coil, which was thus always full of water. The water was led from the top of the outer to the top of the inner coil, and was led off from the bottom of the inner coil as steam. A few coils were added at the crown of the boiler, through which the steam passed on its way to the engine, and in which it was superheated. I have known the steam-pipe to be at a black heat for some inches from the boiler. The efficiency of this boiler depends on the regularity of the feed, and it requires very constant attention. Too much water makes it prime, too little makes the steam nearly red-hot, and spoils the engines. The margin on either side of the right quantity of water is very small.—GLATTON.

[60310.]—**Field Tubes.**—I cannot speak from personal experience, but I know the manager of engine works in the North of England, who spoke to me on the subject some years ago, having had some fitted in a vertical boiler, and he expressed a very high opinion of them; and if my recollection does not lead me astray, I believe he constructed a vertical boiler for a stationary fire engine in which these tubes were used. Why these tubes are not more used I fail to comprehend. The circulation of water in the tube is so good that sudden expansion and contraction does not affect the tube like one rigidly fixed at both ends. I have always found the ordinary vertical tube boiler a source of annoyance. Horizontal tube ones are much better in every respect. When flame and hot gases pass through a vertical tube, the water has a tendency to separate from the tube, thus causing the tube to burn away; and not only that, but the rise and fall in temperature caused by opening and shutting the furnace doors causes the tube to expand and contract, thus making the ends of the tubes to leak. I will just place before the readers of this paper a curious fact. Now, from books on engineering, I have read one cause of boiler priming was from deficiency of steam space. Now, in the instance I quote, a tubular boiler to supply an engine of 250 H.P., worked at 90lb. on the square inch: it was a double end boiler with eight furnaces, four at each end. The glass water-gauge was, as near as I can recollect, from 18in. to 20in. long. Now, when worked with 3in. or 4in. in the glass, the boiler often primed, particularly when the fires were forced or on the safety valves lifting. We then worked with three-quarter glass with success, the boiler never priming. The conclusion I came to was that when working with only 3in. or 4in. in the glass, there was not a sufficient body of water to absorb the caloric efforts of the coal, thus causing it to prime.—INGENIERO.

[60311.]—**Slide-Rest.**— Finish with a broad spring-tool and plenty of soapy water. Every point on the edge of tool cuts a copy of the leading screw. If the tool is wide some of the points which would produce hollows will probably be in such a position as to cut off the tops of the threads left by their predecessors. Therefore, the wider the tool, so long as it does not chatter, the smoother the work.—GLATTON.

[60314.]—**Pollak's Battery.**—TO "R. E. F." OR MR. HABGOOD.—I shall be glad if you will kindly answer the following questions about this battery which requires so little attention. What thickness should the electrolytic deposit of copper be? Would it do for the carbon to rest on a copper plate instead of the deposit; and, instead of the upper portion of the carbon being agglomerated, to have an agglomerate cylinder resting on the carbon? Will the agglomerated portion last as long as the lower carbon, or does it become exhausted? ("R. E. F." does not mention the agglomerated portion in his description.) How is it that the current is so low as $\frac{1}{80}$ amp. when the "E. M. F." is given as 1·3 volt, and the resistance as 0·5 to 0·8 ohm? Would two cells give more power than one bichromate for driving small models; and could it be used ten hours daily for electro-deposition instead of a Daniell battery? I am sure a description of the modified form for electric lighting would be interesting to many beside myself.—H. H.

[60316.] — **Electric Time-Ball.** — You might arrange a swing-door so that the effect of its being opened by yourself or customers would be to wind up the ball, which would then be supported by a catch controlled by an electro-magnet. A very simple arrangement could be adopted to prevent overwinding.—GLATTON.

[60328.]—**Spirit Level.**—I do not know the usual way; but I think I should set about the job thus: Take a flat piece of board, and place it nearly level. Lay your level upon it, and fix the tube temporarily with two small pieces of putty. Mark the position of one end of the bubble with ink upon the tube. Reverse the level, and if the marked end of bubble has moved, mark it again, and raise one end of the board till the edge of bubble is half-way between the two marks. Rub out the marks, and put a fresh one, and try again until the bubble does not move when the level is reversed. Now press one or the other end of tube into the putty until the bubble is in the middle of tube, and mark both ends of bubble, and adjust board more carefully, until the bubble does not move on the level being reversed. Pour a little plaster of Paris over the ends of tube, and, when hard, test again, and mark the positions of the two ends of bubble with a diamond. Screw on the guard-plate, and the job is done.—GLATTON.

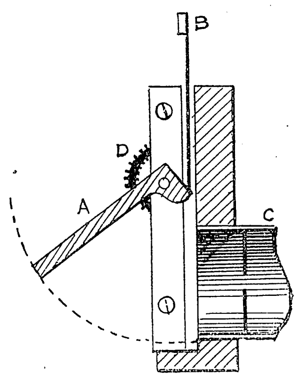
[60329.] — **Fire without Smoke.** — Will a spirit lamp or a Bunsen burner do, or one of Fletcher's gas-stoves?—GLATTON.

[60334.] — **Falling Bodies.** — The eastward distance travelled by a body falling from a height of any given latitude can be found by the same method as I gave on p. 45. For instance, let a body in lat. λ fall from a height of δ miles. A point on the surface has a radius of rotation of m miles, let us say; then the body, at a height of δ miles, will have a longer radius of rotation; but this will not be nearly so much as $m + \delta$ miles, but only $m + \delta$ cos. λ miles. In lat. 60° the radius would only be $\frac{1}{2}$ mile longer. The circles described by the two bodies in 24 hours will be $2\pi m$ and $2\pi (m + \delta \cdot \cos.\ \lambda)$ respectively, and the difference in length $2\pi\delta$, cos. λ. From this it follows that $S_1 = \frac{2\pi t \delta \cdot \cos.\ \lambda}{8640}$ where S_1 is the eastward motion in t seconds. If this is not sufficiently clear to "E. L. G.," I shall be happy to send a diagram. R. E. F.

[60335.] — **Turnbull Transmitter.** — Some years ago I was shown a sketch of a telephone almost identical with this, which represented one which a friend had fitted up. In it the position of the carbons was adjustable, and found by trial.—GLATTON.

[60336.]—**Keeping a Pony.**—Yes, I am in perfect earnest when I say "give the pony 1 to $1\frac{1}{2}$lb. of feeding three times a day, but quantity depends on the work it is doing." This, of course, does not include hay. My pony (14·1 hands high) gets that amount. It is only working, on an average, three days in a week, and its day's work is to run 15 or 23 miles, being in harness 3 to 5 hours. On its working days it gets 4 to $4\frac{1}{2}$lb. of feeding, and its non-working days $1\frac{1}{2}$ to 2lb., with as much hay as it can eat at all times, except when actually in harness. This costs, including hay, about 4s. to 5s. a week. My shopboy spends about two hours each day in cleaning pony and stable, and I give it a good cleaning myself before taking it out and after coming in, and to anyone who has an interest in the animal the work is as nothing. I can assure "Doctor Medicinæ" that in all the county side there is not a pony that has improved more than mine has during the last four months. It was a poor, lean thing when I got it four months ago, and it is anything but that now. If I thought that my pony required more feeding it would gladly get it, and as I am stabling beside a farm, and farmers are often visiting me, I am sure I would soon be told if I was starving my pony. When I say "beware of dealers" I don't mean don't buy of a dealer. Dealers must have good horses as well as any other person; but I hardly ever give a dealer more than half what he first asks for a beast, and I find that he would only offer me half what I gave him if I asked him to buy it back.—I. LOW, 2, Alexandra-terrace, Lenzie, N.B.

[60339.] — **Instantaneous Shutters.** — The sketch shows the principle of one now in the market.



The shutter A is opened by turning the milled head D. When full open, the projecting piece at its upper edge no longer supports the sliding shutter B, which consequently falls and covers the lens C. As shown in the figure, A has moved through about two-thirds of its travel, and the lens is rather more than half uncovered. The upper half is uncovered only during the remaining third of the travel of A, and is then promptly covered up by B. Thus the sky receives from one-third to one-fourth the exposure that the lower part of the picture does. Lancaster's shutter does much the same, but in a simpler way.—GLATTON.

[60354.]—**Box Filled with Spheres.**—A cube's edge is not blunter than an octahedron's, as I said hastily in p. 69; the former being rectangular, and the latter of 109° 28′. The cube, however, is the nearer to a sphere, for if both figures be inscribed in the same sphere, the cube is the bulkier, as 2 to $\sqrt{3}$. So, too, the dodecahedron excels its conjugate figure, the icosahedron. In all cases, the one with most corners (not most faces) excels.—E. L. G.

[60359.]—**Freezing Meat.**—At the Health Exhibition the machinery was shown in action. Powerful pumps compressed air, which in consequence became heated. After being reduced in temperature by water, it was allowed to expand in rooms in which meat was hung. In expanding, the air reabsorbed the quantity of heat which it gave out to the water while compressed, and as the meat was the only available source from which the air could extract the heat, it got colder and colder, and froze.—GLATTON.

[60368.] — **Exploding Spirit Lamp.**—The vapour of the spirit does not do much harm; the trouble is that air gets mixed with it, and produces an explosive mixture. I have had the same trouble, but have not been able to find a remedy. An accident is, I think, less likely to happen if the wicks fit tightly. I, too, thought there was no danger, till one day the greater part of the spirit followed the burner, and covered my head with

flaming liquid, which was not extinguished till I had been severely burnt. Better do as I did, and stop using such a dangerous concern. The price, by the bye, was nearer five than one shilling—it is a French affair, I believe.—GLATTON.

[60374.]—**Solder for Platinum.**—I have used common soft solder.—GLATTON.

[60375.]—**Lifting Power of Engine.**—ERRATUM.—In my answer to this number in "E.M." of 24th inst., for 46 read 36, twice.—E. CONRY.

[60378.]—**Beer-Raising Apparatus.**—I am much obliged to Mr. Paul Ward for noticing my query, and I have no doubt his idea would be very effective and simple, but not automatic. I have been told that there is an arrangement with two tanks, where one is the air reservoir and the other for water, with the valves so arranged that it works automatically, and with no chance of the water getting into the beer; the party who told me so could not describe how it worked, as he saw nothing outside the tank to regulate the water; so if any of your correspondents know anything of such an apparatus, or how it could be similarly done, a description would oblige.—VINO.

[60381.]—**L. B. and S. C. Locos.**—"Richmond—Portsmouth" has made a mistake in his answer to this query. The following is the correct information asked for:—Nos. 208 to 210 and 213 belong to the Richmond, and Nos. 212 and 214 to 219 to the Gladstone class. The Richmonds have 17½in. by 26in. cylinders. whilst the Gladstones have 18¼in. by 26in. cylinders; also larger boilers. The Grosvenor has 6ft. 9in. driving wheels; the others 6ft. 6in.; otherwise they are identically the same.—NORTH WESTERN.

[60382.]—**Equal Balance.**—The weight, by lowering the centre of gauge of the beam, makes the balance less sensitive, and therefore less accurate. If the knife-edges are not very nearly in a line, the scales are of little value. The middle one should be above the others.—GLATTON.

[60391.]—**Inspector.**—I am sorry I cannot advise you. In such an occupation experience tells beyond everything else.—GLATTON.

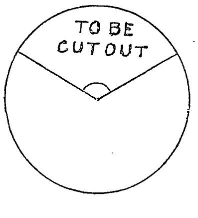
[60392.]—**Magic or Inexhaustible Ink-stand.**—I have heard that these contain a roll of blotting-paper, smeared with a paste of aniline black. What did you find inside yours?—GLATTON.

[60392.]—**Magic or Inexhaustible Ink-stand.**—Many years ago I used some of these, and on one occasion got one smashed by accident. I found it contained logwood chipped very small, and there were traces of some powder and a smell of an iron salt. I would suggest logwood chips—say, half a tumbler full—sulphate of iron, 1oz., powdered inkgall, 1 drachm, gum arabic, ½oz., as a likely mixture for the purpose.—GAMMA SIGMA.

[60395.]—**Water-Motor.**—The water may be unlimited, but it is necessary to know more of it before advising. Is it a river, a torrent, a waterfall, or water in a pipe? If the first or second, what is its speed? If the third, what is its height from the surface of one level to that of the other? If the fourth, what is its pressure and size of pipe, and how fast can it run out—i.e., how many gallons per minute?—GLATTON.

[60403.]—**Revolving Cylinder.**—Make a cylinder of suitable size, with a small hole at bottom, fill with silver sand, and place heavy weight on top; weight to be connected to drum by a cord.—GLATTON.

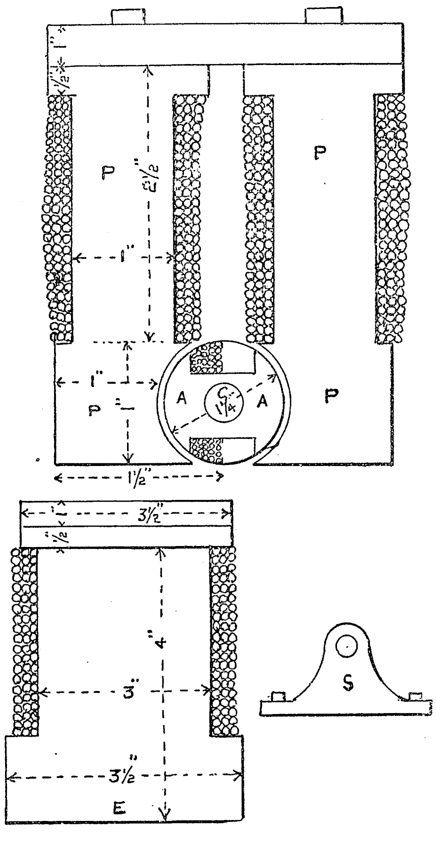
[60405.]—**Chimney Rain Guard.**—You must



cut your sheet of metal in the shape of a circle, and cut out part thus, angle of 120°.—R. S.

[60406.]—**Photographic Exposures.**—Let "N. Y." work with Platt's tables, published in "Beginner's Guide to Photography," Lejeune and Perken, 101, Hatten-garden. Price 1s.—O. O.

[60410.]—**Electro-Motor.**—I send sketch and dimensions, which you will understand if accustomed to dynamos and motors. If you do not know anything of their construction you had better get Mr. Bottone's book, "How to Build a Dynamo." The armature is the H pattern; commutator of two divisions; field-magnets (which may be cast in one piece with pole-pieces) wound with four layers No. 18 cotton-covered; armature with about seven layers No. 16 cotton-covered. If you get the field-magnet cores and pole-pieces cast in one, you will be able to wind the field-magnets in a lathe, and thus save much time and trouble. The crosspiece B is fastened to the heads of the



field-magnets by screws running into holes, drilled and tapped. S is a standard, two of which must be provided, and the pole-pieces must be cast or made with a lug each side, at E, for screwing down to a piece of board. The standards S have similar lugs.—E. CONRY.

[60413.]—**Steam Escape or Relief Valve.**—These are known as "reducing valves," and there are very many forms. Write to Bailey, of Manchester, for list, in which there are some figured.—GLATTON.

[60417.]—**Railway Fish Plates.**—Owing to the constant inspection (on most lines twice every day, except Sunday, and once on that day), nuts on fish-bolts seldom fall off, or allow the bolts to become very slack. Several methods of preventing the nuts turning have been devised (see Patent Specifications). Grover's patent spring washer is probably the simplest and best; they cost something under 3½d. for a joint with four bolts.—LIBRA.

[60418.]—**A Novelty.**—There is another such novelty as "Constant Reader" calls attention to at Plas Newydd, Llangollen, N. Wales. This charming and quaint house was once the home of the far-famed "Ladies of Llangollen." On one of the fine stained-glass windows is a fly, which defies the closest inspection, and has probably been the cause of many fruitless and unended arguments as to its position, in or on the glass. Probably the fly was painted by the same artist as the "Convent" fly, as it is certainly a rare novelty, and I doubt if there are many more such about the country. The fly at Plas Newydd puzzles the best eyesights as to whether it is alive or not.—W. STANLEY SMITH.

[60421.]—**Carriages — Railway Mystery.**—I notice that your correspondent, "Kentish Town," in his reply to this query, p. 94, says that it is impossible for a pistol to fall or ride upon a carriage step; but I think he had not the facts before him as I had when I gave evidence upon the subject. The carriage was one of the Midland 60ft. twelve-wheeled bogies, No. 643, and weighs about 23 tons. Practical experiments proved that it is possible for a pistol to fall from a window and lodge upon the high, continuous footboard. The footboard was rough, and the handle of the pistol was also made rough, and I am convinced that these long carriages ride so steadily (and especially the centre compartments) that, once upon the step, there would be nothing to shake the pistol off. It was found about 2ft. on the London side of the door, or just where it might be expected to fall when the train was in motion. This fact appears to me to show that it did fall from the window, as any murderer who placed a pistol on a step would, of course, put it just under the window; he would hardly stop to think about the laws of falling bodies or motion, or to calculate that the train would move forward during the time the pistol was falling. In further support of my opinion that a pistol would ride upon a step-board, I may say that, on the 28th April, 1885, the Scotch express came from London to Leicester without stopping with a number of brake-blocks, tools, and bolts upon the step of a carriage, these having been left on by mistake.—CLEMENT E. STRETTON, Consulting Engineer, Amalgamated Society of Railway Servants, 40, Saxe-Coburg-street, Leicester, Sept. 25.

[60430.]—**Gravity Daniell Battery.**—Mr. Bottone's reply to "Rho" is hard to reconcile with my own actual experiences obtained from the cell which he recently advised me about (query 60116). Large bubbles of gas will collect under horizontal zinc plate without using any acid, though as a fact a solution of comml. sulphate of copper is very decidedly acid of itself (per test paper). Working electrician, A.S.T.E., told me while watching a cell that the bubbles were of air imprisoned in crystals; but similar bubbles from my own cell exploded when brought to surface under lighted match. Does "C. D. R." hold that a copper-sulphate molecule can dissolve partnership without a zinc-sulphate molecule being formed to make up for it? And if not, whence the gain in free acid which "should be drawn off with a syringe and pure water added"? I doubt if the most careful amalgamation will protect a zinc plate in open circuit after copper has settled on it.—WEALD.

[60434.]—**Crank Movement.**—There is no dead point, because the centre of gravity is always outside the centre of motion whenever the power of wheel and piston are balanced, that is also why it becomes reversible in a simple way. I shift the centre of gravity to the other side of centre of motion. The only complications are a small amount of sliding or rolling motion which keeps continually shifting to balance distance and power, or equal weights on piston and wheel through the whole length of stroke. Would a ball roll down the diagonal of a square quicker than the mean time of same weight on crank? The former is the speed I attain. If "T. C., Bristol," or any other of your able correspondents will tell me the difference they will oblige.—SCOTTY.

[60442.]—**Thimble Battery.**—I shall be happy to write to him if he will send his address, but I do not publish the particulars of my batteries.—CHARLES PENRUDDOCKE, Compton Park, Salisbury.

[60446.]—**Bisulphide of Carbon.**—One fluid ounce = 1·728 cubic inch ∴ five fluid ounces = 8·64 cubic inches. A cubic inch of water weighs 252·5 grains, and as the specific gravity of CS_2 is 1·27, one cubic inch of it will weigh 321 grains, and 8·64 cubic inches = 5 fluid ounces will weigh 2,773 grains. The equation for the combustion of CS_2 is

$$\underset{76}{CS_2} + \underset{96}{3O_2} = \underset{44}{CO_2} + \underset{128}{2SO_2} \quad 172$$

so we have

$$76 : 128 :: 2773 : x$$

from which x = 4,670 grains SO_2 produced. 44·4 cubic inches of SO_2 weigh 32 grains, from which we easily get the volume of 4,670 grains—viz., 6,479 cubic inches = 3·75 cubic feet nearly. The combustion would also produce half this volume of CO_2. I do not know what the querist means by his second query; in what sense does he use the word "saturate"?—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60447.]—**Dynamo.**—To MR. BOTTONE.—The dimensions given are those of the iron ring *unwound*, not with the wire on. The distance between each section will be about ¼in.—S. BOTTONE.

[60448.]—**Legal.**—(1) A married woman cannot claim exemption from Income-tax in the circumstances mentioned by "The Bard." The joint income of husband and wife are held to be only one income. (2) A wife's private property is not liable for any unpaid debts of her husband's at his decease; but the real question here comes to be what is the wife's private property—this depends to a certain extent on whether the marriage took place before or after 1st January, 1883. Get the Married Women's Property Act, 1882, and study it.—B.SC. (Solicitor), Plymouth.

[60448.]—**Married Women.**—(1) The Income-tax authorities persist in assessing jointly the separate income of husband and wife, whom they still treat as one. If, therefore, the two incomes combined do not allow of a claim for exemption or abatement being successfully made, no such claim can be supported as regards each separate income; and so, in this case, the wife cannot claim exemption alone. I believe this rule to be illegal, at all events, in face of the Married Women's Property Act, 1882; but, there it is: and it was lately stated in the Commons that it would not be altered.

(2) The wife's separate estate is not liable for the debts of her deceased husband; of course, provided that it really is her separate property.—FRED. WETHERFIELD, Solicitor.

[60451.]—**Pocket Accumulator.**—You can make one out of the wood of an ordinary cigar box, but mahogany or oak would do better. Soak the wood for a few minutes in melted paraffin wax, made very hot (after having cut the pieces to required shape and bored all necessary holes), and put them together by dovetailing, or very thin brass screws. The right size of the latter is not kept at most ironmongers. You would have to write to Nettlefolds, or some other manufacturers for them; they would be ½in., and as thin as possible. Dimensions of box may be 6in. by 3½in. by 1in. outside. It must have a cover with holes for the connections of plates to come through. To get a good light, you would almost to a certainty require two cells, as I do not think there is any carbon filament lamp made which will light properly with only two volts. I tried to get such a one about twelve months ago, but found the best then obtainable to require nearly three volts, though sold as a two-volt lamp by one of the greatest electrical corporations in this country. Much improvement, however, may have been made since then. For plates, two strips of lead sheet about $\frac{1}{24}$in. or less in thickness, one of which should be completely sewn up in best thin flannel. Box should be lined with hot pitch, or melted indiarubber, but if it is well made, several coats of paraffin wax will do. Lid must be sealed on with pitch or indiarubber, and have filling aperture, closed by wooden plug. You would find two cells the size of the above much more satisfactory than one box divided into two cells, and it would be well for you to buy or make out of guttapercha tissue a small indiarubber bag to hold the cell, in case of a drop or two escaping. Very neat and safe little cells can be made by cutting the tops off two medicine bottles, of such a size as to fit one within the other, leaving sufficient space for the plates, which if of plain lead must be "formed." See back numbers. I sent in a sketch of an electromotor last week in reply to a query, but as it contained a diagram repuiring a woodcut, it was not in time; you will see it next number.—E. CONRY.

[60451.]—**Pocket Accumulator.**—An accumulator to light a lamp of 4 c.p. would not go in an ordinary sized pocket because you would require 4 cells, and if the plates are made too small the charge put into them would scarcely last a few seconds. The following is how I made my battery, which, when charged, lit a 4-volt lamp. Make a guttapercha vessel 3½in. by 5in. by 1in., and divide it into two cells by a strip 4⅞in. by ⅞in. Now cut four plates, each 4½in. by 1¼in., having an ear to each, from $\frac{1}{16}$in. sheet lead; punch as many holes in each plate as you can to within ⅜in. from the ear or top end. Fill up the holes, and also well smear the plates, with a thick paste of red lead and sulphuric acid. Now cut out a piece from some hard wood, 3½in. long, 1in. wide, and ⅛in. thick; pierce it with four slits large enough to allow the ears of the plates to come through (two to each cell), and also, where convenient, two holes should be made and fitted with glass tubes for the purpose of filling the cells. As soon as the red lead has become hard, place the four plates in their positions, and solder the ear of one plate to the ear piece of the next cell. This will leave one free end from each cell; to these a wire or terminal should be soldered. You can now cement on the top, and cover all over except the glass tubes with a composition of 1 of melted pitch and 2 of guttapercha. Having filled the cells three-quarters full with dilute sulphuric acid, connect the wires on a battery or small dynamo, charge, discharge, and reverse every three hours, and let the last charge remain in all night. Do this till you find your accumulator will ring a bell with fifteen minutes charging for about ten. Then only charge one way, and mark the ends in some way so as to know where to connect one next time for charging. This battery, when completed, will light a 3 or 4 volt lamp well during intervals for about two hours. My battery, which is exactly similar to the above, was formed by a 10-cell Daniell telegraph battery, and took a little more than a fortnight. Never charge your accumulator until within an hour or so of its being wanted for use, as it will run down a little by short-circuiting owing to the dampness of the inside. To show how long the charge will remain in such a small battery, I charged my accumulator last Monday evening and let it alone till Friday morning, when it contained sufficient energy to light a lamp for about 30 seconds. I forgot to say that before putting the plates in the cells for good, a piece of indiarubber should be placed between the plates as well as a piece on the two outsides, and held by a piece of asbestos fibre, not indiarubber rings, as they rot and fall to pieces in time. This prevents the plates from touching each other, as well as keeps them from shaking from side to side.—Y. E. E., Walworth.

[60452.]—**Loco. Question.**—The engine with the high boiler is considered to run easier than one with a low boiler, because it makes better use of the springs on which it is carried.—NOMEN.

[60452.]—**Loco. Question.**—The steadiness of a loco. is more marked when the position of her boiler is kept as low as practicable for the cranks to clear. An engine with her boiler placed high above the frame is more susceptible to oscillate laterally through the swerving motion of the frame, and especially is this more apparent at high speeds when traversing curves, crossing points, and other variable inequalities of the road.—W. R., B.A.

[60452.]—**Loco. Question.**—There was an article in last week's *Engineer* stating that the higher the engine the smoother it runs; but I think where the boiler overhangs the rails, it must make the engine run very rough. For example, the Dreadnought on the N. W., and the 2352 class of goods engines on the G. W., where 7ft. driving wheels are used, the boiler must be made to go between the wheels, thus preventing the boiler overhanging the rails.—NORTH WESTERN.

[60452.]—**Loco. Question.**—The greater the height of a locomotive boiler above the rails, the higher is the centre of gravity, and therefore the engine will run smoother. The centre of gravity may be taken as the point from which a pendulum is swung. Let this point be the apex of a triangle, and the gauge of the rails its base; the length of the pendulum is a line drawn from the apex perpendicular to the base. When the pendulum swings past the sides of the triangle, the engine will overturn. To demonstrate this, fix three nails in a wall at heights of 5ft. 6in., 6ft. 6in., and 8ft. Mark off the base properly underneath each, and make a pendulum. Swing the same pendulum on the nail, lengthening the rod each time, so that the bob is on the base line, and it will be seen that the longest pendulum has the slowest and steadiest motion.—O. W.

[60453.]—**North British Engines.**—The following are dimensions of above, viz.:—Diameter of driving and trailing wheels, 7ft.; bogie, 3ft. 6in. Cylinders, 18in. by 26in. Boiler, 10ft. 3½in. by 4ft. 4in. Firebox: length, 5ft. 7½in.; breadth, 4ft. 1in. Diameter of tubes, 1⅝in.; length, 10ft. 7⅝in. Heating Surface: firebox, 119 sq. ft.; tubes, 983 sq. ft.; total, 1,102 sq. ft. Grate area, 27 sq. ft. Weight of engine and tender, 72 tons 15cwt. Capacity of tender: coal, 5 tons; water, 2,550gals.—NORTH WESTERN.

[60454.]—**Wind-Motor for Electric Lighting.**—Such a wind-motor as you describe must be a clever thing, and if of any reasonable size and of sufficiently simple construction to avoid getting out of repair often, would, I should think, be a valuable invention, as there are many places in this country where the wind power, during 18 hours out of the 24, is strong enough to charge accumulators sufficiently to make them light lamps enough for any ordinary dwelling-house for the remaining six hours. Do not you forego a lot of possible power, however, if "the machinery driven by the motor runs at one uniform speed, however much the motor may vary in speed"? Do I understand you rightly that all increase in wind power after a certain point makes no difference to the speed of the dynamo, or do you utilise the wind increase for a separately-exciting dynamo while keeping the speed of the charging dynamo constant?—E. CONRY.

[60457.]—**Winding Gramme Armature.**—An illustrated article on winding Gramme armature appeared in the *Electrical Review* for August 6th, 1886. The *Review* is published at 22, Paternoster-row.—G. BOWRON.

[60457.]—**Winding Gramme Armature.**—TO MR. BOTTONE.—You will find directions for winding Gramme armature at pp. 47 and 94, Vol. XLIII. of the "E. M." Referring to the means of avoiding self-induction, this is impossible to obviate entirely; but it may be diminished very much by laying on only one layer of wire over the core of the armature. This necessitates a large and massive armature.—S. BOTTONE.

[60457.]—**Winding Gramme Armature.**—If the form of your armature as regards fastening on to the spindle admits it, have a 4ft. length of strong board screwed down to a carpenter's bench or fixed table at right angles to it, at a convenient height, and fasten the armature core down by two strips or blocks of wood connected by loose bolts and nuts through the ends, one block passing through the core and the other under the board, and both tightened up by the bolts. This will hold the core firm. You can then screw together or cut out two pieces of wood like tuning forks, with just space enough to take the core between the legs, and having long screws through the ends to similarly tighten them up, and by this means fix them on the core so as to inclose between their sides just the exact space you intend to allow for one coil. You can then wind the coil in the ordinary way, fastening the inner end to the blocks so as to keep a few inches of it free, winding in layers, as closely and evenly as possible, taking where necessary the strand over the previous turns of the layer inside the core, so as by making up for the difference of space between inside and outside to get the maximum number of coils into the outside layer and keeping the wire always as tight as you can pull without snapping the strand. With anything over No. 16, you can pull as hard as you like. A convenient way is to wind off as much wire as will just about make one coil on a strip of narrow board like a fishing-line; it is thus easy to pass it through the core. Of course, the core must first be properly covered with tape or other similar substance, and see there are no sharp edges or corners or jags on it. The above applies more particularly to laminated armatures built up on rods, as most of them are now, and joined to the spindle by brass caps or radiated castings fastening by nuts on to the ends of the rods, but may be useful for other sorts. There is no difficulty in bringing the ends together at the finish.—E. CONRY.

[60459.]—**Crane Chain.**—The old query of impact in a different form. The chain offers an elastic resistance, which depends on sectional area of chain as well as form of link, and even number of links. If the chain gave 1in. under the strain, it would be equivalent to a dead load of $25 \times 9 = 225$ tons, and very little short of the probable breaking strain.—T. C., Bristol.

[60462.]—**Testing Lightning Conductors.**—Tests of lightning conductors are made to find the resistance of the conductor and of the earth connection. The earth resistance can be ascertained by making connection with the bottom of the rod. The resistance of the rod can be found by fixing a wire to the top.—G. BOWRON.

[60462.]—**Testing Lightning Conductors.**—TO MR. BOTTONE.—Calculate height of tip of conductor from ground, measure off twice this length in No. 16 covered copper wire; connect one end of this wire to galvanometer, and the other end to one terminal of battery, the other terminal being connected to other binding screw of galvanometer. Note the deflection produced. Next cut wire in half; attach one end to tip of conductor so as to make good electrical contact; lead the other end of wire to the ground. Clean the ground end of lightning rod, connect one terminal of battery to this, the other terminal being attached to one binding screw of the galvanometer, while the wire led from tip is connected to the other. Deflection will take place if the conductor is unbroken, and if the conductor is fairly sound the deflection will be considerably greater than it was when the double length of wire was used. To know whether the conductor, though unbroken, has got thin at any point, it would be necessary to measure the resistance with bridge and coils, calculating the resistance which the rod should have if perfect, and comparing the trial with the calculated result.—S. BOTTONE.

[60463.]—**Lantern Slides.**—The greenish tint is certainly not due to the wet collodion process; it may be albumen, but more like pyro-developed gelatine.—S. BOTTONE.

[60463.]—**Lantern Slides.**—The green colour mentioned by "B." is caused by the toning of the collodion transparency; it will not answer with dry plates, nor is it needed, as good tone can now be obtained on dry plates equal to that on collodion. I should be glad to send "B." samples for him to see.—A. PUMPHREY.

[60465.]—**Sewing Machine.**—Querist does not say whose machine, but, if it is Singer's, I have been troubled the same way, and find it is mostly caused by needle not descending low enough, and so is cut by edge of shuttle. Remedy is obvious. It may also be caused by rough eye in needle, by bad winding of spool in shuttle, or by too great tension. See that needle is central in hole of needle-plate, and buy a book of instructions, price 1d.—T. C., Bristol.

[60468.]—**Action of Steam.**—I notice engine has cranks at right angles, and the exhaust pipe of h.p. cylinder is therefore the receiver, and acts as such. Following the course of one stroke, steam is admitted at 50lb., and probably cut off at half-stroke; the steam therefore expands and falls to $(17 + 4) = 21$lb. at A D. This is now exhausted, but steam already in receiver prevents a perfectly free exhaust, and this, with friction of passages, gives a back-pressure of 4lb. at A, which is raised to 7lb. at B, owing to the valve in l.p. cylinder not being open yet. This valve is now opened, and the steam, having to fill a larger space, falls to 2½lb. at E; but this is not noticed to so great an extent at B, owing to rapid movement of h.p. piston; it is, however, noticeable by slope of exhaust line in diagram. The valve of h.p. cylinder is now closed, and the steam in cylinder is compressed, and rises to 17lb. at C, and continues to do so until opening of port for steam, at which time it should nearly equal the boiler pressure. I think your difficulty is that you expect to see, say,

20lb. at E, but you must remember that receiver has to be refilled as well as valve-chest of l.p. cylinder, and this reduced the pressure to perhaps 5lb., which is further reduced on opening of l.p. valve.—T. C., Bristol.

[60469.]—**Hygrometric.**—If V is the volume in cubic inches of some air under a pressure, H, and temperature t, E its hygometric state, F the tension of water vapour at the given temperature, and α the co-efficient of expansion for gases, then the weight in grains is

$$= \frac{0{\cdot}31\ V\ (H - \frac{3}{8}\ F\ E)}{(1 + \alpha\ t) \times 760}$$

If the air be saturated, then E = 1. What does "Postulata" mean by a "rule for the correction of the barometric height of millimètres and centigrade scale"? I would have worked out an example for him, but he does not give the pressure.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60476.]—**Dynamo.**—To MR. BOTTONE.—Bring the two ends of the wire on the fields out so as to connect one to each brush; and take off the current for the outer circuit from these same brushes also. This is called "shunt wound." You should be able to light six twenties of 48 ohms resistance; 2,000 revolutions is rather high. I should think 1,500 would be ample; but trial alone can decide.—S. BOTTONE.

[60479.]—**Engineering Formulæ.**—In formula No. 1—

$$D = \sqrt{\frac{8500 \times H}{\sqrt{P} \times R \times S}}.\quad P = \frac{8500^2 \times H^2}{D^4 \times R^2 \times S^2}$$

$$R = \frac{8500 \times H}{D^2 \times \sqrt{P} \times S}.\quad S = \frac{8500 \times H}{D^2 \times \sqrt{P} \times R}$$

In formula No. 2—

$$A = \frac{C \times H \times 4}{(P - 16) \times 7 \times R \times S}$$

$$P = \frac{(C \times H \times 4) - (112 \times A \times R \times S)}{7 \times A \times R \times S}$$

$$R = \frac{C \times H \times 4}{(P - 16) \times 7 \times A \times S}$$

$$S = \frac{(C \times H \times 4)}{(P - 16) \times 7 \times A \times R}.$$

—RED LIGHT.

[60479.]—**Engineering Formulæ.**—

$$1.\text{—}H = \frac{D^2 . \sqrt{P} . R . S}{8500}$$

$$\text{From 1}\begin{cases} D = \sqrt{\dfrac{8500\ H}{\sqrt{P} . R . S}} \\ P = \left(\dfrac{8500\ H}{D^2 . R . S}\right)^2 \\ S = \dfrac{8500\ H}{D^2 . \sqrt{P} . R} \end{cases}$$

$$2.\text{—}H = \frac{14 . A . R . S\ (P - 16)}{8 . C}$$

$$\text{From 2}\begin{cases} A = \dfrac{8 . C . H}{14 . R . S\ (P - 16)} \\ P = \dfrac{8 . C . H}{14 . R . S . A} + 16 \\ R = \dfrac{8 . C . H}{14 . A . S\ (P - 16)} \\ S = \dfrac{8 . C . H}{14 . A . R\ (P - 16)} \end{cases}$$

—T. C., Bristol.

[60479.]—**Engineering Formulæ.**—(1):—

$$H = \frac{D^2 \times \sqrt{P} \times R \times S}{8500} \ \ldots\ldots\ldots\ldots (a)$$

$$D = \sqrt{\frac{8500 \times H}{\sqrt{P} \times R \times S}} \ \ldots\ldots\ldots\ldots (b)$$

$$P = \left(\frac{8500 \times H}{D^2 \times R \times S}\right)^2 \ \ldots\ldots\ldots\ldots (c)$$

$$R = \frac{8500 \times H}{D^2 \times \sqrt{P} \times S} \ \ldots\ldots\ldots\ldots (d)$$

$$S = \frac{8500 \times H}{D^2 \times \sqrt{P} \times R} \ \ldots\ldots\ldots\ldots (e)$$

(2):—

$$H = \frac{2 \times A \times (P - 16) \times 7 \times R \times S}{C \times 8} \ \ldots (a)$$

$$A = \frac{C \times 8 \times H}{2 \times (P - 16) \times 7 \times R \times S}. \ (b)$$

$$P = \frac{C \times 8 \times H}{2 \times A \times 7 \times R \times S} + 16 \ \ldots (c)$$

$$R = \frac{C \times 8 \times H}{2 \times A + (P - 16) \times 7 \times S}. \ (d)$$

$$S = \frac{C \times 8 \times H}{2 \times A \times (P - 16) \times 7 \times R}. \ (e)$$

I suppose this is what "Engineering, Manchester," requires.—YORICK.

[60479.]—**Engineering Formulæ.**—

(1)
$$D = \sqrt{\left(\frac{8500\ H}{\sqrt{P} . R . S}\right)}$$

$$P = \left(\frac{8500\ H}{D^2 . R . S}\right)^2$$

$$R = \frac{8500\ H}{D^2 . \sqrt{P} . S}$$

$$S = \frac{8500\ H}{D^2 . \sqrt{P} . R}$$

(2)
$$A = \frac{4\ C . H}{7\ (P - 16)\ R . S}$$

$$P = \frac{(224\ A . R . S) + 8\ C . H}{14\ A . R . S}$$

$$R = \frac{8\ C . H}{14\ A . (P - 16)\ S}$$

$$S = \frac{8\ C . H}{14\ A . (P - 16)\ R}$$

—R. E. F.

[60479.]—**Engineering Formulæ.** — Wanted D, P, R, and S:—

$$(1)\ H = \frac{D^2 \times \sqrt{P} \times R \times S}{8500}$$

Multiplying both sides by 8,500, and transposing $D^2 \times \sqrt{P} \times R \times S = 8{,}500\ H.$

$$D^2 = \frac{8{,}500\ H}{\sqrt{P} \times R \times S}$$

Dividing both sides by $(\sqrt{P} \times R \times S)$.

$$\therefore D = \sqrt{\frac{8{,}500\ H}{\sqrt{P} \times R \times S}}$$

Taking square root of both sides.

$$\sqrt{P} = \frac{8{,}500\ H}{D^2 \times R \times S}$$

Similarly, dividing both sides by $(D^2 \times R \times S)$.

$$\therefore P = \left(\frac{8.500\ H}{D^2 \times R \times S}\right)^2$$

Squaring both sides.

R and S can be found in the same way. These forms are the nearest values you can get for D and P, and similarly for the others, without substituting numerical values for the letters. If you do this, of course you can multiply out, and work each expression down to a single numerical quantity.

$$(2)\ H = \frac{2 \times A \times (P - 16) \times 7 \times R \times S}{C \times 8}$$

Wanted A, P, R, and S.

$$2 \times A \times (P - 16) \times 7 \times R \times S = 8\ H\ C$$

Multiplying both sides by C × 8, and transposing.

$$A\ [(P - 16) \times 7 \times R \times S] = 4\ H\ C$$

Dividing both sides by 2, and re-arranging.

$$A = \frac{4\ H\ C}{(P - 16) \times 7 \times R \times S}$$

Dividing both sides by co-efficient of A.

$$(P - 16) = \frac{4\ H\ C}{7\ A\ R\ S}$$

Similarly.

$$P = \left(\frac{4\ H\ C}{7\ A\ R\ S}\right) + 16$$

Adding 16 to both sides.

R and S may be similarly found.—E. CONRY.

[60479.] — **Engineering Formulæ.** — The querist should put his eqns. 1 and 2 in this form—

$$(1)\ \ 8500\ H = D^2\ R\ S\ \sqrt{P}$$
$$(2)\ \ 4\ C\ H = 7\ A\ R\ S\ (P - 16)$$

Then from the first he has—

$$D = \sqrt{\frac{8500\ H}{R\ S\ \sqrt{P}}};\quad P = \frac{(8500)^2\ H^2}{D^4\ R^2\ S^2}$$

$$R = \frac{8500\ H}{D^2\ S\ \sqrt{P}};\quad S = \frac{8500\ H}{D^2\ R\ \sqrt{P}}$$

And from the second—

$$A = \frac{4\ C\ H}{7\ R\ S\ (P - 16)};\quad R = \frac{4\ C\ H}{7\ A\ S\ (P - 16)}$$

$$S = \frac{4\ C\ H}{7\ A\ R\ (P - 16)};\quad P = \frac{4\ C\ H}{7\ A\ R\ S} + 16.$$

—NO SIG.

[60480.]—**Conic Sections.**—This is a similar query to the above, only in a literal form—

$$e = \frac{2\ a - e . D\ A'}{2\ a + D\ A'}$$

from which—

$$2\ a\ e + e . D\ A' = 2\ a - e . D\ A'$$

or—

$$2\ a = 2\ a\ e + 2\ e . D\ A'$$

striking out the numerical coefficient of each—

$$a = a\ e + e . D\ A'$$

or, in another form—

$$a = e\ (a + D\ A').$$

—NO SIG.

[60480.]—**Conic Sections.**—If the querist is not able to solve this very simple fractional equation, I would advise him to give up the study of conics until he has a wider knowledge of algebra. Multiplying each side of the equation by $2\,a + D\,A'$ (whereby its value is not altered), we get $2\,a\,e + e . D\,A' = 2\,a - e . D\,A'$; transposing, $-2\,a = -2\,a\,e - 2\,e . D\,A$; changing signs and dividing by 2, $a = a\,e + e . D\,A'$.—R. E. F.

[60480.]—**Conic Sections.**—

$$e = \frac{2a - e . D\ A'}{2a + D\ A'}$$

To find $a = ae + e . D\,A'$.

$$2a - e . D\ A' = e\ (2a + D\ A')$$

Multiplying both sides by denominator, and transposing.

$$= 2ae + e . D\ A'$$

Multiplying out

$$2a = 2ae + e . D\ A' + e . D\ A,$$

adding $e D\,A'$ to each side.

$$a = ae + e . D\ A',$$

collecting and dividing by 2.

—E. CONRY.

[60480.]—**Conic Sections.**—First multiply the equation by $2\,a + D\,A'$, thus—

$$2\,a\,e + e . D\,A' = 2\,a - e . D\,A'$$
$$\therefore\ 2\,a\,e + 2\,e . D\,A' = 2\,a.$$

Dividing this by 2, we get $a = a\,e + e . D\,A'$—RED LIGHT.

[60481.]—**Polarised Light.**—Whether good artificial tourmalines are in the market or not I would not like to say. If they are, the scientific societies who work in the interest of the public should cause it to be known. The high prices "E. W." mentions are forbidding to badly-paid science teachers, who would have to spend half their salaries to procure only a few of the optical instruments necessary for demonstration. I may mention that I get fairly good tourmalines from Paris at a fourth the price he mentions, and still think them unnecessarily dear, though, being scarce minerals, one must not grumble.—A. CAPLATZI.

[60482.]—**Feeble Sum—Carbon in Steel.**—I have taken the liberty of altering the title to one that seems to me more suitable. An error in weight of ·004grm. in the case of the 5 per cent. steel and of ·002 in that of the 1 per cent. steel would make a difference of ·01 per cent. of C. From this the requisite accuracy of the balance may be judged.—B. B.

[60483.]—**Electro-Motor.**—To MR. BOTTONE.—If you will kindly refer to p. 570, Vol. XLI., of the "E. M." you will find both description and illustration of a motor with Siemens' armature, 4in. by 1½in., which works with three bichromate cells; if one gallon capacity, will give ⅙ horse-power easily.—S. BOTTONE.

[60484.]—**Twilight.**—"Laura" has confounded 18° of angular measure with degrees of geographical longitude—quite another thing. The lines on earth dividing day from twilight, and twilight from night, are two parallel circles, about 1,250 statute miles apart, everywhere and always. Twilight begins or ends when the sun is 108° from your zenith; so that a spherical triangle whose points are at the pole, zenith, and sun will give you the time. The shortest possible twilight is near 70 minutes; and that only at the Equator the day of an equinox. At other times it is longer, even at the Equator—at the solstices above 80 minutes, even there.—E. L. G.

[60485.]—**Waterproofing Double Textures.**—"Waterproof" must not bring the two coated surfaces together till all the solvents are evaporated; they will then require only the slightest pressure to make them adhere to each other.—N. PUMPHREY.

[60487.]—**Dynamo.**—To MR. BOTTONE.—If the lamps are coupled up in parallel so as to bring the resistance down to 1/12th of that of a single lamp, the dynamo would light them easily; but if the lamps were arranged in series so that the resistance became twelve times as great, or 300 ohms, then 300 volts would be needed. The shocking sensation will depend whether the current is continuous or broken: if the latter, 20 or 30 volts can be distinctly felt, if the former 400 volts are supportable by some people without any serious inconvenience.—S. BOTTONE.

[60487.]—**Dynamo.**—A dynamo giving 25 volts, 12 ampères, would light 12 of the lamps in parallel. A dynamo giving 300 volts, 12 ampères, would light 144 lamps in 12 parallel sets, each set having 12 lamps in series. As each dynamo gives twelve times the number of ampères required for one lamp, 12 lamps must be put in parallel. As the second dynamo gives twelve times the number of volts required for one lamp, therefore 12 lamps must be put in series. Again, volts × ampères given by dynamo divided by the volts × ampères required by one lamp gives the number of lamps the dynamo will light.—G. BOWRON.

[60488.] — **Medical Battery.**—I have seen Leclanché cells made with a porous diaphragm of

blotting-paper instead of the porous pot, so should certainly think canvas would do. The chief thing to be guarded against would be the bag sinking to one side or other and resting against the zinc, as this would probably result in a short circuit; but you can guard against this by fastening the top of the bag to the top of the jar by some cross-stick arrangement, or wooden cap, or sealing compound. The difference in price of the peroxide means simply difference in quality; the cheaper the price, the more adulteration there is in it. I should suggest a middle course as to price. For pure needle-peroxide, 8d. to 1s. would not be too much. The cheapest sort will do for a time; it is only a question of how long it lasts.—E. CONRY.

[60489.]—**Electric Lighting.**— TO S. BOTTONE.—If you were to work steadily for a week, without stopping to take meals, you might run your four 10c.p. lamps for an hour on Sunday evenings; and I think no one would grudge you the enjoyment that the lights would afford you.—S. BOTTONE.

[60492.]—**Mechanical.**—Find the least common multiple of the two numbers of teeth, and divide this by the number of teeth in each wheel, the quotients will be the number of turns each wheel will make to bring the same two teeth together. Thus, in the case given, l.c.m. of 44 and 28 is 308; and 308 divided by 44 and 28 gives 7 as the number of turns made by the wheels and 11 by the pinion. —PURDUE.

[60492.]—**Mechanical.**—Find the greatest common number that will divide the number of teeth in each wheel. This is called the greatest common measure. Divide either wheel by this number, and it will give you the number of turns the other wheel must make before the same teeth again come in contact. Thus, in wheels of 28 and 44 teeth the greatest number that will divide both is 4, and dividing 28 by 4 gives 7 turns for the large wheel and 11 turns for the small wheel. If there is no whole number that will divide them, the turns will be inversely as their number of teeth. Thus, wheels 29 to 35 teeth, the smaller wheel must revolve 35 times, and the larger 29 times.—T. C., Bristol.

[60492.]—**Mechanical.**—Find the "greatest common measure" of the two numbers. Then divide the number of teeth in the larger wheel by this G.C.M., the quotient gives the number of revolutions, or turns, the smaller wheel makes to bring the same two teeth together. Thus, wheels of 44 and 28 teeth—

G.C.M.— 28)44(1
28
—
16)28(1
16
—
12)16(1
12
—
G.C.M. = 4 .... 4)12(3
12

$$\frac{44}{4} = 11 \text{ revolutions of smaller wheel}$$

$$\frac{28}{4} = 7 \text{ revolutions of larger wheel.}$$

Proof:—28 teeth × 11 revs. = 308 teeth passing the line of centres.

44 × 7 = 308 also.

—YORICK.

[60494.]—**L. and B. S. C. Locos.**—Silverdale belongs to the "D." class. Principal dimensions, viz.:—Driving and leading wheels, 5ft. 6in.; trailing, 4ft. 6in. Cylinders, 17in. by 24in. Chamberry to the "E." class; it is a six-coupled tank, with cylinders 17in. by 24in. All wheels 4ft. 6in. —NORTH WESTERN.

[60495.]—**Britannia Developer.**—Probably it is your dark room, or camera, which is at fault, and not the developer; actinic light getting in somewhere. However, try the pyro potash developer (a recipe for Beach's is given in last number), it does well with Britannia plates, as with all others.—B.SC., Plymouth.

[60495.]—**Britannia Developer.**—If you are a beginner, I think it is a mistake for you to begin with "Britannia" present make of plates, as I have heard a great deal that is highly unsatisfactory about them. They used to be first-class, but now have been cheapened, which seems to have been fatal. I always use "Ilford," which are the old make "Britannia," and are first-rate in every way. I have never heard anyone complain who uses these plates.—R. A. R. BENNETT.

[60495.]—**Britannia Developer.**—One of the following three causes is at work to produce your hazy pictures: 1st. Your plates have been exposed to diffused light. (To see if this is the case, give one to a good photographer, and see if they fog in his hands.) 2nd. Your dark room allows light to enter. Either the blind is too light in colour, or you are working with too strong a light. 3rd. Your measure and dishes are not clean; and perhaps your developing solution was made up carelessly as to weight, or got messed.—S. BOTTONE.

[60496.]—**Telephone Fixing.**—I have not had the pleasure of reading the paper by Mr. Preece to which you refer; but from what I know of telephones should certainly prefer a double line to a single line and earth return, for in the former case you get, unless other wires are very close, no more induction than that of the one wire on the other, which is not much; but with an earth return, you may get the click of the sounder from half a dozen different returns of various telegraph lines, each of which will faithfully repeat its messages on the diaphragms of your telephones, to the spoiling of their utility, while you may also have to contend with the continuous rumble of earth currents, and either of these impediments are, with an earth return, very difficult to get rid of. On the score of expense, however, the earth return is generally used.—E. CONRY.

[60497.]—**Acoustic Telephones.** — Ordinary electrical insulators will not do to convey these wires round corners; but the querist will find all the information that he requires on page 447, No. 1,041.—W. E. S.

[60497.]—**Acoustic Telephones.**—You have not got the conducting wire strained tight enough. Try and arrange so as to get the wire strained as tight as possible without the insulators, and then still further tighten it by pulling it on to the insulators with the hands.—E. CONRY.

[60503.]—**Photography.**—Dry plates at 1s. a dozen are not usually good; for 1s. 6d. you can get several first-rate makes, including Marion's "Ilford" and Fry's "German."—R. A. R. BENNETT.

[60503.]—**Photography.**—(1) For quick-acting portrait lenses the ratio of aperture to focus should only be 1 : 3; for ordinary, 1 : 4; diameter of a lens for cabinets and cartes should be about 3½in. (2). Instantaneous. (3) Depends more on the photographer than the plate; an experienced artist can produce first-class portraits with a good lens on cheap dry plates.—B.SC., Plymouth.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "B. B." has replied to 59943.

Charterhouse Science and Art School.—The winter session of this, one of the largest science and art schools in the United Kingdom, will commence to-morrow, under the presidency of the Rev. Henry Swann, M.A. During the late session about 850 students, mostly elementary teachers, availed themselves of the privileges afforded by this institution, and of that number upwards of 600 presented themselves for examination, and were successful in obtaining a number of 1st class certificates, and also a goodly number of honours' certificates, awarded by the Science and Art Department. Of the 13 national scholarships granted by the Government, three were carried off by London candidates, all of whom were students of this institution. Instruction of a practical character is given in most of the sciences at a nominal fee; whilst in art, at an equally low rate, students can be advanced in their studies. Those who have leisure can, at a moderate charge, attend the day classes in art; day classes will also be held to prepare candidates for matriculation (Lond.), the clerical, medical (including dental), legal and other examinations. Students who aim at becoming proficient in chemistry (organic and inorganic) have the opportunity of working in a well-fitted laboratory, capable of accommodating 60 students. Full particulars of the classes may be obtained from Mr. C. Smith, organising secretary, and we may mention that the institution is located within easy distance of communication to all parts of London.

QUERIES.

[60506.]—**L.T. and S.E. Side Tank Engines.**—Can anyone inform me what is the weight of the London, Tilbury, and Southend side tank engines, built by Sharp and Stewart, stationed, I believe, at Fenchurch-street station?—NOMEN.

[60507.]—**Electrical.** — I require to move a lever through an arc of ½in., against a pull of 3lb. What sized solenoid or electro-magnet shall I require with a small battery of, say, one cell? Perhaps some of your correspondents will kindly tell me the most economical proportions to use between size of battery and solenoid. I also require to fire a small alarm gun from the same battery. Will it be necessary to use a coil?—E. C. H.

[60508.]—**Aureolin.**— There is a fine yellow water-colour pigment, which goes by the name of "aureolin." Where can I find any account of its composition and preparation?—W. A. B.

[60509.]—**Gold in Quartz.**—Will one of your readers favour me with details of some simple method of discovering the presence of gold in quartz rock, and how quantitative results are best obtainable?—GLOBE.

[60510.]—**Mathematical.**— Will any reader kindly explain why the average value of the cosine of an angle which varies between 1 and 0 four times is equal to π (3 1-7)?—A. F.

[60511.]—**Boys' Marbles.**—How and where are these made? I mean, of course, stone ones, which "J. K. P." well calls "wonderful," the most spherical things seemingly in nature or art. It does not follow the fittest for his experiments (Reply 59854), as they specially need uniformity of size, more attainable by bullets cast in one mould. If he puts three marbles in contact on a plane mirror, and another plane over them, I doubt if he will often get the two planes very parallel.—E. L. G.

[60512.]—**Mathematical.** — Can anyone solve the following equation? $a = x^2 + y,\ b = x + y^2$. It is beyond me, a—YOUNG MECHANIC.

[60513.]—**Pianoforte Repairs.**—TO MR. DAVIES.—I have a horizontal grand, by Brinsmead, with spring and loop action. Some of the keys stick through damp, and some springs are broken. How can I get the keys out to ease them after I have removed the action from the piano? Should I take out the hammer rest and draw the key out from behind? If so, how am I to lift up all the hammers at once to get the rest in again?—APOLLO.

[60514.]—**Silvertown Firing Battery.**—Can anyone tell me the internal arrangements of the old pattern cell used for this purpose? It had a large zinc surface (so I am told), and the internal resistance was very small, no porous pot being used. How was the mixture of manganese and carbon kept together and away from the zinc? Any information will much oblige—M.M.I.SC.S.

[60515.] — **Vibrator.** — The arrangement of carbon electrodes, &c., in letter 26285 is not very clearly explained. Can, or rather will, "Vibrator" oblige myself and others by giving full details with measurements, &c., as a good transmitting telephone within the capabilities of an amateur to construct will, to use the ordinary quack medicine vendor's expression, "fill a long-felt want?—LINNÆUS.

[60516.]—**Railway Locomotive Returns.**—Will "G.," or any other correspondent, kindly give me the number of locomotives owned by the L.B. and S.C., L.C. and D., S.E., and all the Scotch companies ending June, 1886?—NORTH WESTERN.

[60517.]—**L.B. and S.C. Engines.**—Would some correspondent kindly give me the following information? I cannot refer to back numbers. Wanted, the numbers and names of all engines numbered above 400, and to what class they belong, with full dimensions and where stationed. Also full dimensions of the Gladstone, Richmond, and E classes; and boiler and firebox dimensions of the Westminster and Ferrier (also number of tubes, heating surface of tubes and firebox) classes. Are there any more engines like the Barcelona, which is slightly larger than the rest of the E class?—NORTH WESTERN.

[60518.]—**The Starry Heavens.**—In the Entrance Hall of the Ordnance Survey Office at Southampton, there is (or was formerly) a large map of the starry heavens, delineated in accordance with the sentence in Latin placed over the top: "Cœli Besse Tenus Liceat Convexa Tuera," "As far as two-thirds of heaven it is possible to see its space." I do not think that this is far from being the truth, but it has been disputed. Will any of our astronomical contributors to the "E. M." kindly show by diagram (or explain) how this is made to appear?—ONE NOT AN ASTRONOMER.

[60519.]—**Large Induction Coil.**—TO MR. S. R. BOTTONE.—Will you please say how much larger and what lengths of wire I should require to make an induction coil, say, twice the strength of the one you describe in No. 1121 of the "E. M."?—M. D.

[60520.]—**Kauri Gum Solvent.**—Will any correspondent kindly inform me what is used commercially for dissolving New Zealand Kauri gum? I know that chloroform and strong scents will do it, and gas tar will mix with it and melt it; but what is used for dissolving it in large quantities for making varnish? Any additional information as to details of process will much oblige—TEST.

[60521.]—**To Mr. Lancaster.** — Thanks for your reply. My aneroid is a pocket one, about 3in. in diam. It is compensated, and appears to be highly sensitive to atmospheric variations. Its outer circle can be rotated; but it is only divided for a very short part of its circumference. If one of its terminal lines is made coincident with the 30in. line of the dial, its other last line will coincide with 30·440. Its central line is numbered 0, and the scale on either side of this runs up to 10. I think its smallest subdivisions are 45ths of an inch. What is its use?—X.

[60522.]—**Evaporation.**—I shall be glad to know what is the average evaporation from an ordinary fresh-water pond, say, on a calm day at a temperature of 60° Fahr.?—SOL.

[60523.]—**To Mr. Striffler.**—I have read, with much

interest, your letter on page 395, Vol. XLIII., on the Daniell cell for electric lighting. I wish to light a room 22ft. by 16 by 12 high with incandescent lamps. Would you kindly tell me how many lamps, and of what power, and the number and size of cells I should require, the maximum time of continuous lighting being six hours? The room is used as an ordinary sitting room. I should like to use "Bernstein" lamps, as, I believe, they take very little power. You mention in your letter the copper plate is to be 50in. by 10. I presume, as the plate is corrugated, this so shortens the 50in. so as to make it go once round the cell. Would not a canvas bag do in the place of a porous pot?—NEMO.

[60524.]—**Hide and Feather Press for China.**—Which is the best hydraulic or other press for hand power, exercising a power of 100 to 150 tons, and turning out bales of about 4ft. by 1ft. 6in., weighing about 4cwt.? Presses requiring solid foundation inadmissible, simplicity and solidity indispensable.—NATIVE POWER.

[60525.]—**Bewitched Barometers.**—Now that our erudite and too-long absent friend, W. J. Lancaster, has returned to us, I shall esteem his consideration of the cause why my barometer has lately become unreliable. For more than half the past abnormally wet month of Aug., I found that as the mercury rose the rain came down, and when the mercury fell the rain ceased. Again, during the past few days of thick foggy weather, I have observed the same phenomena. I was an advocate of the uses and merits of barometers, and frequently told the farm workmen to consult the mercury indication, and be guided by its truthful revelation. Now I have to bear the labourers' free and uncomplimentary jokes. Thus, No. 1 comes on and says, "Master, how has your anney lied (aneroid) this morning." Soon appears No. 2: "Fine morning, sir; is the glass down?" the word "glass" said with an emphasis as though I am not a member of the Blue Ribbon army. Then No. 3 touches his hat (this man has been to Nebraska), "I reckon, boss, things are going up; look out for an anticyclone and a miniature carthquake." Then No. 4 feels confident to tell me to take my glass away to the optician who sold it to me, and get back my money. No. 5 remarks that I could foretell the weather better by a consideration of the changes of the moon; and, with sly irony, No. 6 insinuates that mine are "The kind of instruments used by the man who makes weather for the newspapers." Now I am sure Mr. Lancaster, who is himself often worried, though not as I am with rustic chaff, will sympathise with me and tell me why those erratic readings occur. Have recent cosmic influences produced them? Up to this my barometer behaviour was all I could desire, and now it seems as though some occult influence has bewitched it.—E. B. FENNESSY.

[60526.]—**Cable Winch.**—Could one of our kind readers give a rough sketch, with dimensions, of a winch as used by cable men for transferring telegraph cables from lighters to tanks of temporary cable ships, and vice-versa?—ANTIPODEAN.

[60527.]—**Medical Coils and Paralysis.**—Will Mr. Bottone, "W. S. W.," or any correspondent experienced with medical coils and batteries, kindly give me the following information required? (1) Is the medical coil described by Mr. Bottone in last week's "E. M." suitable for a case of paralysis in the legs, and, if so, how should it be applied? (2) What would be the difference in the effect between using the constant current from the primary coil and the constant current from a galvanic battery consisting of 50 or 60 small cells, but no coil? (3) Is there any difference between the secondary current from Mr. Bottone's coil and the current from a galvanic electric machine? I have been using a galvanic electric machine for some weeks in a case of paralysis in the legs, and have found much benefit from it; but the machine appears to have less effect now than at first, on both spine and legs, so think a coil might be desirable, if properly applied.—D. R.

[60528.]—**Photographic.**—Will any kind reader tell me how I may know when I have washed my negatives and prints enough? Some simple test for this purpose would be of very great use to me. I think there is one with bichloride of mercury, but am not sure.—BOW.

[60529.]—**Polishing Paste.**—Can any of your readers give me a recipe to make a good brass polishing and cleaning paste—one that will both polish and clean well? Do any of them know how the German paste is made?—POLISHING PASTE.

[60530.]—**Lenses—Grinding.**—TO MR. LANCASTER—Shall be very much obliged if you will give me information on above subject? I have ground a lens, but cannot get a good polish when looked at through a magnifying glass. I used the finest emery for polishing, and fastened window leather over the lead tool, which is attached to the face plate in the lathe, and is run at about 600 revs. per min. A can of water is fixed above the tool, and allows water to drop on to the glass, which is stuck to a piece of wood, and is held by the hand and slightly pressed against the concave tool.—J. H. WHEAT.

[60531.]—**Lamp for Boiler.**—Would some reader please tell me if I could get a lamp that would not smoke to heat a small boiler connected with a tank that holds about two gallons of water from 100 to 110 degrees? I have one with a burner without a chimney; but it smokes a great deal. Also would be obliged to hear something about the construction of boiler.—ONE IN A FIX.

[60532.]—**To Mr. Lancaster.**—I am desirous of using, if practicable, a magic lantern for the purpose of exhibiting, in my home circle, microscopic mounted objects. I do not want to enlarge them beyond a disc of, say, 4ft. or 5ft. diam., with the use of a paraffin lamp. I am informed that the intense heat of a magic lantern would melt the Canada balsam, and otherwise injure the objects themselves. No doubt this would be the case with a large and powerful apparatus; but I am anxious to know if such a small affair as I propose (effective for discs and not more than 5ft.) would do any harm? I have made an apparatus, similar to that described in No. 980 of the "E. M."; but the light is so feeble that a very small image can be got properly illuminated. No doubt Mr. Lancaster could easily tell me if I am asking for what cannot be accomplished, and, in any case, I shall be most thankful for his opinion and advice.—D. A.

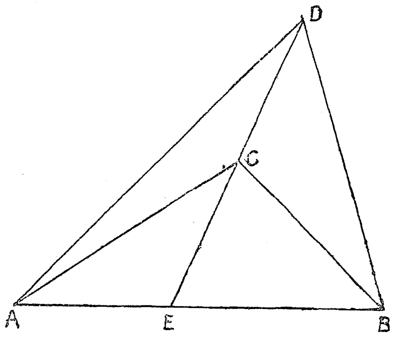
[60533.]—**Crystal Slides.**—Is there any book published on the preparation of chemical crystals for examination with the microscope, giving full and explicit directions for making the solutions and crystallising them upon the slide, &c.? I should be greatly obliged to any chemical reader who would inform me if any such publication exists, and price, &c., so as to enable me to enlarge my range of "crystal" slides.—D. A.

[60534.]—**Dynamo.**—Will some of our readers kindly tell me what to do? I am in trouble with my dynamo: it has a commutator at each end of the armature, one end being large and the other small. Now when in motion I can only get a spark on the brushes from the small commutator. It is a light machine, and it will not light one 20c.p. Swan as it is. Any information will oblige—ANXIOUS.

[60535.]—**To Mr. Bottone.**—Could you say whether a ½in. spark could be got from the coil you described last week without a condenser? If not, would you mind giving dimensions for making one?—F. SCHULTZ.

[60536.]—**Irish Locomotives.**—Can any of our readers give sketch with dimensions of a new locomotive on the Londonderry and Seaham Railway, the which is reported to be a model of engineering skill, and capable of drawing double the load of similar sized engines?—BRASS, JACKINTON.

[60537.]—**Problem.**—Given angles B A C, A B C



A C E, B C E, and A D B to find the other angles.—H. K.

[60538.]—**Formula for Train Speed and Brake.**—Wanted, arithmetical formula for finding time and distance required for a train at rest to attain various speeds on level and various gradients, both up and down. Also time and distance required to bring train to rest on level and various gradients, both up and down, by ordinary hand tender brake, steam brake on driving wheels, hand tender and van brake, and other combinations that can be used. Also by continuous brake.—GOODS FIREMAN.

[60539.]—**Valve Gear of Marine Engines.**—Would any reader inform me if cams have ever in any way been applied for working the steam valves on the marine engine? If so, say where, when, and also if there is a written description of the valve gear to be found anywhere; or, if it will not put the reader too much about, would he describe how the gear works?—J. O.

[60540.]—**Tricycle Matters.**—It is some years since these have been discussed at any length in the "E. M.," and the use of these machines has increased enormously; not only so, but quite recently some very important changes in the principles of construction have been introduced which merit some discussion. Of these, what is termed "automatic steering" and the use of much smaller "geared-up driving wheels" than of yore are especially worthy of consideration. Personally, I have tried neither—they did not commend themselves to my notions of what is good in mechanics; but the evidence I have from some who have tried them, who understand next to nothing of mechanics, but who are practised and skilful riders, and know very well whether they gain an advantage or not, assure me that they not only ride with less labour and cover more ground in a given time with the new than with the old type, no matter whether the roads are good or bad. I was also informed, only yesterday, by a clever constructor of these machines, that he was now actually adapting his patents for use with these geared-up machines, and intended abandoning the manufacture of those with the 50in. and 48in. wheels in favour of the 42in., not from any preconceived idea on the subject, but in consequence of actual experiments which had incontestably proved to him that advantage. The only explanation that he appeared able to suppose was that not only were the smaller wheels of less weight themselves than the larger ones, but their adoption enabled other parts of the machine to be made lighter, though just as stong. This seems to me paradoxical. I don't exactly see why the other parts can be made lighter and yet as strong, merely because the wheels are smaller, and, again, I can suppose that on smooth ground the reduction in weight may compensate for the smaller diameter of the driving wheels; but on rough ground theory seems to me to be all on the other side. I should much like to hear what experts have to say on this question.—GAMMA SIGMA.

[60541.]—**G.W. Trains.**—I should be much obliged to any reader who would answer the following: Does the G.W. Company run through trains between London and Manchester, viâ Oxford, Birmingham, Wellington, and Crewe, or viâ Shrewsbury and Chester, and, if so, what class of engines work them? Also, do they run through trains from London to Plymouth by the narrow gauge, and, if so, what class of engines work these trains?—Z.

[60542.]—**Photography.**—At what stage of development can citrate of silver be used, both in negative plates and printing paper positive? Can it be used with advantage instead of citric acid, relative costs out of the question? If so, please give formula that includes citrate of silver both in developing and printing.—YELLOW FINGERS.

[60543.]—**Steam Diggers.**—Can anyone give me some particulars of the steam diggers used for planting trees, &c., on the Saidaput model farm, Madras? I believe they are made in America; but there may be similar machines made in this country.—F. A. R.

[60544.]—**Microscopical.**—(1) I wish to draw on paper, by means of the camera lucida, a set of scales for the easy measurement of objects for each of the different objectives with the several eyepieces. I have been quite successful with the No. 1 eyepiece, but when I come to use No. 2 eyepiece I am completely floored, as I cannot even get the disc to appear on the paper. (2) How can I best modify the light, so as to read a micrograph slide with a low-power objective, say a 2in.? I can make it out, but not clearly, as the light seems to drown it?—G. E. H.

[60545.]—**Photo. Micrography.**—Given a good compound microscope, also a camera, could I, without much extra expense, enlarge objects and produce them on slides suitable for magic-lantern work?—G. E. H.

[60546.]—**Phantasmagoria.**—I have several oleographs, semi-transparent, about a foot square, and should like to exhibit enlarged reflections of them on a screen or mirror. I have a large magnifying lens. Will anyone kindly give me information?—T. J. MOORE.

[60547.]—**Letters on Glass.**—I want to paint some lettering, &c., on glass, to be silvered afterwards. I have done some, but the silvering process has blackened the colour, for want of a protective medium (to be used after painting). Will one of "ours" kindly tell me what to protect the colour with?—GLASS PAINTER.

[60548.]—**Copper Boiler.**—I have made a small vertical boiler of sheet copper (No. 20 gauge), the size being 14in. by 7½in., with two stays across the body and one from top to bottom. Will anyone kindly give me the following information (1) as to how many pounds pressure of steam per sq. in. will it stand to work with safety? (2) How many pounds per sq. in. will it require to drive horizontal engine, the cylinder being 2⅝in. stroke and 1½in. bore?—A COUNTRYMAN.

[60549.]—**Telegraph Connections.**—TO MR. CONRY.—I want the arrangement in duplicate, so as to ring from both ends in the ordinary manner.—E. M.

[60550.]—**Chemical.**—How can I reduce a mixture of cyanide of copper and potash oxide in solution to metallic copper and potassium cyanide?—T. MORRIS.

[60551.]—**Reed Organ.**—I purpose making a reed organ, on suction, to have one 16ft., two 8ft., and one 4ft. stops, the 4ft. preferably steel, with 2½ octaves of pedals coupled to manual. What size should pallet holes be for 3½ rows reeds? Would reservoir 16in. by 3ft. to fall 8in. be of sufficient capacity? How can I obtain Vox Humana without sharpening? Have plenty of tools, ordinary. What reeds must I use to get the nearest approach to a pipe organ, or would tube boards be best? I may add cost is some consideration.—G. D. G.

[60552.]—**Air Gun Trigger.**—Seeing an engraving of an air-gun trigger in the "E. M." the other week (Sept. 10th), by R. L. Readdie, I should like to ask him, on behalf of myself and others, if he will kindly give an illustration, with your kind permission, how the air passes from the air chamber into the barrel, seeing that the mechanism for firing is between air chamber and barrel? Does it come through the works direct, or through a separate tube? Also show form of valves, if possible. Also if ordinary brass gas tubing will do for air pump and barrel, and if the piston should be solid iron, or packed with hemp, like a garden syringe?—ONE WHO HAS TRIED AND FAILED.

[60553.]—**To Mr. Wimshurst.**—Having constructed a 17in. machine as per your instructions which appeared in these columns, I am desirous of gathering a little more information. Would you be kind enough to give particulars of construction of one of your 8-plate machines, size of bosses, length of stand, conductors, Leyden jars, brass balls, thickness of spindle, how many sectors on each plate? Will 21oz. window glass be strong enough for plates and the straight jars used by confectioners answer for Leyden jars?—EVENO OAKLAND.

[60554.]—**Charging Accumulators.**—Many thanks to Mr. E. Conry, and to the other gentlemen, who have so kindly taken notice of the above query. I have not as yet had time to carry their suggestions into effect, but hope to be able to do so shortly. The cells have, I believe, been short-circuited to a greater or less extent by sulphate of lead within the cells, and they have also leaked enough to keep the place on which they were standing wet. Mr. Conry is mistaken as to the resistance of my dynamo being only half an ohm. It is wound with about 6lb. No. 16 on field, and about 6oz. No. 20 on armature. This quantity of wire would give a resistance of a little over two ohms. For charging the cells in question, I have been in the habit of running the machine in series. Perhaps now that I have given quantity of wire, the correspondents who have noticed this will be able to form an approximate idea as to the capability of the dynamo, and be good enough to inform me if it is powerful enough to form the six cells.—IOTA.

[60555.]—**Sardines.**—Could any brother reader give me some particulars of the manufacture of these in tins? Are the fish boiled in the oil? What oil? What herbs are used to flavour with?—OLD SUB.

[60556.]—**Wimshurst Machine.**—Will Mr. W. be kind enough to give me number of sections for a machine with 16in. plates, and explain construction? Does each disc revolve in opposite direction? Can I get the pamphlet on its construction mentioned as in the press some time ago?—CARNFORTH.

[60557.]—**Honours Exam.**—Can Mr. Bottone, "Sigma," or some other gentleman of experience advise me how to prepare for the honors exam. in electricity of the Science and Art Department? What are the best means of study, and is there any special book?—CARNFORTH.

[60558.]—**Forging Engine Work.**—Will any of our readers who are practical forgemen describe the proper method of forging double cranks for small engine-shafts and similar work—say a 4in. crank out of a round bar of 1¾in. thickness? I find it difficult to prevent the diminished thickness just at the angle of the bend outside, and to get the angles up square and true. Also, which is the proper way to forge the two-eared ends of connecting-rods and valve-rods?—NERO.

[60559.]—**Liquid Compass.**—Will any correspondent kindly say what liquid is used for liquid compasses? Also, in what are the magnets inclosed to prevent rust? Any particulars respecting making will oblige—TADDY.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 29, and unacknowledged elsewhere:—

S. GIBSON.—G. E. Davies.—T. R. Willis.—W. F. Stanley.—T. Dolan.—W. H. Numsen.—G. Birch and Co.—Lux.—A. J. Frost.—S. R. C.—Amateur.—Desideratum.—Billy.—Beginner.—A Vet. Surgeon.—Libra.—B.—C. B.—R. H. Gates.—A Countryman.—Geo. Wells.—Z. Y.—O. H. P. Scourfield.—H. Purse.—Glatton.—South-West.—H. A.—Snipe.—Force Pump.—Induction.—C. D. R.—G. H. L.—K. K. K.—Kappa.—Ingienero.—Ramases.—R. E. F.—W. H. Taylor.—H. Palmer.—Simplex.—J. H.—Jas. Jones.—Arthur Bowes.—A Socialist.

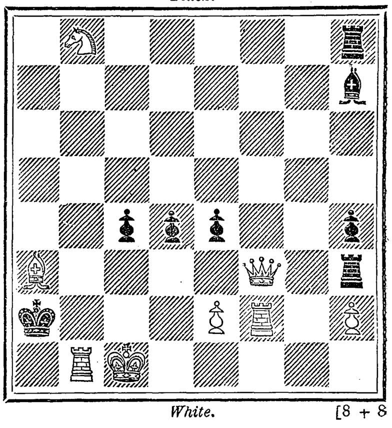
TO SOME VERY PROLIFIC CORRESPONDENTS. (It is absolutely impossible to find space for the shoals of letters that reach us on railway matters and locomotive details. We have given such correspondents considerable latitude lately, and now some want to discuss what details should be submitted for controversy as well as the subject itself! A similar reason compels us to close the correspondence on English versus Foreign Microscopes. Considerable and unnecessary heat has been introduced into it, and nearly all have wandered far beyond the point submitted for discussion.)—GALA. (Allow half an inch for each wire or note, and an inch all round for the frame; but an inch and a half is better; or you can cut the back out of the solid—say, 30in. at one side, tapering off to 15in. at top.)—W. W. (Do not understand what you mean by "loaded at ends with solder." Perhaps they are acetate of soda footwarmers, which contain that salt, and are immersed in hot-water simply—none being required inside, hence they are sealed up.)—ELECTRIC. (See the indices of recent volumes.)—RD. STEWART. (Try a whistle mouthpiece in the spout.)—T. F. FORDE. (We might fill our pages with examples of that kind without getting any nearer an explanation. See what has been said in back volumes, and in works on the subject.)—T. F. F. (The only way is to scarf the ends and cement with rubber solution; but broken tires are never safe, however well they may have been repaired.)—R. W. C. (Do you mean paper balloons or gas-tight affairs, which can be used over and over again?)—SUFFERER. (Ointment of galls is a useful preparation; but see No. 899, pp. 329, 338, and No. 900, p. 361. See also the indices under head Hæmorrhoids.)—R. J. T. (You will get an idea from No. 919, p. 211, and have only to add other magnets to reset the indicators. See also No. 904, p. 455, and the indices.)—VERY PUZZLING. (See No. 1028, p. 308—"Jumping Beans of Mexico." The action is supposed to be due to changes of temperatue.)—GRAVER. (The query was actually answered last week—see p. 93—and as to the tools, look in Nos. 935 and 734.)—MINERAL. (Dana's "System of Mineralogy," £2 2s. (Trübner), is a first-class work. We do not think any work has been published on the microscopical study; but you will find papers in back volumes, and in the *Journal* of the Royal Microscopical Society.)—A. R. F. K. (Is not the "explanation" supplied by the fact itself? The barometer is a measurer of the weight of the atmosphere, and if the column of mercury falls when the air is charged with aqueous vapour, does not that show that wet atmosphere is lighter than dry?)—TRINITY HALL. (There is a groove in the periphery of the piston, and the rings are sprung on, being cut through with a diagonal cut.)—N. W. SMITH. (Surely you can try which sort of socks suit you best. We presume you have tried cotton; if not satisfactory, try silk.)—ANXIOUS. (Answered last week.)—T. M. T. K. (Use a blue lacquer or varnish: that is the only method.)—A. J. G. (Solution of chloride of cobalt is perhaps the best; but see the indices.)—S. S. (We suppose you mean the machine which rolls the thread up instead of cutting it out. That was exhibited by J. H. Ladd and Co., 116, Queen Victoria-street, E.C. No. 1144 in the third edition of the catalogue.)—C. MATHER. (Coat with gold size and dust on the bronze powder. If that is not what you mean, see indices.)—BIOLOGICAL STUDENT. (If you cannot accept the statements of those who have already dissected such animals, you can easily obtain a supply of them from naturalists. An advertisement in the Wanted Column would no doubt bring you plenty of offers.)—F. C. S. (There is much information in the back volumes—see indices to Vols. XIV. and XV., for instance; but if you put specific questions, no doubt you would obtain replies.)—FIDES ET JUSTITIA. (Do you think that the processes of brewing can be described in a receipt? See the indices for much information, and procure one of the cheap handbooks.)—BEN SCROGGINS. (You can obtain a judicial separation, but until you do that you are liable.)—POULTRY. (About 103° Fahr. is the temperature required for hatching eggs.)—E. S. I. (The actual heat of a Bunsen burner depends on its size, as heat refers to quantity. The temperature is about 1,200° Fahr. With an ordinary mouth blowpipe you can possibly obtain a temperature of 2,000° Fahr.; but it is doubtful if you can yet 1,600° C. with anything less than a furnace and a blast.)—W. G. MORGAN. (You should say what you mean by "railway work"—what branch?)—JOSEPH BRYAN. (No doubt your opinion is correct; but what can be expected for the money?)—MINERAL. (Directions for cutting rock sections will be found in last volume, pp. 490, 512. See also No. 1056, p. 342, and the indices.)—W. H. S. (Procure the reprint of the articles by "Sable," which appeared about sixteen years ago, and now published by Mr. Hughes, of Mortimer-road, Kingsland-road, N. See p. 553, No. 908, and the indices, especially of Vol. XXXI., which contains an interesting discussion on transparencies, and an article by the Rev. W. H. Dallinger in No. 782.)—JOHN JACQUES. (A solution of common washing-soda is as simple and useful as anything, but much depends on the character of the water, and it is better in every way to purify that before putting it into the boiler. See No. 974, p. 261, No. 979, p. 374, and look through the indices for a number of suggested, and sometimes useful, methods of preventing incrustation.)—W. B. (We believe the dimensions have been given. Look through the indices.)—YOUNG MECHANIC. (Procure one of the handbooks issued by the agents advertising in these columns. The actual cost for the stamp on application is now only £1, and for a shilling or two more you can sufficiently protect each invention for nine months, as drawings are not required with the application. You can obtain the new Act for 1s. 1d. from the Queen's printers, and the Rules for 7d. 2. If, as we understand you, the glass is not to be engraved, you may possibly succeed by grinding up some of the finest lampblack in oil of lavender, and drawing the lines with a small brush. A good deal of practice will be needed if you have never done such work before.)—F. W. HARRISON. (The "Practical Guide to Photography," published by Marion and Co., Soho-square, W., will no doubt suit you.)—HOLLAND. (The coil referred to is purely experimental, and no one can say what result would follow your plan without actual trial. Silk-covered wire must be used. Better make one on the lines indicated in No. 1,092, p. 543, and look through the indices for much useful information.)—WM. JOHNSON. (You had better procure the salts ready prepared, if the directions given in No. 994 are not sufficient. Battery working is troublesome; but procure a catalogue from Elmore and Co., Charlotte-street, Blackfriars-road, London, S.E.)—G. (There is an illustration of an improved Æolian harp in No. 1048; but any sort of shallow box which is strong enough will do. The strings are carried over bridges at each end.) W. S., Rochdale. (See pp. 424, 514, 535, last volume; but if the instrument is a good one, better let some one who understands it do the regulating. They are described in most works on Physics—Ganot's, for instance.)—NOMEN. (No. See the descriptions of the Siemens' gas and coke stove in Nos. 817, 819. Gas stoves have special advantages, and if you wish to learn what has been done in that way, procure a catalogue from Mr. Fletcher, of Warrington.)—DARK. (We do not know. Apply direct to him at Bowdon, Cheshire.)—W. E. S. (Why not procure the patent specification. There is not much in that part, as the gear simply slackens the driving strap and allows the wheel to run free.)—LANCASHIRE YOW-YOW. (You supply the answer when you say you seem to lose all confidence in yourself. Don't lose it—that is all.)—G. N. (See indices for Muscæ volitantes. If it is very serious, better consult a medical man; but probably if you do not think anything about it, you will not notice it.)—X. Y. Z., London. (Simply want of the lubricant synovia. Probably cold. Rub in a little sweet oil or liniment where the cracking is felt.)—F. A. R. (See indices. If the surface is worn off, dye must be applied, and the glaze be put on with white of egg beaten to a froth.)—PATERFAMILIAS. (No special dimensions. A praxinoscope is better (see No. 732) as slits are dispensed with, and the picture slips revolve round a pillar formed of mirrors.)—M. A. B. (The ends of the secondary are connected to the dischargers.)—LOCO. (If you warm them gently that will soften them; but you must remember that indiarubber is not everlasting when exposed to air.)—C. N. H. (We do not know where you can obtain the machine; but the offices of the company were, until recently, at 58, Coleman-street, London, E.C. No doubt you will see the advertisement in the daily papers.)—FRANCOIS. (Isinglass is made from the "sounds" of sturgeon, gelatine from bones, cuttings of skins, &c.—in fact, anything which contains it, as when it cannot be cleared and purified, it does for glue. No book; see back volumes.)—H. (You give no address; but if in London, attend the classes of the Finsbury Technical College, pass well up, and any electrical engineer will be glad to have you as an apprentice. Not very good condition at present, but is going to be better.)—C. W. (You can get them readily enough through the post. When you ask, Will something else do? one is tempted to reply, "Try," for you do not suppose that everything has been experimented with. 2. If you mean the blown glass, yes; cast won't do.)—DARWEN (Answered last week.)

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXI.—BY J. C. J. WAINWRIGHT.
(From *The Wanderer*.)

Black.



White. [8 + 8

White to play and mate in two moves.

SOLUTION TO 1009.

White.	*Black.*
1. B-Q R 5.	1. Kt takes Kt (*a*).
2. Q-K 4 (ch).	2. Anything.
3. Kt or B mates.	
	(*a*) 1. Kt-Kt 4 (*b*).
2. Q takes Kt (ch), &c.	
	(*b*) 1. Q B moves.
2. P takes Kt (ch), &c.	

In order to avoid the solution 1. Q-K Kt 2, a B P is needed at K R 5 and W P at Q Kt 2.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,008, by Isca and J. Thompson; to 1,009, by I. M. Brown (2), G. A. A. Walker (2), A Beginner (second solution), A. Dean (ditto), and J. MacKenzie (ditto).

A BEGINNER.—If in 1,009 1. $\frac{\text{Kt-K 7}}{\text{B-K R 4}}$, if again 1. $\frac{\text{Kt takes Kt on Q 5}}{\text{B-Q R 5}}$, further, if 1. $\frac{\text{Q-Q Kt 4}}{\text{P takes Kt}}$.

E. ST. EDMUNDS.—If 1. $\frac{\text{Q-K R 5}}{\text{Kt-Q 2}}$.

T. QUILLIAM.—Where is the mate if 1. $\frac{\quad}{\text{Kt-Q R 5}}$?

BLACK PAWN and J. MacKenzie are thanked for the problems sent.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.).

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday, to insure insertion in the following Friday's number.

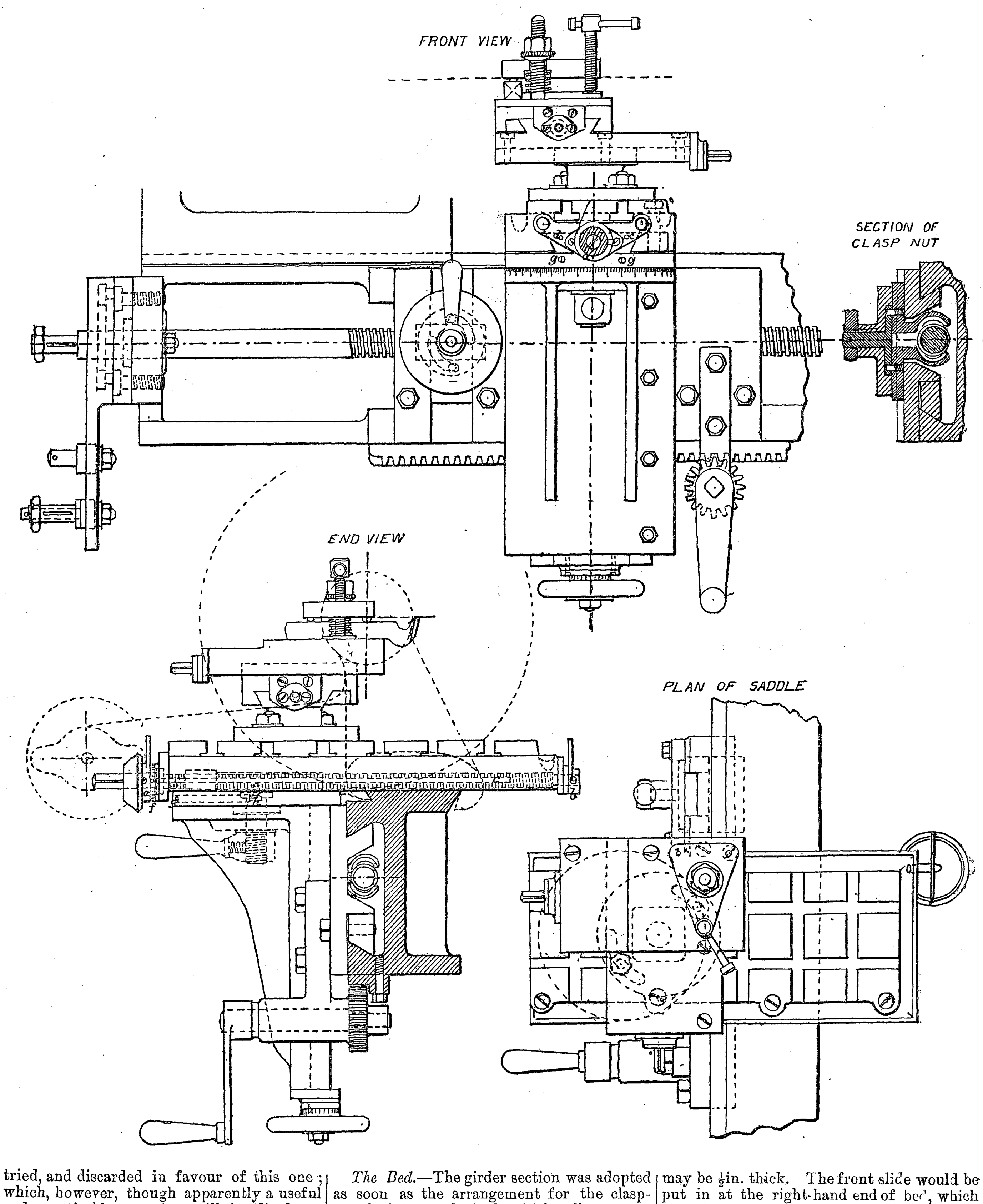
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 8, 1886.

SADDLE WITH FRONT AND VERTICAL SLIDES.—II.

THE arrangement about to be described has been under consideration for some time, and several alternative plans have been tried, and discarded in favour of this one; which, however, though apparently a useful and practicable one, has still its disadvantages.

The section of bed adopted is practically identical with that propounded by Mr. Carre about two years ago, just as the mandrel with traversing bushes is due to a suggestion of "Vulcan," another correspondent. The idea of passing the mandrel stud through the star-guide is due to Mr. Massa, an American amateur, and it has been carried out by him. In fact, every suggestion by whatever correspondent which seemed likely to be of service has been weighed, and the whole design, as it now appears, is in some degree the child of the several writers on "Lathe Matters" in this paper.

The Bed.—The girder section was adopted as soon as the arrangement for the clasp-nut had been devised, which allows of a shallow opening in front between the top and bottom web. The form of the top of the bed is preferred because, whilst the heads have a broad base to stand upon, their alignment does not depend upon tenons which might come to fit loosely, but upon the front top V, up to which they are drawn. In the drawing of the fixed headstock one of two small screws is shown in the base of the headstock, which screws are intended to draw it up into contact with the front edge before the holding-down bolt is fixed; this bolt is omitted in the elevation and plan, and is shown dotted in the end view. The webs at the back would occur about every 9in. and may be ½in. thick. The front slide would be put in at the right-hand end of bed, which must be planed right out clear, there being only a removable bracket-arm to support the end of the lead-screw. The method adopted



for securing this and the other screws employed to move the slides is somewhat unusual; it will be clearly seen by the dotted lines to the left of the front view. These screws are all held by one end only, by means of a kind of gland piece, which contains the large collar and resists endlong motion. On the left hand of the bed there is a strong flange, which is bored and surfaced square; the lead-screw is threaded through from the left till the collar goes up; over the end of the screw goes the gland-piece, the face of which is filed or turned away till the recess is just deep enough to contain the collar (which process must be repeated if any wear takes place), and the gland-piece is secured by two stong cheese-headed screws; next comes the wheel-plate, which contains the circular T-slot. These wheel-plates might have been 1in. longer; they are made so that the studs can be slipped in at the end, and the sides are strengthened that they may not spread when the stud nuts are fixed by the spanner. The reason for fitting the slide-screws in this way is that when a washer and lock-nuts are employed it frequently happens that the screws will move harder at one part of the revolution, proving that the washer and face against which it works are not true, and that a slight amount of endlong motion of the screw takes place at each revolution. Now if this be so it must be evident that it is quite useless to expect a good result when screwcutting even were the lead-screw never so true. In this arrangement the endlong motion is not taken up by lock nuts at all, but by a large turned collar sunk in a turned recess in the gland-piece. The same plan was adopted for securing the traversing screw, since it is intended to use this in connection with the mandrel by means of the upper wheel-plate, for traversing (flat or conical), for giving feed when milling, and for screw-cutting by turning it parallel with the bed; in fact, one might be very well satisfied to have no lead-screw in the bed, since by the long traverse slide screw-cutting 8in. long can be accomplished.

The front slide is 13in. long, which should give a good bearing to resist wear; the gib is placed at the bottom, though the reasons for having it at the top appear to be about as strong. It is evidently of the greatest importance to prevent any spreading of the upper and lower front flanges of the bed, for this reason the webs at the back of the bed were added, and the flanges of the clasp-nut have been placed in front of the front slide instead of inside it, in order to save space, and so bring the front slide closer to the central web of the bed. The front view shows in dotted lines an oblong hole in the front slide, through which the clasp nut is passed till the guide-plate of each half drops into a shallow vertical groove planed in the front. This may be seen in the section as well as in the plan. The guide-plates come flush with the surface of the $\frac{1}{8}$in. circular facing, then the spirally slotted plate is slipped over the pins which control the halves of the nut, and over this goes the recessed cover-plate.

In the vertical slide, as in the others, the usual arrangements are reversed, and it is the larger, or female slide, which moves. This arrangement is stronger, and more convenient in many ways, but it has its disadvantages. The proportions of the vertical slide are not shown in section, since it, with its screw and gib, is arranged exactly like the horizontal or traversing slide, seen just above in the front view; it is strongly webbed up to the top plate, 6in. diam., on which turns the traverse slide to any angle on the graduated circle, and it is clamped by the handle seen underneath. The male vertical slide is 6in. long, and the moving part can rise 4in. The vertical slide is slid on from the top, and the screw, with its hand-wheel, yoke, and gland-piece, fixed afterwards by two screws similar to those seen in front of the traverse slide in the front view.

On the top of the vertical slide is the male part of the traverse slide, with its 6in. flange underneath; it is 5in. long, and its front edge is within $1\frac{1}{2}$in. of being under the lathe-centres, so that work being milled is always overhung to that extent, but never more. The main part of the traverse slide next claims attention. The top of this slide forms a most convenient milling-bed or table for fixing work; the screw is perfectly covered and protected, as is the screw of every slide in the lathe, and there is a gutter all round to catch turnings, soapsuds, oil, or what not, and a little can should be hung on a spout, as seen in plan, to receive the drip. In sliding or screw-cutting with the lead-screw in action, the vertical slide would be down, and the presssure of turning would not come on the vertical slide or on its screw, nor on the bottom V of the front slide, but on the broad top of the lathe-bed, thus obviating the only important objection which has been raised to the use of the front-slide—*i.e.*, that the smaller bearing surface would, in time, wear hollow. Returning to the circular movement under the traverse-slide, it will be seen that it can be instantaneously released by the handle beneath, when the long traverse slide can be swung round parallel with the bed, and then the whole front slide, and all upon it, can be racked away past the poppet-head. Another advantage is that, as already mentioned, the long traverse slide (which may be longer if desired) can thus be utilised for cutting spirals, cones, and parallel work (whether screwing or sliding) up to 8in. long, all this being done very conveniently by connecting the long traverse screw with the mandrel by means of the upper wheel plate, the sliding shaft within it, and the Hooke joints. Also by means of a pair of small bevel wheels, one of which is shown in the end view, fixed upon the end of the screw, which wheels, however, would only be required when the traverse slide lay across the bed, and not when it was turned round parallel with it, or nearly so.

Passing on to remark upon the slide-rest fixed upon the top of the traverse-slide, the two screw-bolts securing it have T heads, which lie in the two longitudinal slots; thus, when the nuts are slackened the whole of this part can be drawn or slid off towards the workman to leave the milling bed clear. The slide-rest consists of *two* slides at right angles, for several reasons. First, because it allows the back-stay to be mounted on the back end of the traverse slide or milling bed; because the second screw will help to save the traverse screw from wear; because the upper traverse screw would give the feed in screw-cutting, whilst the lower main screw could be used for quick withdrawing; and, lastly, because when screw-cutting with the traverse slide set parallel with the bed, the two slides above would be needed to adjust the tool-point.

The Willis tool-holder is arranged so that no spanner or tommy is required to fix the tool.

One more device requires explanation: in turning, and still more in milling, it is desirable, if not essential, to have stops of some kind fitted to the main slide; the usual form of stops cannot well be applied to these reversed slides, but the much better form known as the circular stop is suitable. The difference between them is that, whereas the ordinary form of stop arrests the motion of the slide when it meets the end of an adjustable screw, the circular stop arrests the revolution of the screw which moves the slide, thus avoiding all strain to the parts, and stopping the movement with still greater precision. Mounted upon the boss of the bevel wheel at one end of the traverse-screw, and upon its point at the other end, will be seen two rings or bosses *a*, *b*; these carry short arms, and can be fixed by small pinching screws so as to revolve with the long screw. Through the male or fixed part of the traverse slide, and on each side of it, are bored two long holes through which pass two steel rods $\frac{1}{4}$in. diameter, which fit rather tightly, and yet can be pushed in or out by the fingers; one of these bars or rods is marked *c c* in the end view, and *c* in the front view, and it comes through the yoke in *front*, and is seen projecting $\frac{1}{8}$in. in the end view; the other rod seen dotted in the front view comes through *backwards*, and it stops the revolution of the main screw by means of the arm of *b* when the slide is drawn back far enough, whilst the rod *c c* arrests the motion in the other direction when the slide is moved forwards far enough for the rod *c c* to project through the front yoke and so catch the arm of ring *a*. By pushing the rods in or out the movement can be confined to any number of turns of the main screw, and by adjusting the position of the rings on the screw before fixing them, any part of a revolution can be obtained. A micrometer collar is seen at *f* on the boss of the bevel wheel (it should have been shown wider); the screw being of ten pitch, it might be divided into ten, and would then measure 1-100th of an inch. It can be turned round on the boss and fixed again, and thus the measurement can start from the *o* mark. There is also a simple device for fixing the rods *c c* and *d*: two other holes at *g g* are bored in the flange just under and parallel with rods. In these fit two short rods having their ends for $\frac{1}{4}$in. turned slightly eccentric; short holes are bored from the top of the slide through the holes for the long rod down to the 2nd holes, and in these vertical holes are two bits of rod about $\frac{1}{8}$in. long standing on the eccentric ends of the lower rods and reaching up to the underside of the long ones (dotted at *h*). When the lower rods, *g g*, are turned by a screw-driver, the short $\frac{1}{8}$in. bits will be raised, and the long upper rods pinched and held firmly.

A word, in conclusion, about the uses of the whole arrangement. The front slide allows the whole saddle, rest and all, to be slid out of the way when hand-turning is to be done, without even moving the poppet; this is not a great advantage, since the slide-rest is so easily removed from off the traverse slide, and the hand-rest might very conveniently take its place, being fixed with its sole on the milling-bed instead of on the lathe-bed. The vertical slide allows of work being firmly fixed and fed up to milling cutters carried on the mandrel; also a strong driller can be fixed on the milling bed and adjusted, or fed up or down for slot drilling or milling work fixed on the face-plate; this same driller would carry the wheel-cutters if it were fixed vertically, or they might be carried in a wheel-cutting frame adjusted to height by the vertical slide. For instance, an engine cylinder having been bored out by a slide-rest tool on the face-plate, the slide-rest would be removed, and the long slide being turned parallel with the bed, the strong driller carrying a milling-cutter would be mounted upon it; the cylinder would then be fixed so that the valve-face and flange of chest were vertical, and the driller, by means of the vertical slide, would face the flanges, the valve-face, and cut out the steam ports true with the bore, and all at one chucking. The vertical slide converts the lathe into a very efficient milling machine, and almost doubles its powers. The only wonder is that we have done without it for so long, or been contented with unsteady attachments.

F. A. M.

REVIEWS.

Photo-Engraving on Zinc and Copper in Line and Half-tone, and Photo-Lithography. By W. T. Wilkinson. London: England Bros.; Otley: W. T. Wilkinson.

The art of photo-engraving has been practised for many years with more or less success, but latterly it has made considerable strides, for surface blocks suitable for printing in the ordinary press with type have been produced in half-tone, excellent examples of which may be seen occasionally in the *Building News.* Mere line work is, in fact, looked upon as beneath the artist workman, and the aim of all inventors is to produce a surface in zinc or other metal from which a picture can be printed having all the gradations of tone seen in a first-class photograph. The little book issued by Mr. Wilkinson, though it contains less than 120 pages, is a practical manual, and will be found extremely useful by anyone desiring to take up the art of producing blocks for printing direct, as it were, from nature, without a touch from the graver. We have from time to time given ample directions for producing process blocks, as they are called, so long as the drawing is confined to lines; but the methods of making a zinc surface yield desirable pictures in half-tone when printed with type in a newspaper are very much trade secrets, which, to judge by some of the results, are scarcely worth five minutes' endeavour to discover. Nevertheless, sufficient has been already accomplished to indicate the possibilities of the future, and Mr. Wilkinson says in his Chapter VI., "we now come to the most important chapter of this book—viz., the production of photo-type blocks, or the means whereby the half-tone of a photograph is levelled up, so as to print in a typographic press." Briefly stated, this is accomplished in the ordinary processes by interposing a screen before the sensitive plate, so as to produce a negative with a definite grain. It is here where the skill of the practised worker and the genius of the inventor are required, for it is very easy to have too much grain, and yet grain is essential to the production of the picture. Mr. Wilkinson's practical directions will be very useful to the experimenter, not only in producing the photograph on the zinc plate, but in the subsequent manipulations, which require great care and skill. The photograph having been obtained on the zinc, the image is rolled up carefully with ink, and the plate having been warmed, is cooled, and then coated with thick gum, which must be dried by fanning, or in some other method which will prevent the gum cracking. The plate is then washed under the tap so as to remove the gum from the ink, but not from the surface of the plate, which is then inked up again; that is, to a certain extent, the crucial operation in the whole series of processes. The rolling-up with ink being accomplished, touching up is done by an artist workman, and the plate is then ready for the first acid bath, which is a rocking tray containing a weak solution of nitric acid. The operations of washing, gumming, rolling with ink, &c., are repeated several times, until the etching of the zinc has proceeded far enough, and the plate is ready for testing. It will be seen that there is plenty of opportunity for the introduction of skill and "brains," and as much remains to be achieved, with a certainty of ample reward when it is accomplished, Mr. Wilkinson's little work may be found very useful by many. The second part deals with photo-lithography in line and in half-tone, and here again it is in the latter branch that improvement is required. An appendix which occupies more than one-third of the book contains a number of general hints and extracts from technical serials; but the practical directions given by Mr. Wilkinson will be sufficient for the worker who understands how to "try, try, try again." In a new edition it will be advisable to give specimens of the work produced by the different processes.

Short Lectures to Electrical Artisans. By J. A. Fleming, M.A., D.Sc. London: E. and F. N. Spon.

This volume differs from all the text-books which treat of electricity and magnetism, and for that reason, probably, will be welcomed by the large class who, already acquainted with the workshop rules and details, will be glad to learn something of the principles on which they are based. The work consists of nine lectures, which were delivered at the request of Mr. R. E. B. Crompton to the pupils and workmen associated with his firm, in order that they might comprehend the why and the wherefore of the practices of the shop. We think Prof. Fleming has done well to publish these lectures; for while they will interest the student who knows nothing about the subject, the workman who is acquainted with the practical details of electrical engineering will find in them just the information that he often requires. They are freely illustrated with diagrams which, as a rule, relate to apparatus actually in use, and consequently better comprehended by those engaged in the construction of machines or in arranging the circuits. An index renders the subjects easy of reference, and completes a very useful work.

Money-making Men; or, How to Grow Rich. By J. Ewing Ritchie. London: Brain and Co.

Full of anecdotes of men who have grown rich by their perseverance and industry, as well as by their luck, as Mr. Ritchie would put it, this work should find many interested readers, especially amongst the young. The first two chapters, comprising some 60 pages, are entitled "In the City," and "Across the Atlantic," and contain brief sketches of the careers of many well-remembered names of millionaires, including the most illustrious—George Peabody—whose portrait is selected as a frontispiece. Charles Bianconi, the Irish carman, has a chapter to himself, as has "George Moore, citizen and philanthropist"; there is a curious autobiography of a vegetarian, and a chapter on "A Fortune Made by Teetotalism"; "Money-making Publishers" is a heading many literary men would expect to see. In "Money-making Men in the Provinces" we have a brief note of Benjamin Attwood, who used to leave £1,000 notes at hospitals and ask merely for an acknowledgement in the *Times;* a short account of the career of Arkwright, a more lengthy one of Fairbairn, and Dickens's account of how Salt took up alpaca wool. Mr. Ritchie gives us some account of men who have made money in an "eccentric" fashion, and has produced a very readable book which may be placed in the hands of the young for their advantage and that of others.

Practical Guide to Photography. By Marion and Co. London: Marion and Co.

This is a new edition, revised and enlarged, of a guide to photography which has deservedly obtained a wide popularity, for in the twenty-six chapters of which it consists the reader will find full practical directions for pursuing the art of picture-making by the aid of the camera, and also the theory on which the processes are based. The optical branch of the subject is fully explained with the aid of engravings, so that the beginner can at least choose his apparatus with some definite knowledge, although he may find it difficult to make up his mind, his desires being constrained by the state of his pocket. The work is freely illustrated, and may be confidently recommended to all who desire to learn the art of photography.

Beginner's Guide to Photography. By A Fellow of the Chemical Society. London: Lejeune and Perken.

This is an elementary work, which, as its title implies, is adapted to the wants of beginners. It is not unlikely that many of those who purchase it and study it thoroughly will not require the aid of more expensive manuals, for it contains all that is really necessary to know, and it will assist the beginner in selecting the apparatus. The chapter on Exposure, by Mr. A. S. Platts, will be found serviceable by beginners, as it contains useful tables and simple directions, which, with a little practice, will enable the amateur to successfully master the difficult matter of exposure.

Circular Work in Carpentry and Joinery. By George Collings. London: Crosby Lockwood and Co.

Many carpenters and joiners who are masters of their trade while it is confined to what is known as straight work often find themselves puzzled when engaged in shaping pieces of wood which involve single or double curves. A man may go through an apprenticeship, and even pass several years as a journeyman, without meeting with a job in curved work which calls for the exercise of more than rule of thumb; but, nevertheless, the skilled workman will not consider himself master of his trade unless he knows how by rule to set out any possible piece that may be demanded. The accurate execution of curved work invariably demands the aid of geometry for finding the different moulds, and many young carpenters and joiners in this country and the colonies will thank Mr. Collings for this book, in which all kinds of circular and curved work are clearly set out with the aid of diagrams. The book is one of the excellent series which bears the name of Weale, and, almost as a matter of course, is as cheap as it is useful.

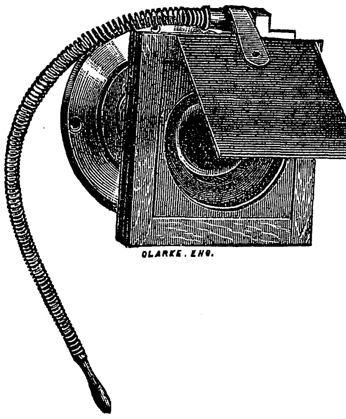
We have also received *The Engineman's Pocket Companion*, by Michael Reynolds (London: Crosby Lockwood and Co.), a work which contains a great deal of useful information for enginemen in charge of the different types.——*Burton's Modern Photography* (London: Piper and Carter) is a sixth and enlarged edition of a well-known work, in which the various processes are described with the most recent improvements.——*The Techno.-Chemical Receipt Book* (London: Sampson Low, Marston, Searle, and Rivington) is a collection of several thousand receipts, edited chiefly from German sources, with additions, by W. T. Brannt and W. H. Wahl. The volume contains nearly 500 pages of closely-printed matter, illustrated by 78 engravings, and will certainly be found useful by everybody.——*Analysis Tables for Chemical Students*, by R. L. Taylor (London: Sampson Low and Co.), and *Exercises on Mensuration*, by T. W. K. Start (London: Sampson Low and Co.), are low-priced little books for the use of junior students.——*Model Dwelling Houses*, by Sir James Gowans, is a little work which contains a description of the model tenement erected in the grounds of the Edinburgh Exhibition. —— *Designing Wrought and Cast-iron Structures*, by Henry Adams, M.Inst.C.E., &c. (London: 60, Queen Victoria-street) is Part II., containing notes, calculations, stress diagrams, and working drawings for a lattice-girder bridge between two warehouses, and gives just the information that the young draughtsman or engineer requires, because all the details of a practical piece of work are clearly set out.——*Walks in Epping Forest*, edited by Percy Lindley (London: 123—125, Fleet-street) is a new edition of this excellent little guide to the Forest, with some remarks on what

has been done since it came under the control of the Conservators.

We have also to acknowledge *Arc and Glow Lamps*, by JULIUS MAIER, Ph.D. (London: Whittaker and Co.); *The Life and Labours of John Mercer, F.R.S.*, by E. A. PARNELL (London: Longmans); and *Modern Steam Engines*, by JOSHUA ROSE (London: Sampson Low and Co.)—works which from their importance will receive a longer notice than we can give them here.

THE LEICESTER EXPOSING FLAP AND SHADE.

THE principal novelty introduced in this instrument, which is made by Messrs. T. S. and W. Taylor, Slate-street Works, Leicester, is the flexible shaft by which the flap is moved, and which possesses the following merits:—Its flexibility relieves the camera of direct movement from the operator's hand; it bears the stoppage and return of the flap, and prevents the "kick" which occurs with rapid shutters of the same class, through the stoppage being borne by the camera; it reduces all jerks and irregularities in the motion of the operator's wrist to a regular flowing motion of the flap.



A catch is arranged to keep it closed, until opened in the proper way by the shaft; it will be seen that the instrument may be used in any position, and that the flap forms a sky or side shade, under control of the operator; a sharp motion of the wrist gives an effective exposure of one-twelfth of a second, and anything from and above that amount may be easily obtained. One-twelfth of a second is as short an exposure as can be given with ordinary subjects, plates, and lenses; shorter times are only given under special circumstances. The instruments are to be obtained through all dealers. The size for an 8in. by 5in. lens occupies a space 3½in. by 3in. by ½in.

THE TOBACCO-GROWING EXPERIMENTS.

SUCH results as have been made known in connection with the experimental trials of tobacco-growing in the fields seem to show that so far as weight is concerned the experiments have been a success; but the more important points have still to be settled—whether the leaves can be properly cured, and what they will sell for when put upon the market, the latter depending entirely on the quality. More than a century ago tobacco was extensively grown in Yorkshire and other parts of this country, and it is still cultivated in Sweden, where, as an instance, it has been grown for fifty consecutive years on a few acres of land near Stockholm. There is, then, nothing in mere height of latitude to prevent the raising of crops of tobacco in this country—the question is, Will they be more profitable than other produce? We mentioned on page 3 the principal experimental plots; but for several reasons, that of the Messrs. Carter, at Plaistow, in Kent, is the most interesting. The first and most important reason is that the land on which the tobacco was grown is decidedly poor in quality—in fact, the only recommendation the plot has is that it is sheltered. But the object of all experimenters is not to prove that the plant will thrive on good land, but that it can be cultivated with success on a great variety of soils, and even on some which would scarcely carry a crop of anything else. The soil at Plaistow is a black sandy loam, which gets too much moisture at times, and for the experimental trials was dressed with farmyard manure and an alkaline compost. The young plants, in seventeen varieties, were set out on June 16 a yard apart, on the top of ridges, so that there would be just 4,840 plants to the acre. When set out, the plants had a height of about 3in., and careful measurements were made at intervals of the growth of the different varieties up to Sept. 18, when the crop was cut. The height of the plants at the end of the twelfth week ranged from 30in. to 46in., and the weight of green wilted plants from ¾lb. to 2lb. The gross weight of the crop from 3,846 plants was 5,163lb., or about 2¾ tons per acre, the weights being taken after the stems and leaves had been left for twenty-four hours on the field. Measurements of the leaves were made of all varieties, the dimensions ranging from the 20in. by 10½in. of the Havana to the 31½ in. by 16½in. of the Connecticut, figures which will give some idea of the appearance of plants of Nicotiana Tabacum, and N. macrophylla. As might be expected, some varieties ripen off before others, and it may be are too delicate for the climate; but it may also be found advantageous to grow them for that very reason, especially if it should turn out that their rich golden leaves are equal in quality to any tobacco grown. The varieties cultivated at Plaistow are divided broadly into two sorts—those, like Kentucky (one of the delicate varieties), having semi-erect pale green leaves, and those having pendent foliage like Big Frederick, a variety noted for leaves more "leathery" than the Kentucky type. A number of species of Nicotiana have been cultivated in this country simply as foliage plants, and it is not unlikely that if the business is taken up in earnest as a commercial crop, that varieties more suitable to the climate may be raised by the skill of the hybridist. It should be noticed that in Messrs. Carter's case the date of planting out is considered to be late, while the season has not been at all favourable. It is also not unlikely that it will be found more advantageous to have larger plants when the time arrives for setting out in the open ground, especially as it will cost little, if anything, more, as the seedlings must, it seems, be raised in heat, except in the more favoured parts of the country. The curing of the leaves is by far the more important part of tobacco growing, and it is mainly on the outcome of that branch of the experiment that the interest centres; for although tobacco is a crop requiring a good deal of care and attention, and therefore involving considerable expense, there is reason to believe that if the curing of the leaves can be carried out so as to obtain fine-flavoured tobaccos, the cultivation of N. Tabacum will pay.

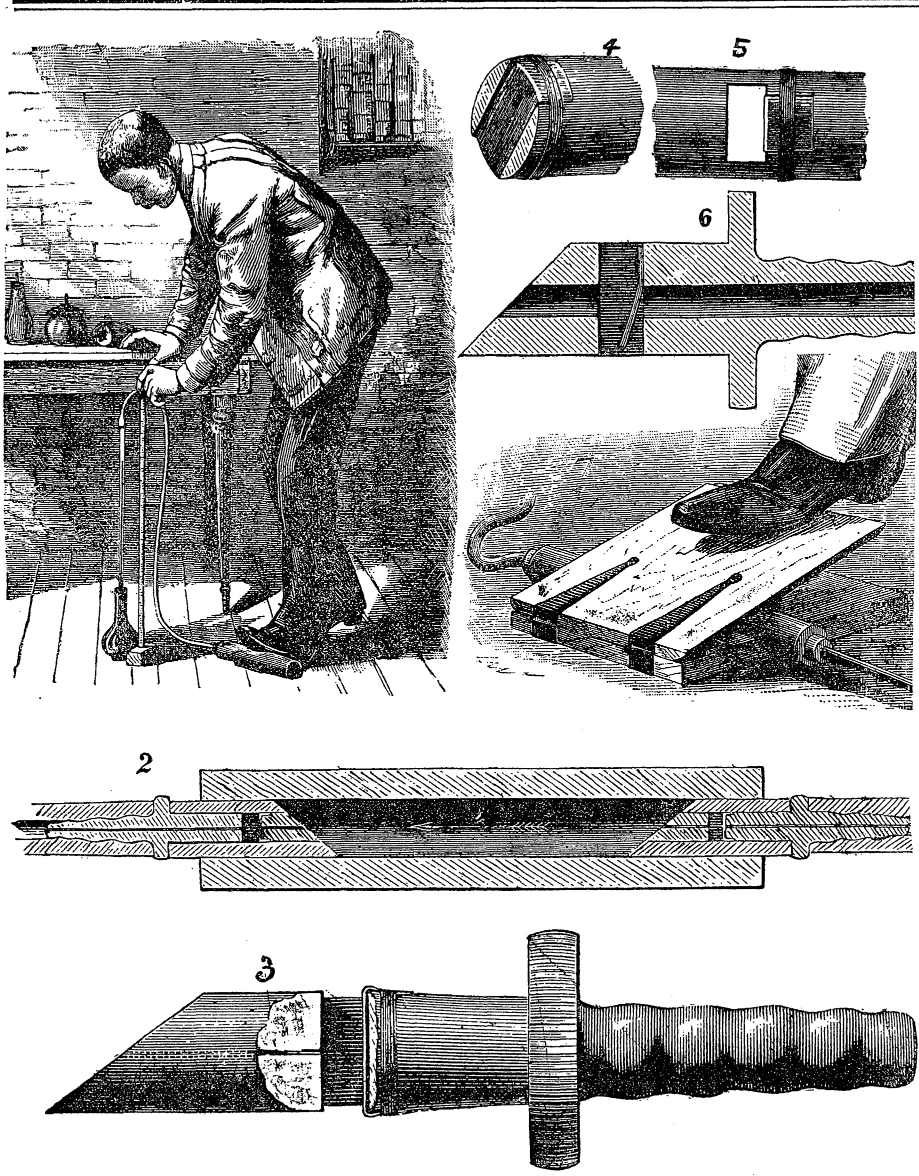
HOW LONG TO SLEEP.

IT is manifestly impossible to lay down any universally applicable rule as to the number of hours which it is desirable to sleep. Probably no two persons require precisely the same amount of slumber, and it is scarcely likely that any person needs the same length of sleep on all occasions. Even the most monotonous lives involve the expenditure of varying quantities of energy, and make differing demands on the stores of nerve and muscle power on several days. We do not, of course, mean to imply that sleep is *the* season of recuperation. That is unlikely in view of the ascertained facts in relation to tissue-feeding and physiological change; but it is nevertheless true in practice that prolonged or exceptionally severe exertion, whether of brain or muscle, requires a correspondingly lengthy or deep repose. Speaking broadly, sleep is the state in which the fires are, so to say, damped down, and the machinery has opportunity for cooling. The bow is, as it were, unstrung, and may recover its elasticity during the recurring periods of slumber. The great point is to secure what Bichât characterised as general sleep made up of particular sleeps. The whole body should be rested—so far as any avoidable demand on its energy is concerned—during sleep. The Irishman, who explained that a short sleep did for him because when he slept he "paid attintion to 't," uttered a truth in his witticism. If sleep be thorough, then a short spell will do more good than a much longer duration of sleep that is incomplete and imperfect, both in its nature and in its effects. We cannot discuss the physiology of sleep in this place; but two or three propositions, based on experience and observation, may be briefly set down by way of suggestion worth thinking out for special application in individual cases. Sleep is a distinctly natural function, and, therefore, both as regards its induction and management, ought to be performed in conformity with natural laws. That it is a state which should recur periodically is evident from the rotation of day and night, and approximately we ought to go to sleep when the natural light fails and wake with the sunrise. It will, therefore, be evident that Nature meant us to sleep longer in the winter than in the summer, for the sufficiently plain reason that the maintenance of animal heat during the cold season necessarily requires a larger consumption of energy than is expended on this vital purpose in the warm season. It has been alleged that the organism takes in and stores just as much oxygen during sleep as it has expended during the waking hours, and when the reserves are replenished wakes; but this is only a half-truth, in so far as it is a truth at all. What happens is rather a rest from the rapid movements of waking life, during which the slower activities of function have time to overtake the faster ones. Recuperation by nutrition is a more tardy process than consumption by work and heat production, and if the hare were not to sleep the tortoise would be left hopelessly behind. It is essential to health that the tortoise should not lag far in the rear, and sleep must be just as long as will enable the laggard nutritive processes to overtake the impetuous destructive processes. Practically, therefore, a man should sleep until he is refreshed. The mistake many persons make is in attempting to govern what must be a matter of instinct by volitional control. When we are weary we ought to sleep, and when we wake we should get up. There are no more vicious habits than adopting measures to "keep awake" or employing artifices, or, still worse, resorting to drugs and other devices to induce or prolong sleep. Dozing is the very demoralisation of the sleep function, and from this pernicious habit arises much of the so-called sleeplessness—more accurately wakefulness—from which multitudes suffer. That day is not the time for sleep is evident upon the face of the fact that Nature has provided the night, wherein no man can or ought to work. Instead of trying to lay down arbitrary rules as to the length of sleep, it would be wiser in a common-sense and physiological way to say, Work while it is day; sleep when you are weary, which will be at night if the day has been spent in honest and energetic labour. When you wake, rise; and if the day's work has been sufficiently well done, the time of waking will not be earlier than sunrise. The difficulties about sleep and sleeplessness—apart from dreams—are almost uniformly fruits of a perverse refusal to comply with the laws of nature. Take, for example, the case of a man who cannot sleep at night, or rather who, having fallen asleep, wakes. If he is what is called strong-minded, he thinks, or perhaps reads, and falls asleep again. This being repeated lays the foundation of a habit of waking in the night and thinking or reading to induce sleep. Before long the thinking or reading fails to induce sleep, and habitual sleeplessness occurs, for which remedies are sought and mischief is done. If the wakeful man would only rouse himself on waking, and get up and do a full day's work, of any sort, and not dose during the day, when next the night came round his sixteen or twenty hours of wakefulness would be rewarded by a sleep of nine or ten hours in length; and one or two of these manful struggles against a perverted tendency to abnormal habit would rectify the error and avert the calamity. The cure for sleeplessness must be natural, because sleep in a state of natural rhythmical function. You cannot tamper with the striking movement of a clock without injuring it, and you cannot tamper with orderly recurrence of sleep without impairing the very constitution of things on which the orderly performance of the function depends.—*Lancet.*

AN INEXPENSIVE AIR-PUMP.*

A BRASS air-pump gleaming with polished and lacquered surfaces, mounted on the conventional mahogany base, and furnished with accessories for convenient experimentation, is desirable and useful, beside being ornamental; but how many of those interested in the study of pneumatics have free access to such a machine, or, indeed, any other apparatus which will enable them to investigate practically and individually the interesting phenomena of the air and gases? It may be safely said that the number is comparatively small. The engraving illustrates an

* By GEORGE M. HOPKINS, in the *Scientific American.*



2, Longitudinal section of simple air pump; 3, valve casing partly in section; 4, transverse section showing valve in perspective; 5, plan view of valve.

efficient air-pump for both exhaustion and compression, which may be made from materials costing one dollar and fifty cents, and with the expenditure of not more than two or three hours' labour. With this pump, the entire range of ordinary vacuum and plenum experiments may readily be performed by the aid of a few well-known and inexpensive articles, such as lamp chimneys, fish globes, a tumbler or so, and pieces of sheet rubber, bladders, &c. Fig. 1 illustrates the manner of using the lamp. Figs. 2 to 5 inclusive are sectional views of the pump and valves. Fig. 6 shows a form of valve for the compression pump, and Fig. 7 shows the application of a foot pedal to the pump.

The materials required are as follows:—A piece of so-called pure rubber tubing $1\frac{3}{4}$in. external diameter, 1in. internal diameter, and 9in. long; a piece of pure rubber tubing 1in. external diameter, $\frac{5}{8}$in. internal diameter, and 5in. long; a piece of heavy pure rubber tubing $\frac{5}{8}$in. external diameter, and 4ft. long; two wooden valve casings (shown in Fig. 2); a strip of the best oil silk, $\frac{3}{8}$in. wide and 8in. or 10in. long, and some stout thread.

The piece of 1in. rubber tube is cut diagonally at an angle of about 30°, so as to divide it into two similar pieces. The wooden valve casing is pierced longitudinally with a $\frac{1}{16}$in. hole and transversely with a hole $\frac{1}{2}$in. square and thoroughly shellacked or soaked in melted paraffin to render it impervious to air. The longitudinal hole is cleared out, and the walls of the square transverse holes are smoothed. One of the walls of the square hole into which the $\frac{1}{16}$ hole enters forms one valve seat, and the other forms the other valve seat. The valves each consist of two thicknesses of the oiled silk strip stretched loosely over the valve seat, and secured by the thread wound around the wooden valve casing. It will, of course, be understood that when the valve casings are placed in the 1in. rubber tubing, and the 1in. tubes are placed in the ends of the larger tube, as shown in Fig. 2, the valves must both be capable of opening in the same direction, so that the air may pass through the pump, as indicated by the arrow, entering by one valve and escaping by the other.

The pieces of rubber tube inclose the valve casings, so that each valve has a little air-tight chamber of its own to work in. The bevelled ends of the rubber tube are arranged as shown in the engraving, and the inner ends of the wooden valve casings are bevelled to correspond, so that when the large rubber tube is placed on the floor and pressed by the foot there will be very little air space left in the pump. The 4ft. rubber tube is attached to one end of the pump for vacuum experiments, and to the opposite end for plenum experiments. To avoid any possibility of the sticking of the valves, the valve seats are rubbed over with a very soft lead pencil, thus imparting to them a slight coating of plumbago, to which the oiled silk will not adhere. As an elastic rubber pump barrel of the kind described requires considerable pressure of the foot to insure the successful operation of the pump, it is advisable to construct a treadle like that shown in Fig. 7. It consists of two short boards hinged together, the lower one having a shallow groove for the reception of the middle part of the pump. The edges of the upper board are bevelled at about the same angle as the ends of $1\frac{1}{4}$in. rubber tube. The width of the hinged boards should be somewhat less than the length of the chamber in the pump. A mark is made on the side of the larger tube at one end to indicate the top, the proper position for the pump being that shown in Fig. 2.

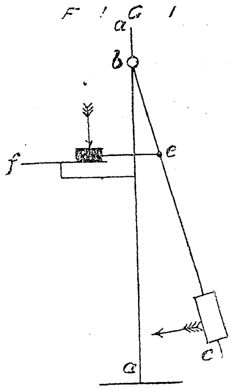
The pressure of the foot on the side of the pump barrel expels the air through the discharge valve, and when the barrel is released, its own elasticity causes it to expand, and while regaining its normal shape it draws the air from any vessel communicating with the suction valve.

A vacuum sufficient for most of the ordinary experimental work may be produced by means of this pump in a short time. A gauge may be improvised by attaching the suction pipe to a piece of barometer tube about 30in. long, and dipping the end of the tube in mercury, using a yard measure as a scale, as shown in Fig. 1. The pump will be found to compare favourably with piston pumps. When it is desired to construct a pump of this kind for compressing air or for a low vacuum, the elastic tube forming the pump barrel may be larger and thinner, and the hole through the wooden valve casing may be made larger, as shown in Fig. 6, and the oiled silk valve may be replaced by a simple rubber flap valve, held in place by a single tack.

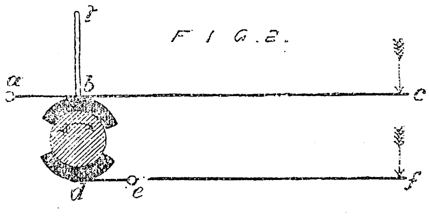
RECENT RESEARCHES ON FRICTION AND THE ACTION OF LUBRICANTS.*

By PROF. HELE-SHAW.

THE engineer has to deal with friction from two opposite points of view. On the one hand he has to employ the useful, and on the other to obviate the prejudicial resistances to which it gives rise. It would, perhaps, be difficult to say which is the more important problem of the two; but, taken together, they form a subject which is second in importance to no other. The nature and laws of friction have been the subject of scientific investigation since the end of the 17th century, when Amontons published his researches; but it is to Coulomb that we owe the first definite statement of the laws of sliding and rolling friction, the general truth of which was established by the experiments of General Morin, between the years of



1830 and 1834. These laws, which are remarkably simple and convenient of application, and which it has been the practice of various writers to state as universally true, have thus not unnaturally been employed until quite recently by practical men, as near approximations to the truth, for all cases and under all circumstances. The above experiments, although very numerous, were, however, made under a limited range of conditions, Morin himself never asserting that the truth of the laws established by them held beyond this range. The extensive investigation which has taken place during the last ten years, not only in connection



with the friction of solid bodies, but concerning that of fluids, has made evident the existence of much more complex laws of friction. We are still far from having arrived at any state of finality in our knowledge as to the nature of friction, and, in truth, such is the vast range of the subject that it is no easy matter to obtain a general grasp of the whole, which will be found to include all the most important questions in what we know as physical science. The literature of the entire subject is not yet published in any one book, and, with the exception of a few treatises on separate portions, is only to be found in the form of papers and articles in scientific periodicals and journals. It is not to be expected that even an abstract of it can be given within the brief limits of a paper like the present one, the object of which is to bring before the members of this society some of the results of recent experimental work which most directly concerns engineers, omitting all reference to the friction of liquids (acting otherwise than as lubri-

* A paper read before the Liverpool Engineering Society

cants), and also to the friction or viscosity of gases.

The laws of the friction of solid bodies enunciated by Coulomb are expressed thus:—

For sliding or lower pairing:

Resistance of friction $= F = \mu R$.

For lower or higher pairing:

Resistance of friction $= F = \mu \frac{R}{r}$

Where R = the pressure between the surfaces in contact.

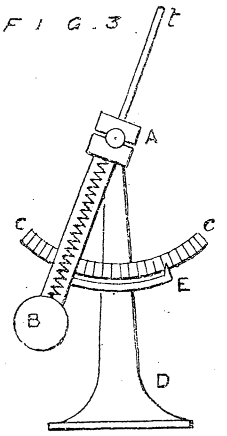
r = radius of the rolling body.

μ = a quantity, called the co-efficient of friction, depending on the nature of the surfaces in contact.

These laws leave nothing to be desired in point of simplicity; but this simplicity is attained by the sacrifice of exact truth, even when the surfaces are dry. When lubricants are used, Morin found these laws to approximately hold for a limited range of conditions; but when the range is extended so as to embrace modern conditions of working they utterly fail, and must be replaced by others of quite a different form. Thus the influences of change of velocity and change of temperature, of which the law takes no account, and of which the resistance of friction is supposed therefore to be independent, are in reality very important factors, while the statement that for any given material the resistance varies directly as the pressure—that is, $\frac{F}{R} = \mu =$ a constant—is, as will be seen, quite erroneous. It is not easy to consider the effects of frictional resistance due to these four conditions at once, and thus they will be dealt with separately in the following order:—

1. The effect of the nature of substances in contact.
2. The variation of effect with variation of pressure.
3. The effect of change of relative velocity of the surfaces.
4. The effect of change of temperature.

FIG. 3.



This separate mode of treatment, which, although convenient, cannot, from the difficulty of dissociating the effect of the various conditions, be in any case rigidly adhered to, will only be applied to the case of sliding or lower pairing. Afterwards the nature of rolling friction, or the friction of higher pairing, will be briefly considered.

I. *The effect of the nature of materials in contact.*—This part of the subject, which may be said to be the most important of all questions, was long ago sufficiently examined for dry surfaces under ordinary conditions by Morin, and the results are well known; but for the important conditions to which the dry surfaces of brake block are subject, Morin's results are quite inapplicable. Captain Galton, in his experiments on the effect of railway brakes (*Proc. Inst. Mechanical Engineers*, April, 1879, p. 174), found the co-efficient of friction was affected both by the material in the brake blocks and by the state of the weather. On dry rails the co-efficient of friction was generally above ·2; but in some cases it was as much as ·25, and sometimes even higher. On wet or greasy rails on which no sand was used it had an average value, for 300 experiments, of ·18, but in one case was only ·15. With sand on wet rails it was always above ·2; but when sand was used at starting, and was therefore not carried off by the wind of the rotating wheels, it was as much as ·35 and even ·4. For lubricated surfaces and lubricants there have been great recent advances in our knowledge. Surfaces may be lubricated with either solid or fluid lubricants. The chief solid lubricants are graphite or black lead, asbestos, and soapstone. Of these graphite is the most important, and though it has been employed for the purpose in question for more than 200 years, it is only of late that its proper mode of preparation has been understood, and its use consequently much extended. It must be free from grit, and in order to attain this end it is floated in water, and treated with a bath of dilute sulphuric acid. The particles of iron and spar are thus removed, and the remaining impurities can be washed out. Asbestos, which has become an article of great importance, as packing for steam engines, is a mineral substance found most plentifully in Savoy and Corsica. It has a fibrous texture which undergoes little alteration by heat, and though known to have been woven by the ancients into cloth, its extensive and quite modern application, when used as packing, has resulted, to a great extent, from its lubricating qualities. Asbestos, it is true, is almost invariably employed in conjunction with some fluid lubricant; but its nature is such as to considerably reduce the friction. Soapstone, which is a silicate of magnesia and alumina, is now prepared somewhat in the same manner as graphite, being used sometimes as a powder, but more generally mixed with a rather larger quantity of oil or grease. In the preparation, choice, and examination of fluid lubricants great progress has been made. With regard to the first two matters, little can here be said; but it may be remarked that the special qualities of the three main classes of oils—viz., animal, vegetable, and mineral—are now understood, their special adaptation to particular purposes known, and the advantage to be derived from their mixture realised. An undoubted authority on the subject says: "Bearing in mind the natural and almost ineradicable tendency of animal oils to develop acid, and of vegetable oils by absorption of oxygen to gum and clog bearings, and to induce spontaneous combustion; bearing in mind that mineral oils can now be obtained in every respect as safe as the finest animal oils, and that the admixture of mineral oil with animal or vegetable oil neutralises the acidity in the one case, and the acidity and oxidising tendency in the other, I am of opinion that the safest, most efficient, and most economical lubricants for all manner of bearings are to be produced by judicious mixtures of animal or vegetable with good mineral oils." The examination or testing to which oils are subjected are of three kinds—chemical, physical, and mechanical. There are, of course, the time-honoured tests by the senses of touch, taste, and smell; but of these, though valuable to the experts, nothing need be said. The chemical tests are chiefly for the purpose of detecting adulteration and measuring acidity and actions upon metals. Various chemists, amongst whom are Calvert, Cailletet, Chateau, Wallace, Waltz, and others, have investigated the subject of the reactions of various oils, and an abstract of the principal results has been given by Prof. Thurston. It may be necessary to ascertain what an oil or lubricant actually is; but it is much more frequently required to know whether it is pure or not, and the work of the above-mentioned chemists and others has resulted, not only in a knowledge of facts, such, for instance, as that chlorine turns animal oils brown and vegetable oils white, but also in certain systematic methods of test. The first step is to place the lubricant in one or other of certain defined classes, next, by other tests, to place it in its proper sub-divisions, and finally to analyse it with a view to the determination of its constituent parts. It must be remembered that by far the greater proportion of lubricating oils are ostensibly mixtures; vendors of such oils holding (as, for instance, Mr. Veitch Wilson, in the paragraph previously quoted) that such mixtures produce the best results. Thus chemical tests, though sometimes employed for examining the actions of lubricants on metals, chiefly tell what the lubricant *is*, and are of little practical importance compared with physical and mechanical tests, which tell what the lubricant *does*. The chief physical tests are the determination of (1) density, (2) the effect of heat, (3) the gumming and drying properties of a lubricant. 1. The density or specific gravity of an oil is sometimes an important matter, as there is a considerable difference between various oils; but the determination is easily affected by ordinary methods. 2. The effect of heat on the nature of a lubricant must not be confounded with the effect of rise of temperature on frictional resistance. The application of heat is important rather in connection with mineral oils which vaporise, and compounds into which mineral oils largely enter, than with animal and vegetable oils which thicken and decompose. There are two points for consideration in connection with the former class of oils, one being the amount of evaporation taking place at temperatures not exceeding the boiling point of water, the other the actual point at which the ignition of the vapour given off takes place. Mr. Wilson in his paper states that, though many oils, considered good, lost 5 per cent., and one or two samples 10 per cent., in a 10-hours' test at 212° F., yet, on the other hand, many oils lost nothing at all. The second point is, however, much more important, and there are strong reasons for attributing several recent conflagrations and consequent destruction of mills to the ignition of the lubricants used in them. The "fire test" thus becomes an important one. There are several pieces of apparatus for the purpose, the principle of them all being simply to heat the oil until the vapour given off ignites on the application of a light, the temperature of ignition, or "flash point," being observed by means of a thermometer. The neatest instrument for the purpose is that of Bailey, in which the oil is heated in a copper vessel about three-quarters full, the vapour from which, issuing laterally, comes in contact with the flame of the heating lamp or Bunsen burner. This is a more satisfactory arrangement than the application at intervals of a light to the orifice. There are many oils which flash at 180° F., some at 150° F.; but an oil should never be used for lubricating purposes which flashes at a point below 250° F., some of the best mineral oils vapouring at 600° F. 3. The gumming and drying properties of oils may be simply tested by allowing samples to flow down an inclined plane, when the nature of the oil becomes manifest; sometimes, if a bad specimen, after an hour or two, and sometimes after a day or so, the best oils remaining liquid, and continuing to flow down even after several days. This is the mode in which the Swiss watch oils are tested. Mr. Bailey has contrived, for this purpose, a convenient arrangement, consisting of a box filled with water, and, having an inclined sheet-glass top, the water is kept at 200° F., and the behaviour of a given small quantity of oil placed on the surface of the glass is noted. There are other modes of physical tests, but not of sufficient practical importance to demand consideration.

(*To be continued.*)

THE NEW APOCHROMATIC MICRO-OBJECTIVES AND COMPENSATING OCULARS OF CARL ZEISS IN JENA.*

Dr. Carl Zeiss has had the kindness to send me four of his new apochromatic objectives, and three of his new compensating eyepieces for inspection, and as a short notice of only one of these objectives has to my knowledge appeared in this country—viz., in the *Journal* of the R. M. S., Vol. VI., part 2, fol. 375-6, I trust that the following remarks, culled chiefly from Dr. Abbe's pamphlet, "Ueber Verbesserungen des Mikroskopes mit Hilfe neuer Arten optischen Glases" (on improvements in the microscope by the aid of new kinds of optical glasses), may be acceptable to the members of our society.

Professor Dr. Ernest Abbe, who is "the first living authority on microscopical optics," and to whom we are indebted not only for the greatest recent improvements in the construction of micro-objectives, but also for the theory of the formation of microscopical images by diffraction spectra, and for lucid mathematical expressions of the relation of aperture, resolving power, focal depth, &c., &c., finding that the aperture of micro-objectives had been pushed to almost its theoretical limit, and foreseeing no adequate advantages in trying to increase the aperture with the means hitherto at our command, directed his attention to further improvements by an entirely different method.

In conjunction with Dr. Carl Zeiss, the eminent optician of Jena, and with the assistance of Dr. Schott, Dr. Abbe began in 1881 to make experiments with the view of producing new kinds of optical glasses.

The relation of the optical properties to the chemical compositions of various kinds of experimentally produced glasses was first established by spectroscopical researches, and finally such glasses were produced as possessed the properties most desired. In this way, and by combining a far larger number of elements than formerly, especially by means of phosphoric and boric acids, besides silicic acid, two new and much desired results have been attained—viz:

(1) The production of crown and flint glass in which the dispersion for the different regions of the spectrum shows approximately the same ratio, and which, therefore, in achromatic combinations permits of the almost complete elimination of the secondary spectrum.

(2) The increase of the number of optical media in such a way that with the same mean refractive index the dispersion, or with the same dispersion the refractive index, may be varied within considerable limits, especially so that high values of the refractive index can be obtained, not as hitherto only in combination with flint glass of high dispersion, but also with lower dispersive indices as in crown glass.

These new kinds of optical glasses are produced in the Glastechnisches Laboratorium, in Jena, which has been supported in the most liberal manner by the Prussian Ministry of Public Instruction, and they are now being supplied to the trade.

Mr. Carl Zeiss, who constructs all his lenses on strictly scientific principles, and according to the

* Read by Adolf Schulze before the Natural History Society of Glasgow, Tuesday, 28th September, 1886.

formulas of Professor Abbe, is the first optician who has produced micro-objectives of these new glasses, and he has thus been able to correct two important defects which up to now could not be overcome with the means at the disposal of opticians and which offered insurmountable obstacles to the further improvements in lenses. In consequence, namely, of the great disproportion of the dispersion of the various colours of the spectrum, a property inherent in crown and flint glass, our best so-called achromatic lenses have up to now been corrected for only two colours of the spectrum, and the hitherto unavoidable remnant of unachromatism, the so-called secondary spectrum, was always more or less perceptible. With the crown and flint glass used by opticians it was equally impossible to correct the spherical aberration for more than one colour. All objectives, although fairly well corrected for the middle of the spectrum, showed, nevertheless, a spherical under-correction for the red and a spherical over-correction for the blue and violet rays, which imperfection appeared as a more or less great inequality of the achromatic correction between the central portion and the peripheral zones of the objectives.

These defects caused an imperfect combination of the image-forming rays, and as a result objectives, especially those of large apertures, did not allow the employment of high magnifying oculars, because those deficiencies of spherical and achromatic corrections became more apparent with them than with the lower magnifying ones.

The practical advantages of Abbe's new objectives made by Carl Zeiss from the new optical glasses are the following:—

(1) The full value of the large apertures of objectives becomes now only apparent, because owing to their perfect corrections, the images formed by the new dry and water immersion objectives are scarcely distinguishable from those formed respectively by the water and homogeneous immersion objectives of perceptibly larger numerical aperture hitherto constructed.

(2) The largest magnifications for a certain aperture can be obtained by high eyepiecing and by objectives of relatively long foci, thus obviating the necessity for objectives of extreme short focal lengths.

(3) By the correction of the secondary spectrum and the perfect spherical correction of these new lenses, the visual and actinic foci coincide, rendering them especially suitable for photo-micrography.

(4) The increased spherical and achromatic corrections of these objectives produce a larger concentration of light in the images projected by them.

Dr. Abbe calls these new lenses *Apochromatics* or *Apochromatic Objectives*, owing to their superior spherical and achromatic corrections, which represent an achromatism of a higher order than hitherto attained.

These apochromatic objectives require special eyepieces in order to utilise their capabilities to the fullest extent, and Dr. Zeiss has constructed suitable eyepieces, and designates them *Compensating Oculars*.

In objectives of short focal length or in high powers the front lens is generally a single crown glass lens, which is, therefore, unachromatic, the result being coloured outlines of the image in the marginal zone, as the lens is only well corrected for its central portion. The front lenses of the high-power apochromatic objectives are evidently also single ones, and the so-called compensation oculars have been constructed with a view to correct this residue of peripheral aberration, and to balance or compensate the chromatic differences of magnification, as the picture produced by the blue and violet rays is larger than that produced by red and yellow rays. In order, therefore, to make the compensation oculars available not only for the high objectives but also for the lower ones, the latter had to be so constructed that the difference of the chromatic magnifications of the marginal zone should be practically the same as in the former. These compensation oculars differ from the ordinary Huyghenian and other eyepieces in this respect, that their eyelenses of even the strongest have relatively long foci, so that they can be used with almost as much comfort as the lower power oculars. The camera lucida can also be used with any of them save the highest, which magnifies 27 diam., and has 10mm. focal length. These are great recommendations, and the wonder is that opticians have not long since constructed high magnifying eyepieces with large eyelenses of such focal lengths that comfort is insured thereby and undue straining of the eyes avoided.

Instead of naming the different eyepieces A B C, &c., or 1 2 3, &c., as other opticians do, Mr. Zeiss designates the compensating oculars by their magnifying power; thus the eyepieces No. 1, 2, 4, 8, 12, 18, 27 magnify the image produced by the objective 1, 2, 4, 8, 12, 18, 27 times respectively. Both the magnifying power or number and the focal length are engraved on each eyepiece, so that when the magnifying power of an objective at the end of a tube 160mm. or 250mm. long is known, one can at once find the magnifying power of the microscope by multiplying the initial magnification of the objective by the number of the ocular with which it is combined.

The compensating eyepieces are divided into three classes—viz:

(1) *Search oculars* of great focal length. The one No. 1 constructed for the short or Continental tube does not magnify the initial magnification of the objective at all, and the two No. 2 magnify, both on the Continental and on the English tubes respectively, the image produced by the objective two diam. These objectives, as their name indicates, are intended to enable the observer to find rapidly an object in the field without employing another low-power objective, and perhaps a cumbersome nosepiece, which is so prejudicial to the centricity of the optical system and to the fine adjustment of the microscope. A great saving of time, labour, and annoyance can thus be effected by these low-power eyepieces, especially when using immersion lenses.

(2) *The ordinary working oculars*, magnifying respectively 4, 8, 12, 18, and 27 diam.; their focal lengths vary from 45 to 10mm. for the Continental stand, and from 67 to 10mm. on the English 10in. tube.

(3) *Oculars for projection*, magnifying 2 and 4 diam. for a tube of 160mm., and 3 and 6 diam. for a tube of 250mm. or 10in. long respectively. These oculars have two diaphragms each, to reduce the effective apertures of the high-power lenses should such be desirable.

They are constructed for photo-micrography and for the lantern microscope, and yield an evenly illuminated flat field and a well-defined image at any screen distance. They can also be used advantageously with the ordinary achromatic micro-objectives.

The mountings of these oculars are so arranged that the lower foci of all those belonging to one series are lying in the same plane, so that when interchanging them no new focussing of the objective is required, the optical tube length remaining the same.

I subjoin tables of Mr. Carl Zeiss' new apochromatic objectives showing their numerical apertures, equivalent focal lengths in millimètres, and their magnifications at 250mm. It will be seen from them that the whole series for both Continental and English tubes together consists of only 11 lenses, and that 3 dry, 1 water immersion, and 1 (or 2) homogeneous immersion lens, in all 5 apochromatic objectives, would constitute a complete series, and in conjunction with the new compensating eyepieces would do all the work for which hitherto often from one to two dozen objectives were required.

The homogeneous immersion lenses are constructed without screw-collars, and they require to be used with thickened cedar-wood oil, having a refractive index of 1·5128. In spite of their large apertures, they will work through covers of about $\frac{1}{100}$in. thickness.

The lenses kindly submitted to me for inspection are the following:—

	mm.		focus.		mm. aper.
Apochromatic objective	16	about	$\frac{4}{5}$in.	and	0·30
,, ,,	4	,,	$\frac{1}{7}$in.	,,	0·95
,, water immersion ,,	2·5	,,	$\frac{1}{10}$in.	,,	1·25
,, homog. ,, ,,	2	,,	$\frac{1}{12}$in.	,,	1·40

and they are undoubtedly the finest objectives which I have ever seen, leaving far behind in their performances many lenses which I have hitherto considered as almost unsurpassed. The pictures produced by these new lenses are remarkably achromatic and bright, and owing to the exquisite definition of these objectives structural details on surface markings come out with wonderful sharpness and distinctness. I am especially pleased with the lens of 4mm. focus and the homogeneous immersion lens of 2mm., which latter, owing to its enormous aperture and brilliant definition, resolves test objects, considered difficult, with the greatest ease. The facility with which high magnifications may be obtained without loss of definition, and without discomfort to the eyes from using high eyepieces, is most agreeable. I have no hesitation in saying that these apochromatic objectives are destined to supersede the present achromatic objectives, and that as Mr. Carl Zeiss offers his new optical glasses to the trade, and, with his usual liberality, places no restrictions, by patents or otherwise, on the making of these lenses, other opticians will soon enter into wholesome competition with him, with the result that apochromatic objectives will shortly be supplied by all good makers. Meanwhile, the high prices of the apochromatics are standing in the way of their general adoption, the lower powers costing almost double the price that our best English opticians charge for theirs, whilst the prices of homogeneous immersion lenses are, considering their great aperture, probably the same as those of our first English makers. Meanwhile, many microscopists, especially students, have to content themselves with a microscope stand and objectives of 1in. and a $\frac{1}{4}$in. focus, costing altogether not more than one of the new apochromatic 1in. objectives, and a good working instrument can be had nowadays at a very small cost. In conclusion, I express the hope that other optical apparatus besides the microscope will derive important benefits from the invention of these new optical glasses.

Tables referred to in this paper:—

APOCHROMATIC OBJECTIVES.

	Num. apert.	mm.	
Dry system.	*0·30	24·0	screen distances.
,,	0·30	16·0	,,
,,	*0·60	12·0	,,
,,	0·60	8·0	,,
,,	*0·95	6·0	,,
,,	0·95	4·0	,,
Water immersion	1·25	2·5	,,
Homog. ,,	1·30	3·0	,,
,,	1·30	2·0	,,
,,	1·40	3·0	,,
,,	1·40	2·0	,,

* These are manufactured only for the English tube.

Table of the magnifications of the apochromatic objectives and compensation oculars for 250mm. screen distance:—

Screen distance of the objective.	Search oculars.		Working oculars.				
	1	2	4	8	12	18	27
24·0		21	42	83	125	187	281
16·0	15·5	31	62	125	187	281	
12·0		42	83	167	250	375	562
8·0	31	62	125	250	375	562	
6·0		83	167	333	500	750	1125
4·0	62	125	250	500	750	1125	
3·0	83	167	333	667	1000	1500	
2·5	100	200	400	800	1200	1800	
2·0	125	250	500	1000	1500	2250	

A number of test objects, such as Amphipleura pellucida (half a dozen valves in one field showing all their crossmarkings most distinctly resolved) Navicula rhomboides, Surirella gemma, Pleurosigma angulatum, Heliopelta, Podura scales, &c., were exhibited under the new apochromatic lenses at the close of the meeting, and as a proof of the photographic excellence of these objectives, negatives of photo-micrographs of most of the above-mentioned, including Amphipleura pellucida, all taken by ordinary lamp light, were placed upon the table.

SOME LATHE WRINKLES.*

EVER since lathes have been used, there have been cases when the largest available lathe was too small for the work to be done upon it.

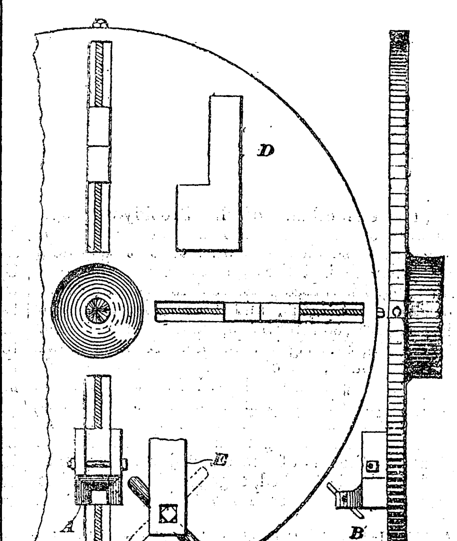


Fig. 1

Rigging up seems to be one of the principal parts of the jobbing machinist, and the more jigs and kinks available, the better off he is. The examples given below are from the production of O. C.

* By JAMES F. HOBART, in the *American Machinist*.

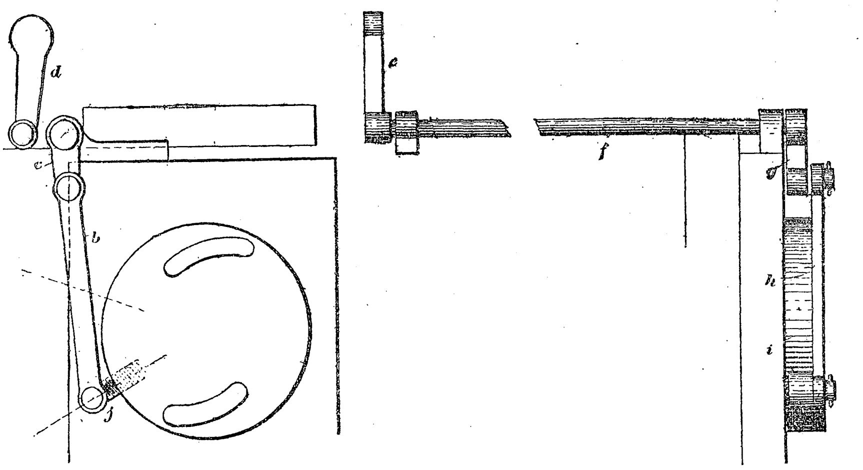


Fig. 2

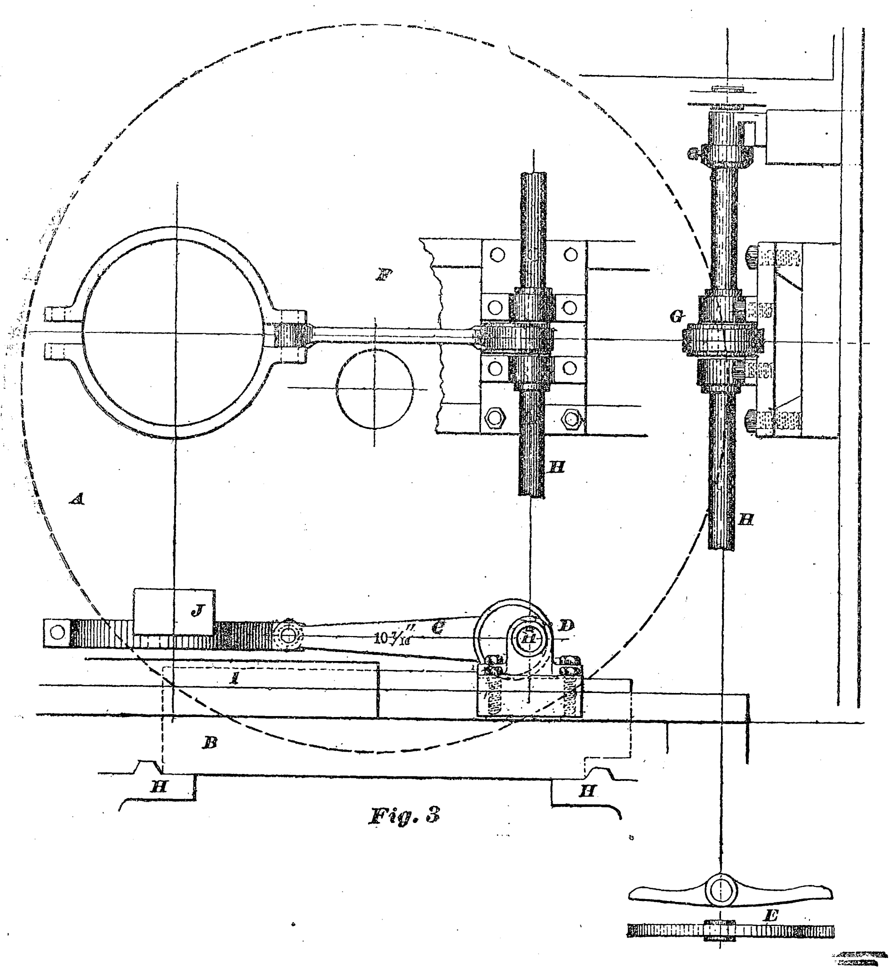


Fig. 3

Crane, master mechanic of the Brooklyn Bridge. Some of them are well known; the method of application is so clearly shown that it may help others when their lathes get too small for their work. Fig. 1 is a face-plate tool for turning work placed upon the lathe, and bolted thereto. For facing columns, counter boring, and facing cylinders and like jobs, this rig is valuable. At D is shown one of the four jaws of the independent chuck, which has a $\frac{5}{8}$in. hole drilled in it as shown. The rig shown at A and B is bolted to the jaw D, and the end of the rig is drilled for tools and a set screw as shown on a larger scale at E. At C a star is placed on the end of the chuck-jaw screw, and a pin F, in the lathe bed, engages the star and revolves one point at each revolution of the face plate.

A 32in. lathe in this shop has the nut-locking mechanism at the back side of the lathe, and to operate the nut, the lathe man must either lie down upon and reach across the lathe bed, or travel around it to the other side. To help this matter, the screw eye *j*, Fig 2, was tapped into the nut cam, and the rod *f* placed besides the cross slide on the rest is connected by crank *c* and rod *b* to bolt *j*. The crank *d*, as shown at *e*, serves to operate the nut from the front of the lathe, and proves a convenient time saver. Sometimes the rod *f* is in the way when work is being done close to the tail stock. In this case the rod may be quickly detached, and removed altogether.

Fig. 3 shows a rig for turning an eccentric shape in the lathe, or for turning but one side of a body. The tool nut J is disconnected from the cross-feed screw, and connected with the cam P by the lever C, the whole sliding easily upon the slotted rod H, which carries the clip E. This clip engages two pins upon face plate A, causing the rod H to make one part of a revolution, and moving the tool to and from the work. The cut shows so plainly the construction of this device, that further description is unnecessary.

An old drill press which had become so worn that $\frac{1}{8}$in. of lost motion presented itself in spindle connections, was "cured" by means of a forked lever attached to a loose collar just below the tight collar. This lever was weighted by means of a wire cable carried over two sheaves. The weight was just sufficient to overbalance the weight of spindle, allowing a hole with a $\frac{1}{10}$in. drill to be drilled through a piece of iron without the risk of the drills dropping suddenly through and breaking off.

PRACTICAL SUGGESTIONS ON BOOKBINDING.

AT the meeting of the Library Association of the United Kingdom, Mr. J. W. Zaehnsdorf read a paper entitled "Practical Suggestions on Bookbinding," in which he remarked that there was no doubt the strength of a bound book was like every other built-up fabric, and that was in the foundation; for if th foundation was good, the finished building would be firm, and he took it that the foundation of a bound book was in the binding. He passed over the pressing or rolling, because pressing only gave the book a better or firmer feel, and it had nothing to do with the strength. If they examined a book bound, say, 200 years ago, they would find the whole of the binder's craft in the sewing, thread being used made of hemp or flax. Each sheet was sewn round the bands, of which there were never less than four, in many cases six, eight, or many more. They would find even the head band worked round a cord which gave further strength to hold all together. If a book was now sewn with bad thread or three bad cords, it was considered to be very well done; and if the book fell to pieces in a short time it was nothing more than the bookbinder expected, and he got the book back to rebind for his benefit. Arnett, in the introduction to his "Art of Bookbinding," quoted one of the statutes and rules of 1750 about sewing: "That the master binders do sew all their books with thread and real bands, and that in case of infringement for each volume the sum of £30 be paid." (Cheers.) The importance of good sewing was not lost sight of by the binders of that date as it was by those of to-day. He would admit that the old paper was of a very different quality to that now used; but in times gone by the paper-maker manufactured a paper that enabled the binder to make the back of his book as firm as a wooden board, the paper being so fine and pliable that it laid down and gave little or no strain to the back. Binders did not get such paper to work upon now, for often it was so thick that it was impossible to get it to lie down flat under any treatment except that of "guarding." His first suggestion was that the books should be sewn with the best thread, for when bad thread was employed the book had to be re-bound. His second was that the books should be "sewn all along," if that were possible—that was to say, that each sheet should have a thread to itself. His third suggestion was that the books should be sewn flexible or on raised boards, if the value of the book warranted the spending of the extra sum. His fourth was that good boards should be used. He would further suggest a cloth joint for all books. The importance of good leather should not be overlooked. They must not be misled by some of the imitations now so often used. There was no leather which wore so well as morocco, but green should be avoided. He would not advise them to have anything to do with russia leather, as this had deteriorated. Within the last year or two pigskin had been manufactured expressly for binding, and this ran morocco very close, and perhaps for hard wear would prove to beat it. He suggested that all books in libraries should be tipped at the corners with vellum, and should be covered with cloth. Mr. Zaehnsdorf exhibited a sample of hemp-thread which ought to be used in sewing books, and also showed a fireproof box invented by himself for valuable books.

USEFUL AND SCIENTIFIC NOTES.

Allen's Gumming Machine.—A useful little gumming machine has been recently patented in this country by Mr. Allen, of the Allen Machine Company, Halifax. It is made in various sizes, but the most generally useful has a length of $8\frac{1}{2}$in., breadth $4\frac{1}{2}$in., height $4\frac{1}{2}$in., and a weight of $7\frac{1}{2}$lb., so that it is readily portable, while its chief merit is its cleanliness. The base of the machine forms the gum-well, through which the gumming cylinder revolves, being driven by a little crank handle which can be turned only in the proper direction. Toothed gear imparts motion to the feeding cylinder, which is covered in parts with rubber, and it is impossible for any gum to get on to the wrong side of the label. The amount of gum can be regulated from the thinnest film to the thickest coat desired, by a similar arrangement to that adopted for supplying ink to printing machines. One end of the feeding roller projects beyond the bearing, so that a machine which will gum labels $4\frac{1}{2}$in. wide may also be used for gumming edges. For speed, cleanliness, effectiveness, and economy of gum this machine leaves nothing to be desired. We understand it can be seen at Messrs. New and Co., 15, Devonshire Chambers, Bishopsgate-street, E.C. As there are few wearing parts, the machine will last a very long time, and rarely if ever need repairs.

MR. THOMAS ANDREWS has carried out a long series of tests on pieces of iron and steel submerged at the mouth of rivers, where the fresh water began to mix with the salt water of the ocean. The tests have proved that under these circumstances the corrosion is from 15 to 50 per cent. greater than when the article is submerged in pure ocean water. This increased action is attributed by Mr. Andrews to a galvanic action that is brought into play by the difference of potential caused by the mixture of the waters.

SCIENTIFIC NEWS.

BY the death of Mr. James Kennedy, who was born in Edinburgh in 1797, another link connecting the present with the past history of the locomotive is snapped. Mr. Kennedy, as manager to George Stephenson, made the plans for the first three locomotives employed on the Stockton and Darlington line; but he subsequently became a partner in the firm of Bury, Curtis, and Kennedy, designing amongst other locomotives the Dreadnought, which obtained some celebrity on the opening of the Manchester and Liverpool railway. Mr. Kennedy was the first to use the cranked-axle and horizontal cylinders, the Liverpool being the earliest example, and also the first case of a broken cranked-axle. Mr. Kennedy was afterwards engaged in iron shipbuilding and in the construction of marine engines, and was the first to use pressures so high as 60lb. in marine boilers. In 1860 Mr. Kennedy was elected President of the Institution of Mechanical Engineers.

The death is announced of Rear-Admiral Bedford Pim; an Arctic voyager who played an important part in the rescue of the crew of the *Investigator*, which, under Capt. McClure, had been ice-bound for three years. Lieut. Pim was under Capt. Kellett in the famous *Resolute*, and after an arduous sledge journey of twenty-eight days, reached the *Investigator* and rescued the crew. The deceased Admiral was only in his sixty-first year.

The death of Mr. William Muir, who for more than half a century has been engineer superintendent of the fleet of steamers owned and managed by Messrs. G. and J. Burns, removes from the world a man whose life was intimately connected with the growth of the marine engine. As an apprentice he saw the engines built for the *Dumbarton Castle* in 1814; he superintended the construction and equipment of those famous West Highland steamers so well known to tourists, and as a fitting crown to a remarkable career, he was responsible for the enormous engines of the *Umbria* and *Etruria*, the latest representatives of the Cunard line, every steamer in which was fitted with engines under the superintendence of Mr. Muir, who died recently in his native city, Glasgow, at the age of 81 years.

From Dun Echt Circular No. 125 we learn that Prof. Krueger has distributed a telegram announcing the discovery of a comet by Mr. W. H. Finlay, chief assistant at the Cape Observatory, on Sept. 26. The comet is described as circular, 1′ in diameter, not brighter than an 11th mag. star with some condensation, but no tail. The position was G.M.T. Sept 26, 8h. 0m. 49s.; R.A. 17h. 2m. 1·9s.; S. Dec. 26° 4′ 6″. Daily motion plus 2m. 20s., 4′ south.

The Rev. T. E. Espin, observer to the Liverpool Astronomical Society, says in Circular No. 10:—

A star was observed by Prof. Vogel and Dr. Müller on the night of Feb. 24, 1880, "Spectrum III. *a*, farbe röthlich gelb; geschätzt 9·2m.; fehlt bei Argelander." This star was looked for with the $17\frac{1}{4}$ equatoreal on the nights of Sept. 14 and Sept. 30, but not found. There is no star above 11·5 now in this place; it will probably turn out to be an interesting variable. The star's place for 1885 is R.A. IV. 21m. 25s.; N. Dec. 15° 50·7′; it lies 0m. 35s. *p.*, 0° 8′ N. of θ_1 Tauri.

A new observatory is being erected near the town of La Plata, under the direction of M. Beuf, an ex-officer of the French navy. The instrumental equipment will include a telescope of 31in. aperture, an "équatorial coudé" of 17in., a meridian instrument of 8·6in., a photographic apparatus of the same dimensions as that employed by MM. Henry at Paris, and a Thollon spectroscope with objective of 9·8in. aperture. M. Beuf will at first devote his principal attention to the carrying out of a geodetic survey of the province, including the measurement of an extensive meridian arc in the plains of Chaco and Patagonia.

The International Geodetic Conference will assemble in Berlin on the 20th inst. The chief business is a consideration of the best method of executing the resolutions arrived at in Rome and Washington respecting the actual measurement of a degree on the earth's surface, and in reference to a scientific survey of the European continent. The adoption of Greenwich as the prime meridian is to be insisted upon; but the introduction of international normal time will be postponed.

The Cryptogamic and Botanical meeting of the Essex Field Club will be held on the 15th and 16th inst., the headquarters being at Buckhurst Hill.

The annual report of the Secretary for Mines and Water Supply to the Minister of Mines for Victoria has been received, as has also the report on Mineral Statistics. These are useful works, for mining is carried on with a high degree of perfection in Australia. The Report on mines and water supply contains a number of sheets of drawings of parts of machines, &c., and a large sheet showing the plant of the Port Philip Co.'s Crushing Works, Clunes.

The University of Durham is about to try a novel scheme of University Extension. As in similar schemes, the lectures will be delivered in the evening; but unlike any other extension scheme, this provides that the lectures shall be the same, and be delivered by the same lecturers, as those given to students resident in Durham. Students having attended these evening lectures, and having passed an examination, may then obtain the degree of B.A., or the License in Theology, by one year's residence in Durham. Before being admitted to attend evening lectures, students are required to pass a preliminary examination equivalent to the matriculation. The experiment will first be tried in Sunderland.

A gas locomotive has been tried for several months in Melbourne, Victoria, on the street railways. The gas is carried in four copper containers, 16in. in diameter by 6ft. long, and is compressed to 150lb. on the sq. in. The contents represent about 280 cubic feet of gas at normal pressure, which is found sufficient for a run of fifteen miles. The locomotive weighs about $4\frac{1}{2}$ tons, and the carriage 35cwt.

The congress of the Amalgamated Society of Railway Servants was opened at the town hall, Brighton, on the 5th, when in the absence of the president, Mr. C. E. Stretton occupied the chair, and delivered the address, as well as a lecture in the evening. On the 6th inst. the meeting resumed at 2 p.m. at the Brighton railway station, where the examination and practical trials of the train fitted with the Westinghouse brake were carried out under the direction of Mr. Stretton.

The Baldwin Locomotive Works have nearly completed four Honigman locomotives, which are to be used on the Minneapolis, Lyndale, and Minnetonka railway. The boiler or furnace in these engines is charged with acetate of soda or caustic soda, as explained in No. 962, p. 598.

Herr Paul von Ritter some time back gave £15,000 to the Jena University, for the furtherance of scientific investigation on the basis of Darwin's theory. It has been decided to use half the interest of that sum in maintaining a "Ritter professorship of Philogeny," and the other half is to be expended in grants for scientific travel. Dr. Arnold Lang, formerly assistant to Prof. Haeckel, will be the first occupant of the chair.

At the meeting of the San Francisco Microscopical Society on Sept. 8th, the Secretary, Mr. A. H. Breckenfeld, exhibited specimens of "jasperised" wood from the petrified forest at Chalcedony Park, Arizona Territory. This material, by reason of its extreme hardness and great beauty, is beginning to be extensively used in the manufacture of jewellery and for various ornamental purposes. Under the microscope, the woody fibre, with its characteristic markings, is seen to be perfectly preserved. In fact, it is in many cases possible to determine not only the genus but even the species, by a microscopical examination. Some exceedingly minute "jumping seeds" from Calaveras county, California, each probably containing an insect larva, were shown by the President, and referred to Dr. Bates for further examination.

Dr. Junker, the African traveller as to whose fate considerable anxiety had been felt, has reached Msalala, on the southern shore of Lake Victoria Nyanza, in safety.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE LIVERPOOL ASTRONOMICAL SOCIETY — THE EXTENSION OF ASTRONOMICAL RESEARCH—STELLAR PHOTOGRAPHY AT HARVARD COLLEGE OBSERVATORY—PANCRATIC EYEPIECE—TWILIGHT—TIME—VISIBLE AREA OF THE HEAVENS—BAROMETER.

[26332.]—IT must gratify all who have the interests of amateur observational astronomy at heart to learn of the very marked recent success of the Liverpool Astronomical Society, for the membership of which, I am credibly informed, there are at present upwards of 60 new candidates. Following as this does so closely upon the resumption of office by those to whom the Society owes its origin, and under whose fostering care and judicious management it so rapidly developed during the early part of its career, it surely offers a tacit rebuke to the well-meaning gentlemen who temporarily supplanted them, and were so anxious to eliminate the cosmopolitan element from the Society, to circumscribe its sphere of usefulness, and to convert it into a small and strictly local association. Their success in this respect must of necessity have ruined it; in fact, it is a most instructive fact that, as I am told, scarcely six out of the 60 candidates at present up belong to Liverpool itself; and that of the overwhelming majority 35 are from various other parts of the United Kingdom, and no less than 22 from South America. Nor are the new members likely to be disappointed in their anticipation of the advantages to be derived from their connection with the Society, inasmuch as already its lending library has been got into order and a catalogue of it issued; and the *Journal* is, as appears from a prospectus before me, to be converted into a kind of epitome of astronomical news, in addition to the records of members' observations, which it will of course contain. May this valuable Society go on and prosper!

Under the title of "A Plan for the Extension of Astronomical Research," Prof. Pickering, of the Harvard College Observatory, has published a weighty pamphlet, the perusal of which may be commended to all who are anxious for the advancement of astronomical science. The great American astronomer begins by pointing out how much money has been wasted in the endowment of astronomy through a want of thought, or of a competent knowledge of the best means to be adopted to secure the end in view. "Striking instances," he says, "may be mentioned of observatories without proper instruments, large telescopes idle for want of observers, and able astronomers unprovided with the means of doing useful work." And he goes on to add (what may well be impressed upon our own executive when clamorous people demand the erection of "Solar Physical Observatories," and the like, at once as genteel sinecures and advertisements for themselves): "The establishment at a university or college of a new observatory, or the gift of a large telescope, is not in general an aid to astronomical progress." In illustration of the manner in which money might really be profitably devoted to the furtherance of astronomical knowledge, Prof. Pickering adduces the recent determination of the places of about 100,000 of the Northern stars, the joint work of fifteen observatories, which was begun nearly 20 years ago, and has continued ever since. Two American observatories participated in this great work, and one of them—that at Albany—has completed the observation and reduction of the stars which it undertook. The MS. is prepared, but no funds exist for its publication. 3,000 to 5,000 dollars would suffice for this purpose, but it is not forthcoming. Meanwhile the result of many years' labours might at any moment be destroyed by fire, and it is, of course, quite useless until it is published. So, in another way, the great Chicago telescope long lay idle and unused until that

altogether admirable observer, Mr. S. W. Burnham, devoted his evenings to it as an amateur, of course without the slightest remuneration. And again, the Observatory at Litchfield, U.S., spent 25 years in collecting the material for a series of star charts; and in despair of obtaining the funds to publish them, the director did so, "at his own expense, from the savings of a scanty salary." From these and cognate examples Prof. Pickering deduces the conclusion that what is needed just at present is a fund, to be employed in publishing memoirs, &c., too long to be included in astronomical periodicals, furnishing instruments to astronomers, and paying salaries of observers for large telescopes which would otherwise lie idle; and he suggests that such a fund might be most safely and advantageously intrusted to the Harvard College Observatory. I will not weaken the force of his arguments for this by any attempted condensation of them here, but will refer all interested in the matter (and what astronomer is not?) directly to the pamphlet itself.

Yet another work reaches us from Harvard, by its indefatigable director, under the title of "An Investigation in Stellar Photography, conducted at the Harvard College Observatory," which is replete with interest to all who know anything of celestial photography. It will not be forgotten that the first photograph of a star that was ever obtained was one of Vega, taken at Harvard on a daguerrotype plate (under Prof. Bond's direction) by Whipple, on July 17th, 1850; and seven years later we find Bond photographing Vega, ζ Ursæ Majoris, and ε Lyræ, and measuring the distances of their components on the photographic plate. There is then a certain fitness in the carrying on of this research in the observatory in which stellar photography had its birth. It is quite superfluous to add that, as the investigations were under the personal supervision of Prof. Pickering himself, they were of the most elaborate and exhaustive character. A very large number of star charts were obtained showing the stars as discs or points; while other very instructive ones were procured by letting the stars traverse the plate by the diurnal motion, and thus leave trails upon it. A facsimile of the trails left by a number of circumpolar stars forms one of the illustrations of the volume, and very interesting it is. A plate illustrating the photography of stellar spectra, which has been most successfully carried on, is also both curious and valuable. In short, to all who wish to understand stellar photrgraphy in its latest developments the perusal of this work of Prof. Pickering's is indispensable.

In answer to reply 60324 (p. 92), a pancratic eyepiece is simply a terrestrial one in which the two lenses in the eyepiece are separable from the two next the object-glass; the further these pairs are separated the higher being the power. If "D. G." will unscrew the eye-cap of his telescope he will find that the eyepipe will pull out of the tube. Let him then pull it out as far as it will go without shaking or getting loose, and look at any object in the landscape through the instrument (he will have to push the whole eyetube in to refocus it), and then observe how notably the magnifying power is increased. What he here does as a makeshift is done properly by the construction of the tubes in a regular pancratic. Apropos of trusting what he is told anent the power of a telescope, I have myself describe several times in these columns the method of accurately measuring the power of any telescope.

"Lanka" (query 60484, p. 96) is in a little confusion as to his "degrees." A degree of a great circle in the heavens is identical everywhere; at the Poles, at the Equator, in latitude 45°, or anywhere else: the 18° being measured on such a circle passing through the zenith and that point of the horizon vertically beneath which the sun is situated when twilight ends. There is no doubt that twilight not only should, but does, last 72 minutes at the Equator at the date of the equinoxes. When the sun has either North or South Declination twilight there lasts a little longer. As for calculating the duration of twilight, it may be done by aid of the formula given in letter 26218, paragraph two, p. 36, for any latitude and any day of the year, if we only call the sun's zenith distance 108°—*i.e.*, 90° (the distance from the zenith to the horizon) + 18°, then will the result give us the sun's hour angle from the meridian when he is 18° below the horizon, or time when twilight ends; and, subtracting the time of sunset from this, we get the duration of twilight.

If "Chronos" has (as he tells us in query 60491, p. 96) "three regulators," he certainly should procure one of Mr. Latimer Clark's excellent little transit instruments, by the aid of which he will be able, after a little practice, to determine his time within 0·5 second. To go to the cost of even a single regulator, without some such means of obtaining the time from the heavens, seems to me a simple waste of money.

Premising that the Latin of "One not an Astronomer" (query 60518, p. 118) is not exactly as the Latin of Horace, Livy, and Virgil, I may tell your correspondent that no diagram is needed to understand that, in (say) latitude 51° N., the whole of the heavens from the North Pole to the Equator + that part of the celestial concave between the Equator and 39° of South declination, is evidently visible during the course of the year, and this is, roughly, 129-180ths of the entire vault of the heavens.

Mr. Fennessy (query 60525, p. 119) seems to have fallen into the far too common error of employing the barometer as a hygrometer. Thousands are thus deceived almost daily.

A Fellow of the Royal Astronomical Society.

PLANETARY NEBULA.

[26333.]—On reading in the English Mechanic of August 6 (letter 26050) Mr. Sadler's interesting and valuable *résumé* of the various observations of the Planetary Nebula G.C. 4373 (37 H iv. Draconis), I thought I would take an early opportunity of re-examining the object with my $7\frac{1}{3}$in. refractor. Owing in part to absence from home, a favourable opportunity for doing so did not occur till Saturday last, October 2, when the following results were obtained.

The nebula is decidedly bluish in colour, and is distinctly elliptic in outline, with axes in the estimated proportion of about 4 to 5. The major axis lies obliquely across the parallel on an estimated angle of 45°—225°. The nebulous disc appears a little soft, or diffused, at the margin. Nearly in the centre, perhaps a little *n.f.*, is a small star, glimpsed with 191, but better seen with magnifying powers 424, 605, 791. It stands out as a white spot on the bluish ground of the nebula, and presents the appearance, perhaps, of a minute planetary disc, rather than that of a star. I should not, however, wish to speak too decidedly on this point.

It will be noticed that these results agree, on the whole, with those obtained by me in August, 1863.

George Knott.

Knowles Lodge, Cuckfield, Oct. 4th.

STAR MAGNIFICATION—LATHE WORK — SHELLAC — SMALL DYNAMOS — GOLD IN QUARTZ—KAURI GUM—EVAPORATION—LETTERS ON GLASS —COLOURING GOLD.

[26334.]—I hope, Sir, you will not think I am trifling with your valuable space if I thank Mr. W. A. Haren for his lucid exposition of stellar magnification. My own ideas on this matter have hitherto been rather hazy, and I feel that I am personally indebted to your correspondent.

Why does "B. H." (26328) want to use his chisel with a scraping action? He can true up his wheels by turning off the excess in the usual way; if he will get a flat piece of wood which has been planed, and scraped with a chisel across the grain, the same result will ensue.

You have a short paragraph from the *National Druggist*, advising the use of benzole to assist in obtaining a clear solution of shellac. I frequently (in common with other people) make clear solutions of shellac in a very simple manner. We mix the lac and spirit and allow it to remain (with occasional agitation) till solution is complete. If it is now left perfectly quiet for a day or two the insoluble portion will settle to the bottom, and a perfectly clear and bright solution can be decanted.

Would someone kindly say why all the small motors and dynamos figured in the Mechanic have H armatures? Cannot we have a small machine with a ring armature? And if not, why? Some years since I saw Weston's machine at work plating; it seemed much more compact and portable than those at present in use.

I don't wish to be dogmatic, but I have an idea that a simple method of discovering gold in quartz (60509) would be to crush the mineral and look for the gold, which for estimation can be amalgamated with mercury, which latter is then driven off by heat, the gold fused to a globule and weighed.

Strong scents are generally made with spirit of wine, and if they will dissolve kauri gum (60520) methylated spirit will do it better.

The question of "Sol" (60522) reminds one of a piece of chalk. How is anyone to tell what the evaporation from a pond would be without knowing the size of the pond and depth of water? If the water is shallow, the evaporation will proceed faster; if deep, a portion or all of the heat will be absorbed by depth of water for a time before evaporation commences. I would suggest (if the game is worth the candle) to calculate the superficies of the pond, and then expose near it a small surface of water in a pail or tub; then, having ascertained how much the water in the tub has decreased in volume or weight, it is merely a question of multiplication and division.

"Glass Painter" (60547) might try a little shellac varnish.

Some time since I answered a query relative to cleaning gold after soldering, and the correspondent in question made a further application to me. This I omitted at the time, perhaps because I had no reply to offer. 9 carat gold, after being soldered and pickled, does turn a bad colour; nothing but polishing will remove it. There is no liquid into which it can be dipped to improve the colour, the only way is to gild it, but this does not give it the same colour as polished 9 carat gold. Personally, I consider 9 carat gold little short of a delusion and a snare, and should be glad to see it legally abolished.

Os.

CHAMBER ORGANS.

[26335.]—I am very much indebted to Mr. Audsley for his valuable papers on the Chamber Organ, and shall be greatly obliged if he will kindly publish the specifications of his own organ in the next chapter, along with the scale of his pipes at CC, tenor C, middle C, 12in. C, and 6in. C. I am about to build a large chamber organ, with the console placed about 15ft. away from the organ, the connection being by electric and pneumatic action; and in order to make it as neat as possible, I shall place the feeders and wind reservoir in a room behind, working them by a small hydraulic engine; the distance between the reservoir and organ soundboard being 5ft. This arrangement will enable me to place the "great" soundboard on the floor, the pipes being arranged with the large ones at each end, and the small ones tapering to the middle. The "swell" organ will be above the "great," the soundboard being 5ft. 6in. above the floor. With this arrangement I find I can get 6 stops on the great, and 8 on the swell, with pedal bourdon, in a space 7ft. by 3ft., and 11ft. high—i.e., provided the scale of the pipes is not too large; and it is for this reason I should feel greatly indebted to Mr. Audsley for the scale of all his stops. I have applied to two organ-builders whom I know, and they both recommend different scales, so I do not know which to adopt. Of course I shall buy all the pipes from some London maker, and shall endeavour to get them of the best make and of A1 quality, price not being an object with me. Can Mr. Audsley recommend me to a good firm?

I quite understand the combined electric and pneumatic action for the stops and manuals; but I am in doubt as to method of operating the swell louvres. Can any of our readers help me in this matter?

In order to save room, I intend to have all my pipes (except the pedals) of metal, the following being my specification:—

Great.	Pipes.	Swell.	Pipes.
Open Diapason 8ft.	58	Geigen Principal 8ft.	58
Lieblich Gedact "	58	Rohr Flöte ...... "	58
Dulciana .... "	58	Gamba .... "	58
Harmonic Flute 4ft.	58	Voix Celeste ... "	58
Piccolo............ 2ft.	58	Gemshorn ...... 4ft.	58
Clarionet ...... 8ft.	58	Flautina .... 2ft.	58
		Oboe .... 8ft.	58
		Keraulophon ... "	46

Pedals.

Bourdon, 16ft. 30 pipes.

I will conclude this by asking a question or two, in the hope that Mr. Audsley or some other reader will kindly answer:—

1st. How close may the back of a pipe be placed to lip of another without injuring the tone? I have allowed 2in. between mine, but would like to put them closer.

2nd. Does it injure the tone of the pedal pipes if they are packed closely together, or laid horizontally on the floor?

3rd. Will the tone be injured by having the wind reservoir 5 or 6ft. from the soundboard, or will it lead to unsteadiness?

It is quite probable I may adopt many of Mr. Audsley's suggestions, more especially the divided "great"; but I am waiting to see all he has to say before deciding finally.

George Landel.

[26336.]—I have read with much pleasure Mr. Audsley's letter in reply to "Country Solicitor" upon the above interesting subject. I am very glad to see Mr. Audsley defends with so much vigour the properly-constructed chamber organ, and I hope that before the articles respecting "Chamber Organs" are finished, the pipe organ will stand in better estimation among the musical readers of "ours" as a fitting instrument for home use. I know full well that the majority of so-called chamber organs are simply abominations, not perhaps to their owners, but unquestionably so to a musical hearer, to whom music and musical feeling are something more than noise or ear-tickling effects.

If "Country Solicitor" has never had the pleasure of playing, or hearing played, a properly-appointed chamber organ, I do not wonder at his dislike; but no matter how "nice" the Mustel harmonium may be, it can never, in my humble opinion, even compare to a well and properly made

chamber organ. As usually made, the chamber organ is sadly deficient both in the requisite quality of tone and mode of expression; but who is to blame? Generally the purchaser, and perhaps quite as often the builder. The builder seldom takes into consideration the proper requisites for chamber organ use. Why? If he did, the amount he would charge would lose him the order; consequently he puts together the most simple affair he can, and also the cheapest. Then, again, if a purchaser, we will presume musical, lays down the law to a builder as to how he is to build the organ, the result would, no doubt, be an excessive charge, because more time and study would be required to bring the affair to a satisfactory ending. Even if a builder is left to his own judgment, he will, as a rule, put in a small church organ, and call it a chamber organ. Such and such like is why we have such poor instruments.

I have questioned many organists and others, but they are almost with one voice in favour of the pipe organ. The general remark is that the reed organ "will do," when the other is not obtainable. This is always what I have entertained, that the ordinary reed organ exists on suffrage. If room and cash is available, the musician will always prefer the pipe organ. That the reed organ makers know the pipe organs are the best is exemplified in their advertisements, where they will tell you the quality of their instruments are the nearest approach obtainable to a pipe organ.

The purchaser of a reed organ will always be very particular to impress upon any friends to whom he is showing his purchase that "the tone is just like a pipe organ." All this points to the pipe organ as being the best, and in any opinion, when properly designed, scaled, and voiced, any effects that may be produced upon a reed organ can be produced in greater depth and grandeur upon a chamber organ.

Now comes the question of price. According to Mr. Audsley's article, No. V., he gives the number of manual stops in the organ he is describing as fifteen. This, with three pedal stops, will make eighteen. Now, to build this organ to the perfection laid down by Mr. Audsley would not cost less than £20 per stop, or a total of £360. This is beyond the ordinary figure of reed organs, and beyond the ordinary purse, and would take up considerable room; but there are, I believe, reed organs up to that figure, and what man of musical culture would prefer the reed organ of that price to the instrument now being described by Mr. Audsley? None, I presume.

I cannot say I agree with all Mr. Audsley states in his articles; but, taking them as a whole, I can endorse with confidence the excellent directions and explanations he gives therein, although for the ordinary amateur the sized organ he describes would be far too ambitious an attempt to make himself.

Mr. Audsley has several times referred to the organ he is the happy possessor of, and if it agrees with his description, which I would not doubt, it must indeed be nothing short of a marvel, and truly "a pearl of great price." Taking this amount of perfection as granted, I think if "Country Solicitor" once hears a good selection upon it, he will be convinced that although a reed organ may be the most convenient for a room, the pipe organ possesses a depth of resource, grandeur of effect, brilliancy and power, refinement and body of tone, and combining in a well-appointed instrument the capability of producing a wondrous flow of smooth, powerful, rich harmony, also subtle and weird effects, which almost border on the mysterious, and which no reed organ yet manufactured can by any stretch of imagination lay claim to.

I was certainly surprised to find in "Country Solicitor's" letter that he only considered music a mere recreation, especially after so much talk about expression. Perhaps this little point may be some clue to his inability to appreciate what can be obtained from a good organ. It certainly is a very different thing to hear an organ sonata of Mendelssohn's played even on a small pipe organ to an operatic air tootled at one end of a reed organ, and a ramping accompaniment at the other; it may be pretty, but not substantial. Yet I can scarcely think this, to judge from the programme he quoted.

I hope, if "Country Solicitor" sees Mr. Audsley's organ he will give us his opinion, for I am sure I should be delighted to hear it myself, and if Mr. Audsley would courteously extend me the same permission I should consider myself greatly honoured, and would take the opportunity the next time I am in town, for nothing would give me greater pleasure.

There are many other remarks I could make on the subject, but am afraid I have overstepped the limits of space already. **Uranium.**

"HAS ENGLAND GONE UP-HILL OR DOWN DURING THE LAST FIFTY YEARS?"

[26337.]—"B. R." (26257, Sept. 17, p. 64) adopts a somewhat original, but, I fear, hardly successful method of answering the above question. He grabs hold of a handful of statistics at random, and flings them unceremoniously in the faces of his readers. Now, as one of those readers, and as, moreover, a socialist, I beg to protest against this sort of proceeding. It is not only unconvincing to our reason, but insulting to our intelligence. What is more, when his statistics are not irrelevant they are inadequate, and when they are not inadequate they are incorrect. The worthlessness of the statements advanced, as showing the condition of "the people"—those who by labour produce all the wealth of the world, and without whom, under present conditions, human existence would be impossible—will be apparent on a little examination. They prove that "England has gone up-hill," truly; but the "England" is the England of the upper and middle classes (to one of which "B. R." obviously belongs), not the England of the producers—the workers; and like the rest of his class, "B. R." evidently cannot conceive of anything beyond his own narrow microcosm. He measures everybody's corn by his bushel, and imagines the rest of mankind are as fortunately conditioned as himself.

In a moment of generous weakness, I was induced to make one exception to the unappreciative estimate I formed with regard to the value of "B. R.'s" statistics. It was in reference to the figures *re* population. Alas! on a second consideration I was compelled to place these, too, in the general category. "The population of England, Ireland, Scotland, and Wales," he commences by saying, "was . . . in 1871, 31¾ millions; 1881, 35¾ millions." True. But in taking the four countries together in this unwarrantable fashion, it will be seen that "B. R." evades the question of *Ireland* altogether. The increase shown, of course, is confined almost exclusively to England, Scotland, and Wales. During merely the last few years Ireland has been first depauperised by landlordism, and then depopulated by emigration to the number of *millions*. But this fact is conveniently "jumped" by "B. R."

With regard to the Savings Banks question, "B. R." says, "The deposits in the Savings and all other banks [have] very much increased." Now, if this statement is meant to apply all round, it is untrue. And if it is not so intended, it is useless. I make "B. R." welcome to whichever of the two horns of the dilemma he likes best. Furthermore, if the assertion were absolutely correct, it would not serve his purpose—it would not prove that the poor were less poor. It would, perhaps, *imply* as much, it would not *evidence* it; and implying is not proving. As a rule, the *darker*, not the brighter, a man's prospects are, the more he saves. As a rule, if his prospects are bright he does not save at all. There are exceptions, of course, but they only prove the rule. "They that are whole need no physician"; and, with mundane as well as spiritual things, those whom the future does not trouble do not trouble about the future.

But, maugre all this, let us examine into "B. R.'s" assertion—that deposits in the Savings Banks have "very much increased." Take only the Post Office Bank, which he will admit is a very fair example indeed. From the Annual Report of the Post Office, just issued, it appears that the depositors in 1885 numbered 6,474,484, giving an average of £2 6s. 5d. per deposit. But the number of depositors since September 16, 1861—well within "B. R.'s" "fifty years"—is 75,088,023, say an average of £2 14s. 8d. So that the deposits are decreasing instead of increasing, and the deficiency on last year was no less than £2,670,000!

But heedless of these serious facts, "B. R." skips blithely on. "Ten times more people have pianofortes, watches, and jewellery," he says, which is one of those statements which are not quite correct, but which are too ambiguous to be disproved. How many, does he think, of the real "people," the workers, ever get a piano or a watch and chain?—never to speak of time to learn the piano, and opportunity to wear the watch and chain? Why, their very Sunday coats and petticoats are almost invariably pawned on Monday and redeemed again on Saturday. But a little further on "B. R." gives himself more rope, and, as a natural consequence, duly "dances on nothing." Says he, "All classes . . . are better paid for labour, and work shorter hours." Now, this assertion is at any rate definite. As a certain hero in fiction would say, it is "d—— definite." But how does it stand otherwise? Let us apply it to only two of "B. R.'s" "*all classes*": the "slop workers" and the tramcar men—the victims of the "sweater" and the victims of the shareholder. The slop workers are men and women who make up the cheap suits of "shoddy" for the sweater, or middleman, of the manufacturing tailor's trade. These unfortunates work at their sewing-machines in the "sweater's den" from seven or eight in the morning till nine or ten at night, receiving at the week's end an average wage of from twelve to fifteen shillings. They more often than not work under conditions impossible of description with any regard to detail here, and on the slightest displeasure they give their employer are instantly dismissed. Here is a representative "class," taken hap-hazard from "B. R.'s" "all"; but I fail to see that they are "better paid for labour," or that they "work shorter hours." "B. R." says he can see it. He should be counselled, as the old lady says in the story, to "take care of his eyes." He is an ophthalmic *rara avis*; and I shall be glad to be informed, at his convenience, whether he can gaze upon the invisible and look through a brick wall.

Turn to the tramcar employés. These men work fourteen and sixteen hours, in all weathers, and for seven days in the week, and receive as wages the magnificent and munificent remuneration of about thirty shillings or less. The only reason why they don't work *nominally*, as they do *actually*, eight days in the week instead of seven, is that there are, unfortunately, *not* eight days. But wait a moment—*peccavi!* I have forgotten something. Let me give even the dev—I mean the shareholder, his due. The men, if they happen to have been born while their lucky star was in the ascendant, and if they are good, and if circumstances permit of it, and if a few more "if's" only act in an honourable way as they should do—if, in short, "all's well," the men are allowed one (whole) Sunday off—*in ten years!* Such, at least, was the beatific experience of one old driver as related a little time ago. Please, then, I would say, don't forget the one (whole) Sunday off. To do so would be indeed calamitous. There is not much of it; let us, therefore, as is usual in such a case, and as the men doubtless do—make the most of it.

And how much interest does the "anxious, careworn capitalist" (as Samuel Smith, M.P., immortalised himself by calling him) get on his money invested in the tramway? What reward does he receive for *not* constructing the line, for *not* maintaining it, and for *not* working it? What guerdon is his, in short, for manfully and heroically taking the dividends when they are earned? Weep, weep, and tear your hair! he gets a paltry 9½ or 12 per cent. Pity the sorrows of a poor old—also anxious and careworn—capitalist. Only 9½ or 12 per cent., when even Government bondholders have to think themselves lucky if they get 2½. 'Twas ever thus. Brethren, let us weep some more. **A Socialist.**

LIGHT — SUMMARY OF NEWTON'S DOCTRINE OF UNDULATIONS.—IV.

[26338.]—NEWTON did not treat especially of undulation of light; but as his doctrine is general, and applies to the motion of particles in any medium whatever, it will be to the purpose to give a summary of it.

He treats, then, two cases—First, that of waves on the surface of water, and which are due not to its elasticity, but to its fluidity, and consist of elevations and depressions of surface; and secondly, of waves which are due to the elasticity of the medium through which they pass, as is the case with sound.

With regard to the first of these, he shows that the velocity of the waves varies as the square root of their lengths; and with regard to the second, that it varies as $\sqrt{\frac{e}{d}}$ where e and d are the elasticity and density, and is independent of length of wave. To these might be added the vibrations of an elastic cord, which may be shown to follow the second law.

In applying his doctrine therefore to light, the only question which can arise is, Which of the two cases does it come under, for there is no other alternative? There could be no doubt how to answer this, but for one point in Newton's theory, which has not yet been mentioned, but must be kept for another letter. In the mean while, however, we may say that observation suffices to make it perfectly clear that it comes under the *second* case, where the velocity is the same for all lengths. For, if it comes under the other, v must vary as $\lambda^{\frac{1}{2}}$. Now according to Fresnel's calculations, the ratio of the length of red to blue waves is 620 : 423, and therefore the ratio of the velocities would be 1·21, which is the square root of the above ratio. But the quantity known as the coefficient of aberration varies as the velocity, and therefore ought, according to our supposition, to have a difference of 21 per cent., in its observed value, for red and blue rays; whereas none whatever has been detected, which is just what ought to happen if the velocities were the same for all cases, but what could not happen in the other case. We conclude then from this that the rate of travelling is the same for all waves.

But this, too, appears at first sight contrary to observation. For, according to the information which "F.R.A.S." has most opportunely supplied, (letter 26141), Michelson finds that the percentage of difference between two colours which he mentions, for disulphate of carbon is from 1 to 2 per cent. instead of being either 0 or 21, so that it might seem as if either his observations were unreliable, or Newton's laws untrue—which of the two is it? Assuredly neither one nor the other;

the seeming discrepancy is easily explained. Newton and Michelson are evidently handling two different cases; Michelson must have made observation upon light which had passed from one medium into another, whereas Newton's calculations were made for the case where it had not. Let us see how this makes all the difference. Newton mentions expressly that one of the conditions upon which his conclusion rests is, that during the time of a vibration the front of a wave travels through a space equal to the length of a wave, and when it is so the velocity is the same for all lengths. From which it follows that if a case occurred in which it does *not* travel as above, neither would the velocity be the same for all waves. And conversely, when the velocity is not the same for all waves, neither does the front of the wave pass over a space equal to its length in a vibration. But Michelson's observation shows that when light has passed from one medium to another, the velocity is not the same for all waves, and consequently the front does not move over a space equal to its length during a vibration. And this is precisely what was mentioned in letter 26251 as being the necessary consequence of the disturbing force, causing the motion of the front to be not uniform during the passage.

The observations of Michelson therefore in no way throw discredit upon the doctrine of Newton, or upon its applicability to light in particular, as it is to all cases of a wave passing through an elastic medium; and the two together completely confirm the conclusion arrived at in letter 26251, that the velocity is not uniform during the passage, and that colour dispersion is a necessary consequence thereof.

Refracted light, then, differs in several particulars from that which has not been refracted. So far as we have gone, the differences are thus:—

1. In unrefracted light waves of different lengths travel both in the same directions and at the same rate, whatever the medium be in which they are moving; but in refracted light neither of these things happen: the waves are dispersed and move at unequal rates.

2. In unrefracted light, if the front passes over a space equal to the length of the wave during a vibration, when it enters a refracting medium this no longer happens. We shall refer to this again in next letter but one, when we shall have occasion to speak of something similar.

3. We may also anticipate what will be spoken of in the concluding letter of this series, by reminding the reader that there is another very notable difference between refracted and unrefracted light, known as polarisation. **W. G. Penny.**

(*To be continued.*)

ANALYSIS OF SILVER ALLOYS—POLARISED LIGHT—ARTIFICIAL TOURMALINES—RAILWAY MYSTERY.

[26339.]—POSSIBLY the difficulty of "G. E." in the analysis of silver alloys (query 62307, page 92) lies partly in the use of *excess* of sodium chloride or hydrochloric acid for precipitating the silver from solution. The text-books—which are usually written by "professors" for their pupils, and not by practical analysts, who have to take care that the methods they use are accurate—do not lay sufficient stress on the solubility of silver chloride in saline solutions. To obtain good results, "G. E." must add the precipitant drop by drop in the least possible excess, and then take care not to filter till the solution is quite cold. Further, the precipitate should not be washed to an unnecessary extent, as silver chloride is not wholly insoluble in water. For determining the amount of silver deposited on plate goods, the articles should not be entirely dissolved in acid, but "stripped" of the silver in the manner familiar to every electro-plater. The silver can then be precipitated from the diluted solution.

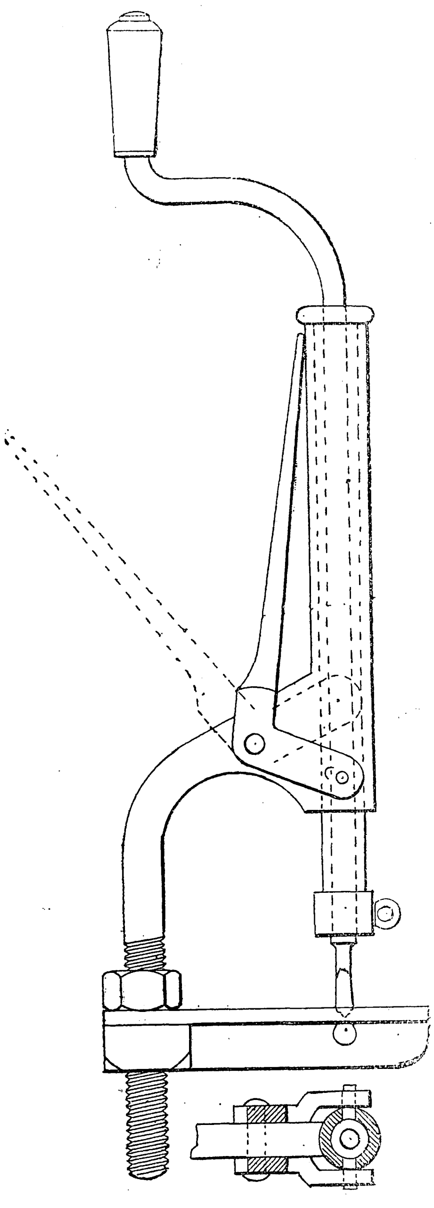
In reply to the query of "E. W.," headed "Polarised Light" (No. 60481, page 96), I am afraid no advance has been recently made in the manufacture of artificial tourmalines of Herepathite. Some eighteen years ago the sale of them was pushed by Messrs. Horne and Thornthwaite, and I still have a very perfect crystal purchased from them about that time. More recently, perhaps five years since, I was informed by one of the firm that they had lost the art of producing them. It had always been a very delicate operation, necessitating the most complete absence of vibration, to obtain scales of any magnitude, and of late years all attempts had failed. Here, then, is a chance for someone who lives "far from the madding crowd" to supply a real want. Of course, the production of small crystals, which form magnificent microscopic objects, is easy enough. It is the production of large crystals which is so difficult. It seems quite possible that something may depend on the purity of the quinine employed, and that the more complete separation of the cinchonidine and other accompanyıng alkaloids now effected may militate against the production of large crystals. As to real tourmalines, I seem to remember the increasing rarity of natural crystals of suitable colour and size for optical use being commented on some time since.

The "Railway Mystery" referred to in query 60421 has connection with the possibility of a pistol continuing to ride on the step of a railway carriage in rapid motion. Have the correspondents who doubt this seen the way in which grain, beans, and even peas travel along the flat band used in warehouses where grain is unshipped? A long horizontal elastic band, about 20 to 24in. wide, travels with considerable velocity, and in a state of violent vibration, and the loose seeds of all kinds are carried along by it without showing the least tendency to run off the edge. Would not a pistol remain practically stationary on the floor of a railway carriage, and, if so, why not on the step?

Sheffield, Oct. 4. **Alfred H. Allen.**

DRILL FOR SMALL WORK.

[26340.]—I SEND sketch of a drill I made for small work which might interest some readers. It



is handy for drilling plates for riveting, and many other odd uses, and is easily made. **Silke.**

LATHE APPLIANCES, &c.

[26341.]—I TRUST some of our practical men will reply to the question asked by "O. J. L." in his clever letter on "Things Old and New." Why is it that people will try a new patent medicine but will not try a new chuck?

"J. H." has been giving us some admirable papers on "The Amateur Workshop": they would make up into a useful book. Has "J. K. P." never thought of writing a book on tools, &c.? It is not everything to *know* about tools, it requires to know how to describe them clearly, and that is just what "J. K. P." can do. Can anyone tell us what progress has been made with Holtzapffel's Vol. VI., and when it is likely to see the light? Mr. William Hartley's work will, I fear, be lost to the world, he having died on September 13th.

I have often wondered why the form of toolholder shown by "J. H." this week is so universally used, rather than the Willis form. There was one on my lathe, but it would not conveniently grasp a large driller 1¼in. thick, and had such a clumsy look I had it changed for a true Willis.

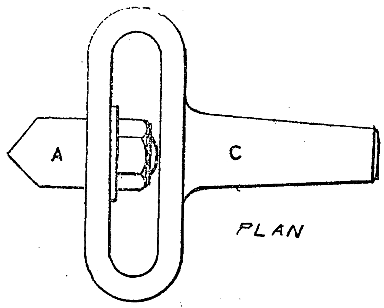
"B. H.," who inquires the cause of his scraper chattering (letter 26328), can try resting his scraper on something elastic, such as soft leather, or even on the finger, or with only one corner of scraper on rest. Let him do all the work he can with the router (or round nose tool), then let the scraper have elasticity: try putting the rest ½in. off and holding the handle high, as if to lift the work out of lathe as by a lever, and scraping below the centre. **F. A. M.**

LATHE WORK.

[26342.]—"B. H." will overcome the difficulty due to the vibration or tremor of tool and work by tilting his tool more or less. I mean that the edge of tool must not be horizontal, but at an angle. Brass frequently shows these ridges unless tool is tilted. **T. C.**, Bristol.

SETTING SLIDE-REST TAPER.

[26343.]—HAVING noticed letter 26271, page 67, under the above heading, I have ventured to send a sketch of a movable back-centre which I have



seen used in our shop. It consists of an iron centre C with a flat bow shut on the front end of sufficient thickness to bear any ordinary amount of screwing up, and wide enough to admit of a slot being cut to carry a short steel centre A, and is turned to fit in place of ordinary centre. The sketch being a plan, it will be seen that A has a nut fitted to it, so that it may be set "to" or "from" the slide-rest, as far as the slot will allow. **Simplex.**

STATIC ELECTRICITY—TO "SIGMA."

[26344.]—IN reply to your observations on p. 107 of the "E. M.," the only edition of your work, "Electricity: its Theory, Sources, and Applications," to be had at the Picton Reading-room in this city is that dated 1875, so that I may be excused my ignorance of later developments; and seeing in it an illustration of a conical bag capable of being turned inside out by means of a silk string, as well as a description of Faraday's construction of one room inside of another, I merely wished to have what appeared to me to be an erroneous statement explained. My reason for mentioning "that I found that if any part of a piece of glass be rubbed, the whole of it is electrified simultaneously," was to ascertain if you were aware that, as my experiments seem to show me, as long as the rubber is kept in contact with the glass, the so-called leakage is really a flow on to said glass, in order to take up its position "opposite" to the rubber, and rub as we may, so long as we keep within the boundaries of the opposite piece of foil laid upon the glass, the electricity gathered upon it does not seek to join that upon the rubber; but the moment we break contact between the rubber and the glass it would appear that the two qualities or conditions of electricity are, so to speak, anxious to unite, and both rush to meet each other. Thus I find that with the smallest rubber and largest sheet of glass the electricity is coming on apparently whilst contact is maintained between glass and rubber, over the whole surface and is given off the moment contact is broken. Thus it follows that the best arrangement for a frictional machine would be so that the rubber alternately rubbed and left the glass, and this is easily accomplished by means of a light roller, having a system of cushions parallel to its axis, so that each one touches as large an area as possible of the glass and then releases it. I also find that the rubber is acted upon at every discharge, and the foil becomes perforated; also, if the back of the rubber be of glass and several sheets alter-

nately foil and paper pasted upon it, upon examining these after some use holes will be found burnt through, showing that the foil has been melted or disintegrated. Is it generally known and admitted "That what is usually called leakage is in reality a flow towards the opposite face of a sheet of glass to that which is the excited face"? Also, that this electricity is much more powerful, painful, and difficult to insulate and make use of than that developed upon the same side as the rubber? It just occurs to me to mention that if any kind of metal apparently be allowed to touch the inside of a glass tube, or even a piston made on the end of a wooden rod with common pack thread and smeared with amalgam be rubbed inside, it is certain that the glass will fly to pieces, probably within 24 hours, as I have experienced with tubes up to $1\frac{1}{3}$ diameter.

A., Liverpool.

PHYSICAL BASIS OF LIFE.

[26345.]—CAN any reader enlighten me on the following point? Prof. Huxley, in his article on "The Physical Basis of Life," says, on p. 137, "If scientific language is to possess a definite and constant signification whenever it is employed, it seems to me that we are logically bound to apply to the protoplasm or physical basis of life, the same conceptions as those which are held to be legitimate elsewhere. If the phenomena exhibited by water are its properties, so are those presented by protoplasm, living or dead, its properties. If the properties of water may be properly said to result from the nature and disposition of its component molecules, I can find no intelligible ground for refusing to say that the properties of protoplasm result from the nature and disposition of its molecules; but I bid you beware that in accepting these conclusions you are placing your feet on the first rung of a ladder which, in most people's estimation, is the reverse of Jacob's, and leads to the antipodes of Heaven. It may seem a small thing to admit that the dull, vital actions of a fungus, or a foraminifer, are the properties of their protoplasm, and are the direct results of the reaction of the matter of which they are composed. But if, as I have endeavoured to prove to you, their protoplasm is essentially identical with, and most readily converted into, that of any animal, I can discover no logical halting place between the admission that such is the case, and the further concession that all vital action may, with equal propriety, be said to be the result of the molecular forces of the protoplasm which displays it. And, if so, it must be true, in the same sense and to the same extent, that the thoughts to which I am now giving utterance, and your thoughts regarding them, are the expression of molecular changes in that matter of life which is the source of our other vital phenomena."

Now, in his previous address on the "Educational Value of Natural History Sciences," he writes at page 76, "What is the cause of this wonderful difference between the dead particle and the living particle of matter, appearing in other respects identical?—that difference to which we give the name of Life. I, for one, cannot tell you. It may be that by-and-by philosophers will discover some higher laws, of which the facts of life are particular cases; very possibly they will find out some bond between physico-chemical phenomena on the one hand, and vital phenomena on the other. At present, however, we assuredly know of none, and I think we shall exercise a wise humility in confessing that, for us at least, this successive assumption of different states (external conditions remaining the same), this *spontaneity of action*, if I may use a term which implies more than I would be answerable for, which constitutes so vast and plain a practical distinction between living bodies and those which do not live, is an ultimate fact, indicating as such the existence of a broad line of demarcation between the subject-matter of biological and that of all other sciences."

In the preface of the same book to Prof. Tyndall, on page 6, Prof. Huxley says that the essay on the "Educational Value of Natural History Sciences" "contains a view of the nature of the differences between living and not-living bodies, out of which I have long since grown."

Now, what are the reasons, or evidence, on which this change of opinion is founded?

No Sig., Paris.

EGYPTOLOGY.

[26346.]—IN reply to "Memnon" (26286, p. 85), I should like to be permitted to say:—

(1) The Hebrews, in their genealogies, do not always give us all the links. Gesenius, one of the greatest of Hebrew scholars and a rationalist, says that a generation with them often meant a century. These two facts need to be taken into account in examining the Scriptures.

(2) The original of 1 Kings vi. 1, has *about* 480.

(3) Answered in number one.

(4) Josephus, no doubt, followed the Septuagint (*Codex Vaticanus*), which has 215 years for Israel's sojourn in Egypt. This was currently regarded as the correct number in New Testament times, hence St. Paul's reference in Galatians. The 430 of the Hebrew Scriptures is regarded as the correct time, and Joshua's genealogy of eleven generations supports this number. It is not said that the Israelitish population had only two midwives. The King spoke to two, and they were Egyptians. The Israelites had their own, no doubt, since they had them before they went into Egypt.

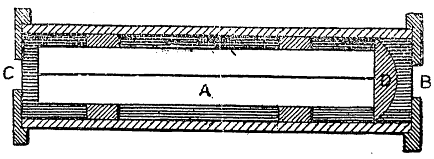
(6) The Egyptian monuments and inscriptions were for the glorification of everything Egyptian; little or no notice is taken of their humiliations. Diodorus cxxxiv. 1, has a record with an Egyptian colouring, in which it is said that Egypt suffered from the pestilence, because of a multitude of aliens, who were affected with a foul, cutaneous disease. They were, however, driven out, and the main body went to a land afterwards called Judæa, which was a desert.

(7) This is contradicted by "Memnon's" "impression" in No. 6. Other assailers of the Bible declare that Israel got everything from Egypt. "Memnon" thinks they got too little. How strange a thing is this! How about the many Welsh who, after a thousand years, speak only their own tongue? That Moses wrote in pure Hebrew of the time of David is an error. His writings are a mixture of archaic and more modern Hebrew; just as we might expect from its being copied from generation to generation, and in degree altered to the language of the times. The Israelites believed in the immortality of the soul because they were commanded (Deut. xviii. 11) to have no dealings with the spirits of the dead. No nation of the East was without this faith. As Max Müller has said, they may have doubted their present existence, but never their future, and this opened a wide gate to many forms of idolatry. Hence, the scriptures which came *to* this people, but were not *of* them, rose far above their habits of thought, and enforced attention upon things necessary for their temporal welfare. "Memnon" ought to know that whatever of reliable evidence which has come to hand from monuments and inscriptions in the East goes to support the truthfulness of the Scriptural narrative, and to dispose of the cavils of objectors.

September 26. **Ramases.**

THE DICHROISCOPE.

[26347.]—SOME time since an interesting discussion on the phenomenon of dichroism appeared in your columns. I believe it was then spoken of as being of very rare occurrence, and the mineral dichroite was the only example mentioned. As a matter of fact, however, this phenomenon is extremely common, more so perhaps than fluorescence, for it is exhibited to a greater or less degree by all crystals belonging to the hexagonal, quadratic, rhombic, monoclinic, and triclinic systems—in fact, by all except those which crystallise in the regular or cubic system. In general the dichroism is so feebly marked that it requires the use of a special instrument called the "Dichroiscope," devised by Prof. Haidinger, of Vienna, and shown in longitudinal section in the figure. It consists of a brass



tube, about 6in. in length, having at one end a circular hole B (the eyepiece), and at the other a square aperture C. It contains a long cleft piece of Iceland spar A, with its ends ground flat, that next the eyepiece having cemented to it a plano-convex lens D. The Iceland spar is cut to such a length that the two magnified images of the square aperture appear to touch, but do not overlap. On placing near the square aperture a non-crystalline body, such as green glass, or a crystal of the cubic system, as garnet, the two images will be seen to be identical in hue. If we take a crystal of any other system, for instance an emerald (hexagonal system), and examine it along its principal or optic axis, the same result is obtained. But if we now apply the instrument at right angles to one of the hexagonal faces, and gently rotate it, one image is seen to be greenish-yellow, and the other greenish-blue. The former is due to the "ordinary ray," the latter to the "extraordinary ray," the green colour of the emerald being resolved into two components, one preponderating in yellow rays, the other in blue. As there are hundreds of crystals which can be examined in this way, the instrument is well worth the trouble of constructing, and can be easily made by anyone familiar with optical work.

R. E. F.

NON-CONDENSING VERSUS CONDENSING ENGINES.

[26348.]—I HAVE read with interest the discussion betwixt "Engineering," "Ingeniero," and others on the above subject. The relative merits of both classes have been discussed at great length by our friends. I have an opinion myself that in the long run the extra expense that has to be laid out in the compound condensing engine is fully compensated by economy in fuel and greater cleanliness on board the vessel. The simple high-pressure has fewer parts, we all admit, and is generally better understood; but when we live in a part of the country where fuel stands at a high price, and we use a large quantity, economy in fuel is a great consideration.

I should like to ask the opinion of our friend "Engineering" with regard to a little matter. A friend of mine had a pair of high-pressure engines fitted in a launch—the cylinders were 6in. diameter by 8in. stroke; boiler pressure, $\frac{1}{5}$lb. He exhausted the steam in a tank from which he fed the boiler. A valve was arranged on the tank, so that when the pressure became excessive it opened to allow the steam to pass up the chimney—a very wasteful practice, for the tank was filled with salt-water, and consequently incrustated his boiler.

My friend built a larger boat, and thought of placing in the engines from the other boat, with an additional one to compound them; his reason for only using one additional cylinder being to keep expenses low. I got up a design, the additional engine to have 14in. cylinder and 12in. stroke., or about four times capacity of high-pressure cylinders, and to add a surface condenser of coiled copper pipes placed in the tank, the sea-water to circulate outside the pipes. The three cranks were to work at 120°; with this arrangement I calculated on getting power to drive the larger boat, and have greater economy in fuel. I spoke about the matter to some of my more advanced engineering friends; but their principal objection was: the low-pressure engine having so much longer stroke than the two high-pressures would make the turning moment very irregular. This point I could not get over, as I was confined to have only one low-pressure engine to save expense. So I think I was bound to have either a longer stroke or a very large diameter cylinder. Perhaps some reader of "ours," or our friends "Engineering" and "Ingeniero" will see the way out of the difficulty, and for an answer I shall feel greatly obliged.

Middleton Junction. **W. H. Taylor.**

HIGH-PRESSURE VERSUS COMPOUND CONDENSING ENGINES.

[26349.]—MANY of the readers of this paper will think I am leading them astray when I state that there is practically no benefit to be derived from expanding steam in two cylinders placed tandem-fashion, and that all the benefit to be derived from expanding steam can be practically accomplished in one cylinder. Now my observations refer only to non-condensing engines. In the case of the condensing engine, we get the benefit of at least 14lb. on the square inch additional pressure; but I maintain, although a benefit in the condensing type, it is not the best position to place them, and the only reason I can assign for placing them thus is the limited space which they had to occupy. One example I saw in a small launch had the cylinders placed thus, and one pump acted both for air and circulating pump; it was very compact, but not handy to stop and reverse quickly, and although it outstripped the double-engined launches, and was very economical in fuel, the owner had it taken out and a double engine put in. How is it that there is such a marked difference in the economy of the triple expansion engine compared with the ordinary expansion engine? In my opinion the economy is caused by the difference in the larger ratio between the small and large cylinder, also taking into consideration that the power is distributed upon cranks placed at an angle of 120° with each other, so the power is split up and more uniformly distributed on cranks in a more favourable position to develop that power than is the case in engines with only one or two cylinders. As I stated, it is a question of £. s. d. whether we will pay a few pounds more per H.P. and have an engine that works with the highest economy, or save this extra cost and lose it afterwards in fuel; and as regards requiring a skilled attendant, I am confident that the engine I advocate can be made so simple that a person who could manage a high-pressure engine would be quite capable to look after a compound condensing one.

London, Sept. 25. **Ingeniero.**

COMPOUND LOCOMOTIVES.

[26350.]—FROM the very interesting discussion going on in the "E. M." respecting locomotives, it appears to me that the usual formula for estimating the so-called tractive force of the engine at the rails is somewhat misleading.

In the case of the locomotive, it is not sufficient

to know the tractive power on paper; but what we want is to measure the actual pull at the tender draw-bar at various speeds.

Now this is proved by the remarks of G. D. Seaton (24th September) in comparing Precedents with Dreadnoughts: the latter appear, on paper, to be among the most powerful engines in this country, but what are they in practice? The Precedents have great "hauling power," which latter term better expresses locomotive work.

The matter would be greatly simplified if some locomotive engineer would have the courage to experiment with different engines, with the same weight of train on the same road.

The nearest approach to this took place some time ago on the G.N.R., when Mr. Stirling found that the "single" engine had the best of it to Potter's Bar. The outcome of this was the 8ft. engine, a great success, and I think that if experiments could be properly conducted it would be found that the single engine works with more economy. The friction of coupling rods does not appear when estimating tractive force. The point to work upon should be the tender draw-bar. I hope this subject will be taken up by others.

R. H. Gates.

LOCOMOTIVES, ETC.

[26351.]—I WOULD point out to "Kappa" that on most lines the drivers are stationed on that side which has been called the wrong side for signals. The domes would consequently be more in their way where the signals were fixed on the right side.

Libra.

[26352.]—IN reply to "Engineer," the heating-surface of a locomotive engine should not be less than the following for 18in. cylinders: Tube-surface, 1,115ft., and the firebox should be 110ft., making a total 1,225ft, with a pressure of 140lb. in the gauge, and a dome on the boiler, "Engineer" would find, with a well-constructed engine, would meet his requirements. As regards the Midland No. 1,667 class of engine, I cannot for the life of me understand what man that calls himself an engineer would build engines with 19in. cylinders, with a heating surface total 1,121ft., which is much less than *Mr. Kirtley's* build of engines, such as the 800 class; but that *gentleman* was a thorough engineer, and the Midland Company knows it, and I know it, for he never wasted the company's money by experiment, but went to the point at once, and this will answer the question. "Engineer" asks how is it that no engines can be built equal to the 800 class. Because they don't know how, or they would have done it long ago. Your writer speaks of what a *disgrace* it would be to rebuild the new engines. Let me inform him that it is no *disgrace* for some railway engineers to throw money away by *thousands*, but if a man even is doing his *duty* to his *company*, and it don't suit the so-called engineer, he must be discharged, or have the *Irishman's* promotion, and if "Engineer" or any other correspondent wants to know anything more, if I can oblige I shall be glad to do so.

Loco. Erector.

L. AND N. W. R. LOCOS.

[26353.]—I OUGHT to have said "the incline between Tebay and Grayrigg," instead of "between Low Gill and Oxenholme." As even the Scotch express comes at quite a moderate speed down the hill through Oxenholme, I do not suppose they would let the fish train, with only the hand brakes, get out of hand over that part of the road.

Some of the L. and N. W. locomotive arrangements seem quite inexplicable. For instance, on a journey over that system from Welshpool to Windermere, one of Ramsbottom's "Lady of the Lake" class took my train from Welshpool to Shrewsbury, over a rough branch, stopping at all stations, while one of the 4-coupled, 8-wheel side tanks, with 4ft. 8in. driving wheels, was put on the tourist express (10.30 p.m. Euston) between Preston and Oxenholme! The latter was tried as an experiment (and experimenting with a heavy express seems to me a queer proceeding), and lost nearly 15 minutes in 40 miles.

I cannot see that Mr. Drummond's 6ft. 6in. Cal. bogies are anything out of the way. We were about 24 minutes getting from Beattoch to the summit on Sept. 20th, with the day mail and 10 coaches on, and could make up no time between Carlisle and Carstairs, though on the same train, with a Precursor, we picked up 7 minutes between Oxenholme and Carlisle with only two carriages less, and that is a much greater load in proportion to the Precursor.

I travelled yesterday by the 11.38 a.m. Midland express from Birmingham to Gloucester. We left 20 minutes late, and only made up one minute to Cheltenham, though we had only 10 six-wheeled coaches and two bogies and an engine (109) just rebuilt. It was, however, wet and windy, and we had to stop just after leaving New-street for a signal and make the usual stops at Blackwell and Bromsgrove.

I cannot understand why, if it is necessary to run trains through Gloucester without stopping, the old loop east of the station should not be re-opened, and the trains allowed to run over the Great Western to Standish Junction. This would save a mile, and a very dangerous mile too, as not only is there a network of lines and points to be got over (often at a great speed), but there are a number of level crossings in the south and east of Gloucester. I should have thought that it would have been well worth the Midland's while to run a few local trains between Bromsgrove and Wadborough, viâ Spetchley, and open the old stations, as the district is populous, and the local traffic between the market towns would surely be large.

O. H. P. Scourfield.

RAILWAY SIGNALS.

[26354.]—AS your correspondent, "Libra," page 110 (letter 26321), does not give the name of the railway upon which he claims to place the signals, it is impossible for me to examine them, or to know if they are or are not properly fixed. I know for a fact that very many signals are placed upon the wrong side simply to save cost, to save signal posts, and to employ short posts instead of tall ones. I know of several cases where a post has been placed on the wrong side simply to save two pulleys, which would be required to cross the wire from one side of the line to the other.

"Libra's" remarks with regard to "evil-disposed persons who laugh at or ridicule" the Amalgamated Society are of no importance; the very fact of their being *evil disposed* is quite sufficient to cause any reader of the ENGLISH MECHANIC, as well as any member of the society, to treat them with that contempt they deserve.

On page 577 of last volume (letter 26149), I asked a correspondent who signed his letter "G. L. Watkinson" to be good enough to furnish his address, as his letter contained libellous statements. I am now in a position to state that the true name of the writer of that letter is not "Watkinson," and the address sent to my solicitors has been proved not to be the correct one. He referred in his letter to "his experience" with regard to signals. It is rather interesting to find that he has not ever been in a position to obtain any "experience" with regard to the matter.

Your readers will doubtless form their own conclusions as to the conduct of such a correspondent, and I shall not occupy your space by referring to the false statements contained in his letters.

Clement E. Stretton,
Vice-President,
Amalgamated Society of Railway Servants.
Railway Congress, Town Hall, Brighton,
October 5th.

PERMANENT WAY.

[26355.]—A FEW printer's errors occur in letter 26316 on this subject in the last issue, which I beg to call attention to, and to solicit kind correction.

Line 38 from top, 2nd column, it should read, "secured by 1in. bolts and nuts." Line 57 should read, "The bolt-holes are oval shaped." Line 6th from bottom, read "outfall" instead of "output."

Rhine, Oct. 2. **S. G.**

BODIES FALLING FROM TRAINS IN MOTION.

[26356.]—MR. CLEMENT E. STRETTON, on p. 115, argues in favour of the pistol which was found on the footboard of the Midland carriage having fallen from the window, because it was not directly under the window, but behind it, saying a murderer would hardly stop to calculate that the train would move forward while the pistol was falling. Now, by the second law of motion, the pistol, if dropped, would fall directly under the window, just as if the train were at rest; for the pistol before being dropped would have the same horizontal velocity as the train, and gravity could not alter this. The two stock examples given in text-books on mechanics are a stone dropped from the top of a mast of a ship in motion and from the roof of a railway carriage. No doubt the resistance of the air would decrease the horizontal velocity, and so the law would not be strictly fulfilled; but this would hardly, in a heavy body like a pistol, retard it to the extent of 2ft. while falling the height of a carriage door. I should draw the opposite conclusion from Mr. Stretton, and say it was placed behind the place from which it was supposed to have fallen by some one who wished to take account of the laws of fallen bodies, with which laws he was imperfectly acquainted.

Shaftesbury. **T. Perkins, M.A.**

ORDNANCE SURVEYS.

[26357.]—REFERRING to your correspondent (26279), page 84, whether it is delay or parsimony I know not; but it is nevertheless the fact that the patience of Job even would be tried in expectation of certain maps. The Geological Survey is especially slow for the work that is to be done, and the full staff there is to execute it with. In West Cumberland, the Carboniferous, with Rocks above it, was begun some fifteen years ago, and has since been continually worked upon, yet the work remains unpublished. The district, a most important one, abounds in iron and coal, &c., and occupies a little over 150 square miles, which any ordinary geologist could have carefully surveyed in less than one-half the time and with half the resources the staff can command. Surely the officials in chief delight in prolonging the work, instead of expediting it.

Whitehaven, Sept. 29. **Matthew Brown.**

ON THE SUPERIORITY OF ZINC AND STEEL PENDULUMS AS COMPARED WITH MERCURIAL PENDULUM.

[26358.]—WOULD you kindly allow me space in your valuable paper for a few remarks on the above subject, suggested by Mr. Thomas Buckney's interesting letters, published in the ENGLISH MECHANIC of August 20 and 27?

At present I do not wish to argue which is the best compensation, only that Mr. Buckney's experiments, as published, do not prove which is the best. Mr. Buckney compares a very badly-constructed mercurial pendulum to a well-constructed steel and zinc pendulum. The mercurial jars used for experiment were one 2in., the other 2¾in. diameter, and about 6in. high, one solid column of mercury. The zinc and steel tubes were, I suppose, less than 1in. diameter, and about ⅛in. thick in metal. As a matter of course, any change of temperature will act upon the light and thin steel and zinc tubes much sooner than upon a short column of mercury of about 12lb. weight. Such mercurial pendulums have been out of date many years, and are certainly inferior to a good steel and zinc pendulum.

Christian Lange.
23, Great Portland-street, W.

USEFUL AND SCIENTIFIC NOTES.

Sound Telegraphs.—The system of sound telegraphy used by the people living on the border of the Gulf of Guinea, West Africa, is of interest as a primitive solution of the problem of communication through short distances. The instrument is made as follows:—Take a log of hard wood, about 2ft. long and about a foot in diameter. Plane off one side longitudinally, to a surface four or five inches wide. In the centre of this surface mark off an elongated and somewhat distorted Greek cross. The longer arms are placed longitudinally, and occupy about one-third of the plane surface. The transverse arms are three times as broad, and extend entirely across this surface. The natives dig out the wood within the outline of the cross, and from there gradually hollow out the whole log. The sides beginning at the centre are trimmed off laterally toward the ends, which are rounded off. The instrument is now ready. It will be perceived that by the methods above described we have a hollow drum with four tongues in the centre, each of a different thickness, so as to produce a different sound when struck. Two pieces of bamboo, the size of a man's wrist and about 2ft. long, are selected and stripped of the hard outside, which leaves the soft, pithy portion for use. This bamboo is of a peculiar kind, free from knots, and solid throughout. With these sticks, used in a proper manner on the four tongues of the drum, a combination of sounds is produced, which, in connection with time as used in music, forms a perfect telegraphic language, readily understood by the initiated, the air being the transmitter. With this simple instrument the natives of the Gulf of Guinea readily communicate with each other for a distance of a mile at least on land, and a much longer distance by water. Messages can be sent long distances in a short time by parties at different points passing them along from one to the other. The writer has seen canoes coming down a river from the bush markets signalling people in the town and giving and receiving general news at a distance of fully three miles.

IMITATION amber has largely taken the place of real amber in the manufacture of pipes. This is the last information from the Konigsburg coast, where amber has, time out of mind, been sought by dragging at Schwartzort, and by mining for the last 20 years at Palmnicken. The company pays 2,000,000 marks (£100,000) to the German Government for the right of mining for amber. The mines produce about 3,000cwt. a year, and large pieces fetch £6 per kilogramme as taken from the mine. The largest manufacture of pipes with mouthpieces of amber is at Vienna, and there the sham article is very much used. In the mines at Palmnicken about 1,000 men are constantly employed.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[59842.] — **Mathematical Probabilities.** — Surely dividing by ·434 is more operose than multiplying by twice or even thrice as many figures. It is equivalent to multiplying by 2·304147, &c., whereas the proper multiplier for this operation is 2·302585, &c. It comes a little nearer your mark than multiplying by 2·3 alone; but not a quarter so near as by 2·303, which latter "R. E. F." will hardly, I suppose, think comparable with his dividing.—E. L. G.

[59842.]—**Mathematical Probabilities.**—To "R. E. F."—I must decline to enter into a discussion with "Libra" on this subject, as he holds opinions which are more peculiar than correct, and, persists in an error which I had previously pointed out. An ace would turn up on an average of four times, and not six, as the probability increases from throw to throw, and does not remain constant at $\frac{1}{6}$. The probable number of times 3 and 5 will turn up in 900 throws is $900 \div 12$, or, very roughly about 75 times. The number of combinations in 900 throws is 36^{900}, or 47016×10^{1386}. It does not appear to me that "Libra" is considering any problem at all, unless he supposes only one throw to be made in each case.—R. E. F.

[59926.]—**A Wonderful Lamp and Battery.** —This query was not answered on p. 464, Vol. XLIII., for "Sigma" is the only person who can answer, and it was asked because in Vol. XXXVII. he wrote an excellent article on chromic acid in the battery.—MAG. EST VER.

[60073.]—**Battery.**—ERRATUM.—For October 3rd, 1883, read September 3rd, 1886.—E. CONRY.

[60186.]—**Mathematical.**—The cube of 9·4 is not large enough to contain two spheres of 6. "T. C." should give us the exact dimension in the form of an integer + a surd.—E. L. G.

[60248.] — **Locomotive Proportions.** — This query appears in a letter on page 110 last week, and possibly may be answered at some length now. The rule is 50 square feet of heating surface for each square foot of grate, and that has been found to work well. To find how many square feet of grate are necessary, it is usual to reckon that 125lb. of coal can be consumed on each square foot per hour, and as coal varies in its quality it is not safe to reckon its evaporative power at more than 8lb. of water per pound of coal. Those are the elements required by the querist, who will perhaps forgive me for saying that he puts rather simple questions. Firebox surface is of more value than tube surface, but in what proportion has not been determined. If querist can refer to the letters of Mr. Gobert, some eight vols. back, he will see some of the operose calculations.—J. T. M.

[60255.] — **Hydrostatic Pressure.** — To "M.I.C.E."—I think the result by integral calculus will be interesting to many readers. What is the position of the point of suspension when the rod, when vertical, is in a state bordering on unstable equilibrium? There is another position of this point where the rod floats horizontally on the water. The x length is not the same in both. I hope "M.I.C.E." agrees with me on the question of strains in arches.—J. S. C.

[60264.]—**Mariners' Exams.** — Examination papers can be obtained, I believe, from the publishers of nautical works; but querist can hardly expect them to be set out at length as a reply to a query.—NUN. DOR.

[60265.]—**Gas-Engine.**—I should "advise" this querist to look in the advertisement columns, or to put an advertisement in the Wanted column.—VIDEO.

[60268.]—**C.G.S. Units.**—My authorities are "Units and Physical Constants," by Prof. J. D. Everett, page 24; and "Elementary Lessons in Electricity and Magnetism," by Prof. Silvanus P. Thompson, page 209.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60287.]—**Cloth Binding.** — Rub some glair over the spots.—NUN. DOR.

[60288.]—**Decay of Stone.**—Impossible to answer definitely without examining the stone, and perhaps not then; but in general terms, the decay is due no doubt to the action of the atmosphere on some constituent of the stone. It must be remembered that the air of a church (if well attended) is sometimes highly charged with aqueous vapour, and that condenses on the monuments, and quickly destroys some of the softer stones, and even some kinds of marble.—F.R.I.B.A.

[60294.]—**Action of Steam.**—ERRATA.—In my reply on p. 113, line 18 from the bottom, for "D A H" read "D A X"; line 8 from bottom, put a comma after "so," and erase that after "much"; p. 114, line 9, for "consideration" read "condensation." Line 27, after "end" insert *of the high-pressure cylinder which*, and underline from *the end* to *considering*.—GLATTON.

[60314.]—**Pollak's Battery.**—To "R. E. F."—"H. H." will find a description of this battery in the *Electrical Review* for July 30th, 1886, p. 105. No mention of the agglomerated portion is there made, and Mr. Habgood appears to have described a different modification altogether. The one I referred to was used for telegraph working, for which a current of $\frac{1}{30}$ ampère would be suitable.—R. E. F.

[60334.]—**Falling Bodies.**—"Dubliniensis" made this quite sufficiently clear, showing why we cannot exhibit the eastward deviation (as I once thought might be possible) in a lecture-room experiment. Can he or "R. E. F." now tell us if the body were falling down a shaft of unlimited depth at what depth, or time, its angular slope from the plumb line would reach a maximum?—E. L. G.

[60336.]—**Keeping a Pony.**—If I. Low will kindly refer to his first letter, he will find that his 1lb. to $1\frac{1}{2}$lb. of food for his pony included hay; hence my astonishment. If a horse or pony has only light work, and no fast travelling, he could be kept in excellent condition on hay alone, provided he gets enough of it, and of good quality. I have often fed and worked high-spirited horses on hay alone for months at a time, to keep them from smashing all before them.—DOCTOR MEDICINÆ.

[60336.]—**Keeping a Pony.**—Two years ago the 12th of September last, I bought a pony, trap, and harness. The expenses the first year averaged per week 8s. (nearly) for food and bedding, 5s. 6d. boy to look after it (I had to give him a little instruction at first), 2s. 4d. rent of stable and coach-house, making 15s. 10d.; twelve sets of shoes during the year at 3s. 6d. each set; compo. and polishing paste, &c., for the harness, occasional little repairs to same; the renewal of brushes, and painting trap once a year would be well covered at £5. The querist would probably have to give more for rent of stable, as I have mine of a neighbour who has no use for it. The wages of boy have now risen to 6s. 6d. per week, but he is not more than half the day on an average at the stable, doing odd jobs in the house the other half. From observation at a row of stables close to mine, I think I am rather an extravagant feeder; but I like any animal about me to be fat and happy. I have this year tried the mixture recommended by Mr. Low, but do not find the pony thrive on it so well as on oats; I give it for a change very occasionally. The opinions of the number of stablemen near to us are the same as "Doctor Medicinæ," that it costs £1 per week keeping a horse, and they have been a little surprised at the cost of my pony. —G. H. D.

[60349.]—**Florida.**—The climate of Florida is fairly equ ble and healthy, though in the extreme southern portion it is somewhat malarial, the temperature very seldom, in winter, falling below freezing point in any portion of the State, and in summer it is not hotter there than in New York, or any other part of the U.S. The chief industries are orange-growing, lumbering, general farming (cotton, Indian corn, and fruits), and, on the southern plains, cattle raising. Florida is not the best place in the world for an emigrant without money, though a little capital will go a long way there. Living, such as it is, is cheap—in fact, in the country (i.e., away from the towns) a man may live with hardly any exertion at all, edible animals and vegetables being abundant, and free to the gatherer; but if the querist has any intentions of making a fortune, he had best give Florida a wide berth. If the querist is a skilled labourer or artisan, he would find ample room in some of the other Southern States, where not only would his pay be as good as he could get anywhere in this country, but his living expenses would be far lower, and his social position better. If he has neither capital nor skilled labour, he had best not go South, as the labouring class there are for the most part ignorant negroes, and their wages are probably the lowest paid anywhere in the world outside of Asia.—AMERICUS, New York.

[60359.]—**Freezing Meat.**—I see that in my reply on p. 114 I have omitted to point out that the compressed air was made to do work as it expanded. More heat was extracted in the form of work from the air than could be removed by the water alone, and the heat absorbed by the air as it escaped was correspondingly increased.—GLATTON.

[60359 & 60362.]—**Dry Cold-Air Machinery.** —I saw at the Health Exhibition a cold-air machine in use in one of the dairy farm exhibits (the Express Dairy Farm Co.) This little machine was keeping their milk, butter, cream, &c., cool during the hot weather. The process the air undergoes is a very interesting subject; first, air is compressed in a cylinder of a given capacity to, say, 60lb. per square inch; it is next delivered into a reservoir composed of a number of small tubes, around which is circulated cold water, by which means the heat is abstracted (which was got in the compressing); the air being still under pressure is next used in an expanding cylinder, it being allowed to expand to atmospheric pressure, and by so doing gives out some of the power it took to compress the air, thereby helping to drive the machine. After the air leaves the expanding cylinder at a very low temperature, say 20° to 40° below zero, or to suit the requirements, it is sent into a chamber or large cupboard fitted with shelves that are made so as the air circulates freely, and the butter, milk, cream, &c., can be kept in prime condition for an indefinite period. This machine and chamber seemed to excite a great deal of interest among visitors to the exhibition. It was made by the General Engine and Boiler Co., Hatcham Iron Works, London, who have made this cooling business one of their many specialities and study. I saw at the Docks, awhile back, a very large air-cooling machine made by the same firm. This machine was capable of delivering 83,000 cubic feet of cold dry air per hour, and was one of the first to bring home from Brisbane a large cargo of frozen mutton, the same being in splendid condition. It is essential that the air delivered should be dry.—H. PURSE.

[60374.]—**Solder for Platinum.**—Platinum combines very readily with zinc, arsenic, and also with tin and other metals—so much so, that it is dangerous to melt either of those metals in a platinnm spoon, or to solder platinum with common tin solder, which fuses at a very low temperature; although platinum is constantly soldered with fine gold, the melting point of which is very high in the scale." Holtzapffel's "Turning and Mechanical Manipulation," Vol. I. p. 302.—J. K. P.

[60382.] — **Equal Balance.**—ERRATA.—On page 115, for "gauge" read "gravity."—GLATTON.

[60386.]—**Letters on Brass.**—To fill up the letters in your brass plate, you will want some red and black sealing-wax. Warm the plate over the gas or with a hot flat-iron, and then run the sealing-wax in till the letters are quite filled up. As you have got some bolts on the back of your plates, you had better get a piece of wood to lay the plates on, with holes bored through for the bolts to slip in, so that the plate lies perfectly flat and solid. To dress the plate down, rub it well with pumice-stone and water till the surplus wax is all taken off. Now wipe the plate dry and then sprinkle some fine pumice-powder and a little oil. Rub this on with a large cork or bung, or, failing pumice-powder, wrap a piece of emery cloth round the bung and rub with that. Wipe the plate clean again, and then put on some rottenstone with a little more oil. Wrap a piece of cloth round the bung and polish. Be careful not to make the plate too hot when filling up, or the sealing-wax will boil. This will make it porous, which will show as holes after the plate is polished.—GEO. WELLS, Needham Market.

[60410.] — **Electro-Motor for Boat.**—Your query, along with "Another Rochdale," had slipped my memory until too late for last week. Am sorry that I cannot at present give you all particulars of my boat; but, with Editor's permission, may do so at an early date. You will be disappointed if you look at page 570, Vol. XLI., for there is no motor there. Mr. Bottone has made a mistake. The motor sketched by Mr. E. Conry this week is quite unsuitable for your boat. You want something not more than half the weight. Will you send dimensions of your boat—length, beam, and depth—is it wood or iron; what cells you have, and size, and how many your boat will hold before sinking; or, what would be more suitable, what weight is required to sink your boat to water-line? With these particulars, I shall be pleased to give you a helping hand. Mr. Conry, I see, has made a serious error in quantities, or else in the gauge of wire he recommends for his motor. It would not even work, much less drive a 3ft. boat.—E. THOMSON.

[60412.]—**Steam.**—It is not possible to predict exactly what the steam in any engine will do without particulars of trials of other engines of the same general design. The work lost by condensation, friction, wire-drawing, &c., varies in every engine, and can only be found by trial. I will, therefore, estimate the saving which would result if there were no losses, which will exceed that actually realised. (1) The steam is cut off at $\frac{1}{2}$-stroke in the h.p. cylinder, and is then expanded till it first fills the whole of the h.p., and then it is made to fill the low-pressure cylinder, after which it is exhausted. (2) The area of the l.p. cylinder is 572·6 square inches, and the h.p. is 201·1 square inch. The volume of the l.p. cylinder is, therefore (the strokes being equal) $\frac{572 \cdot 6}{201 \cdot 1} = 2 \cdot 85$ times as great as that of the h.p. cylinder, and as a quantity of steam = $\frac{1}{2}$ the bulk

of the h.p. cylinder is expanded into the l.p. cylinder at each stroke, it will then be $2{\cdot}85 \times 2 = 5{\cdot}7$ times its original volume. (3) As the absolute pressure diminshes nearly as the volume increases, and the initial pressure is $(50 + 15) = 65$lb., the terminal pressure will be $\frac{65}{5{\cdot}7} = 11{\cdot}4$lb. absolute, or $(15 - 11{\cdot}4) = 3{\cdot}6$lb. less than atmospheric pressure. (4) To get the same terminal pressure with $(65 + 15) = 80$lb. absolute pressure you must alter the cut-off in your h.p. cylinder to $\frac{1}{2} \times \frac{65}{80} = {\cdot}406$ of the stroke. (5) The number of expansions then becomes $\frac{2{\cdot}85}{{\cdot}406} = 7{\cdot}025$, instead of $\frac{2{\cdot}85}{{\cdot}5} = 5{\cdot}7$. Taking the vacuum behind l.p. piston as 24in. of mercury, or, say, 3lb., we have the following figures:—(6) By the table on page 129 of last volume, the mean absolute pressure reduced to l.p. cylinder, when the initial pressure = 65, and the No. of expansions is 5·7, or just under 6, will be $(65 \times$ say ${\cdot}48) = 31{\cdot}1$lb. Deducting 3lb. back pressure leaves 28·1lb. useful pressure. (7) In the second case the mean absolute pressure with 80lb. steam and 7 expansions will be $80 \times 42 = 33{\cdot}6$. The useful mean pressure $= (33{\cdot}6 - 3) = 30{\cdot}6$. (8) The weight of 1 cubic foot of steam at 80lb. is 1·22 times as great as that of the same volume at 65. The volume used in the present arrangement is $\frac{{\cdot}5}{{\cdot}406} = 1{\cdot}231$ time as great as in the new one, and $\frac{1{\cdot}231}{1{\cdot}22} = 1{\cdot}008$ time as heavy. (9) That is, you will use the same quantity of water per stroke and get $\frac{30{\cdot}6}{28{\cdot}1} = 1{\cdot}09$ time as much work as at present. The losses due to condensation during expansion will be greater than before, and the saving will be even less than the above.—GLATTON.

[60414.]—**Overhead Wires.**—The advice given by E. Conry to run wires without permission is exceedingly bad. No person, or body of persons, have a right to monopolise any portion of public property. The streets and roads are the property of the community, and the "fussy vestry" is elected to look after its interest. The folly of E. Conry's remarks would be more apparent had he gone a step further, and told the querist to put his insulators and posts up without asking permission of the owners; he would probably have designated them "fussy owners." If the "fussy vestry," or some other body, had no control over their streets, we should have clothes lines and other abominations obscuring what little sunlight is left in crowded thoroughfares. "Armature's" assertion that local boards have no powers is simply nonsense, as anyone will soon find out by attempting to act without permission.—C. D. R.

[60421.]—**Carriages.—Railway Mystery.**—I see Mr. Stretton makes a slip on p. 115. A body let fall from a railway carriage window, if the train were moving at a uniform rate, would fall behind the door, not by the action of gravity, which would make it strike the footboard below the window; but because the wind would blow it back.—GLATTON.

[60434.]—**Crank Movement.**—You say that you "shift the centre of gravity to the other side of centre of motion." I must be very dense, but really I do not see how you avoid crossing the dead centre in so doing. Can't you give us a sketch of the motion?—T. C., Bristol.

[60449.] — **Music.** — I should recommend "Musik Freund" to read Beethoven's "Pianoforte Sonatas," by Ernest von Elterlein," also "Unrequited Love, or Records from a Young Lady's Diary" who was a personal friend of Beethoven's. I think these will give him the information he requires.—PRACTICAL.

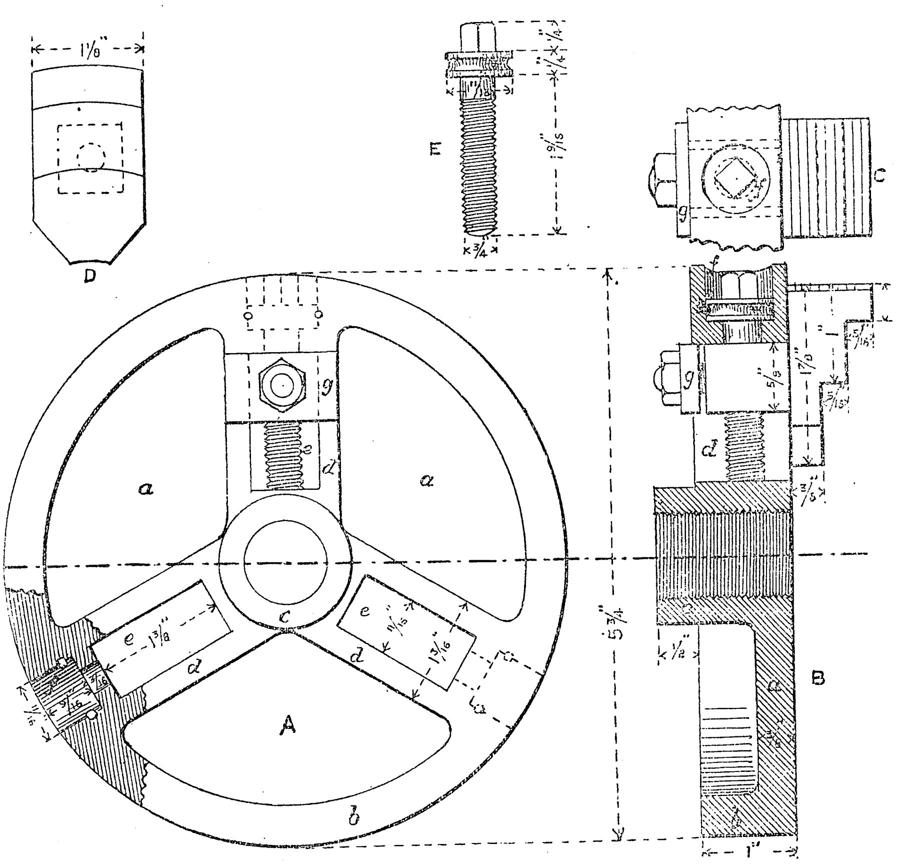
[60450.]—**Electric Power for Tramcars.**—These questions are evidently taken from examination papers, and it was never intended that they should be answered other than by the person to whom they were addressed. To endeavour to pass an exam. from information gathered in this manner is simply a farce.—C. D. R.

[60451.]—**Pocket Accumulators.**—Described several times. Look up indices. See replies last week to 60346.—C. D. R.

[60454.]—**Wind Motor for Electric Lighting.**—If this is all you describe it to be, it must be a most unique machine. Before expressing any opinion, suppose you give details of it in these columns?—C. D. R.

[60454.]—**Wind Motor for Electric Lighting.**—I am much obliged to Mr. Conry for his remarks on my motor. I have no practical knowledge of electric lighting; but I have for some time read carefully everything bearing on the subject in the "E. M." and in the *Electric Review.* Two things seem to me to be necessary—cheap motive power and steadiness in work. Wind is cheap, but unsteady. I have endeavoured to overcome this unsteadiness by regulating the speed of the machinery, instead of regulating the speed of the motor. As to reasonable size, it is reasonable, considering that the motive power is wind. Wind pressure rarely exceeds one pound to the foot for any length of time. There must be a reasonable surface to produce any palpable power. It will not easily go out of repair. I have had one running for three months night and day, when there was wind, without being touched, except for oiling. As to possible loss of power, it does not necessarily follow; for if there were two or three dynamos they could be attached in succession, as the power of the wind increased, and all worked together when there was sufficient power. All increase in wind power, after a certain point, makes no difference in the speed of the dynamo. So far as I have understood these matters, I have thought that it was not advisable to increase the speed of the dynamo beyond a certain point, and in my invention I have kept this in view. I am now making a small model of the motor and gearing, which I hope to have ready in course of a few weeks, and shall be glad to show it to anyone really interested in the matter.—F. G. GWYNT

[60472.] — **Chuck for 3in. Lathe.** — The figures represent a half-sized chuck for a 3in. lathe. A is the back view, B a section, C view on edge, D jaw, E screw. The pattern of the main plate is made by building up or turning out of the solid a ring *b* on a plate *a*, giving taper to the inside of the ring. The central boss *c* is put on to suit the mandrel nose; the thickness pieces *d* are fitted between the boss and the ring, and prints



put on the face of the plate to core out the spaces *e*. This is all, unless you like to make a plain core box as well, to insure getting true holes. The circular holes *f*, for the shouldered portion of the solid, and likewise the central hole for the mandrel nose are drilled. The jaw with its nut may, in so small a plate, be slotted from solid wrought iron or steel; the screws should be of steel; the jaws are clamped by means of the washers, *g*. If you want a smaller chuck you can easily reduce from these dimensions.—J. H.

[60472.]—**Chuck for 3in. Lathe.**—If you look into the Sixpenny Sale Column, you will find castings and working drawings advertised that will suit you.—C. D. R.

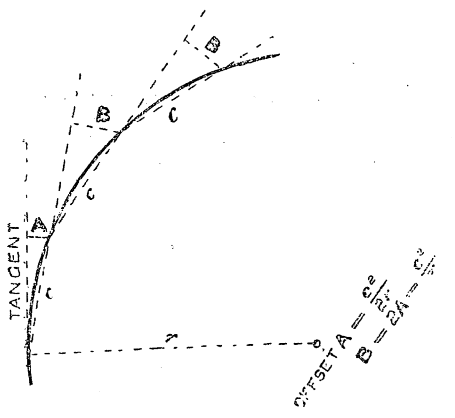
[60465.]—**Sewing Machine.**—Machines usually miss stitches when the needle is improperly set, so as not to throw the loop square into the shuttle race. Turn it a little to either side. See that it is not too far up or down. Sometimes the needle is too near or too far from the shuttle, and requires to be altered when a change is made from a fine to a coarse, or vice versâ. The "Howe" has a contrivance for effecting this. If a "Singer" machine with pinions, see that the marks on these correspond; also see to groove of needle if on proper side. I once saw a sewing machine which missed stitches with silk (a thing of rarer occurrence than with linen or cotton) cured by passing the thread once round the needle. "F. W. S." might have stated maker's name.—R. B.

[60473.]—**Resistance Coil or Switch.**—You will want both, it seems to me. The switch you can make by a strip of strong sheet brass fastened at the middle by a bolt and nuts to a board just loosely enough to turn, the end of which slides on a number of small pieces of the same material, ranged in a semicircle, at the proper distance to come under the end of the strip, and having the spaces between them filled with hard rubber or wood. Each of these contact pieces should have a hole drilled through it to admit of a round-headed screw passing through it and into the wood underneath, so that a wire can be fastened down under the screwhead. This is a general design, and can be varied to suit all sorts of currents. A very slightly-made switch will do for electroplating. For the resistance coil, make two squares of wood, say, 1in. square in section, and join them by four similar pieces at the four corners. Notch slightly the outermost edges of these four, and wind on the frame in the notches whatever wire you want the gauge, which depends on the current you want to carry, and the amount of it upon the maximum resistance you will require. Then, if you want several resistances of different strengths, mark off your drum of wire into corresponding sections, half, quarter, and so on, and at each mark solder on a short end of wire. These ends you can then connect to the various contact pieces on the switch, and thus by leading one wire of your circuit to the central bolt, and completing the circuit through the various parts of the resistance coil and the contact pieces, you can switch into the circuit the whole coil, and consequently the whole resistance, or three-quarters or half, or any part you desire. If you will state the current of your battery, the number of cells in series, and about what proportions of the whole current you want to have at command, I can give you the length, gauge, and divisions of wire you want for your coil. German silver is best; but copper will do.—E. CONRY.

[60484.]—**Twilight.**—Might I ask "E. L. G." to give his authority for the statement that "the lines dividing day from twilight, and twilight from night, are two parallel circles, about 1,250 statute miles apart," as I obtain a result about double that distance? If he will take the trouble to draw a diagram, his error will be evident enough. Describe a circle to represent the earth, and at any point on the circumference (the observer's station) draw a tangent *o a p*, and the diameter *a c d* at that

point. Next draw a line ab, making an angle of 18° with ap, cutting the circle in x, and join x with the centre c, and the other end of the diameter, d. Then it is apparent that the arc ax is in twilight, and the length of the arc is the distance apart of the two great circles. It will be seen that the figure is the same as Euclid III. 32, and it follows that the angle pax is equal to the angle in the alternate segment adx, that is, angle $adx = 18°$. But the angle at the centre being double that at the circumference, the angle $acx = 36°$. The length of the arc ax is equal to the circular measure of 36° multiplied by the earth's radius, or $\cdot 62832 \times 3956 = 2485$ miles, which is about double the incorrect value given by "E. L. G." This is the distance apart of the two parallel circles measured on the earth's surface, supposing it to be a sphere; but the actual distance between them is sin. 36° × earth's radius, or about 2,363 miles, being 122 miles less. This is, however, only the theoretical twilight, which is said to last until the sun is 18° below the horizon; but as a matter of fact this gives but a very inaccurate measure of its duration. Very often the twilight is over long before the sun has reached this depression, or may persist for some time after. The presence of aqueous vapour or particles of snow in the higher regions of the atmosphere may prolong the twilight until the sun is fully 10° lower than the usual angle. The shortest possible twilight (the actual, not the theoretical) is nothing like so long as 70 minutes, for in the tropical regions of South America it may be only a few minutes, in Chili 15 minutes, and in some parts of Europe half an hour. On the whole, the astronomical twilight (ending the moment a sixth magnitude star appears near the zenith) is the most exact and constant estimate.—R. E. F.

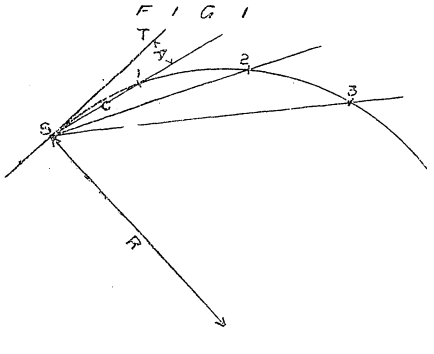
[60478.]—**Setting Out Curves.**—The inclosed sketch shows, I think, the simplest way of



doing this. Chords of 50, 66, or 100ft. are the most convenient for ordinary curves; of course the sharper the curve the less the chord that should be taken. If "Curvist" does not understand, and will state a case, I will explain further.—LIBRA.

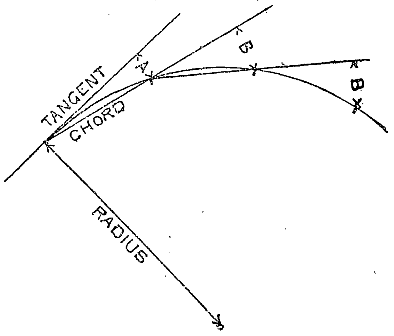
[60478.]—**Setting Out Curves.**—Either by tangential angles or by off-sets. Method by angles. Fig. 1, let R = radius of curve, C = any chord,

FIG. 1



A = tangential angle of C in minutes; then $A = \frac{1719\,C}{R}$. Example: Let R = 40 chains, and C = 1 chain. $A = \frac{1719 \times 1}{40}$, or 42′ 58″ the angle required, which is set out from the tangent T, the theodolite being at the springing of the curve S. Measure off the chord C 1 chain, the point 1 will be on the curve; points 2 and 3 will be found the same way. Method by offsets, Fig. 2:—

FIG. 2.



$$\text{Offset A from tangent} = \frac{\text{chord}^2}{2\ \text{radius}}$$

$$\text{Offset B} = 2\,\text{A} \quad = \frac{\text{chord}^2}{\text{radius}}$$

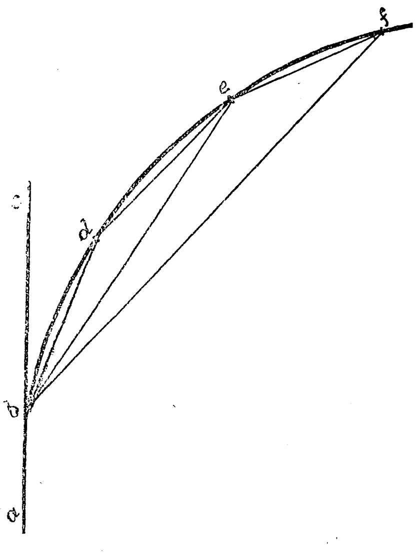
Various formulæ for the different problems in setting out railway curves will be found in "Molesworth's Pocketbook."—J. LATIMER.

[60478.]—**Setting Out Curves.**—A very easy method of setting out curves with a theodolite and chain (or tape) is as follows:—First work out this formula:

$$A = \frac{1{,}719' \times C}{R}$$

A = tangential angle of C in minutes.
C = chord (take 1 chain).
R = radius of curve.

In the figure, let $a\ c$ be a line, from which a curve



is to be set out (say from pt. b), set up the theodolite at b, point it to e, and swing it round to d, making angle $c\ b\ d$ equal to angle A (which is found from above formula), and measure along $b\ d$, making $b\ d$ equal to C the chord; then point d is a point on the curve (put a peg in d). For the next point, make angle $c\ b\ e$ = 2 A, and $d\ e$ = C = $b\ d$. For point f, make angle $c\ b\ f$ = 3 A, and $c\ b$ = C = $b\ d$, and so on, adding angle A to the last reading for the next point. For curves of short radius, best to take short chords (say half-chain).—K. K. K.

[60487.]—**Dynamo.**—Depends upon how the lamps are arranged. If in multiple arc, 25 volts and 12 ampères will do it; but if in series, 300 volts and about 1 ampère will suffice. The first method is the practical one. A potential of 200 volts is highly dangerous.—C. D. R.

[60488.]—**Medical Battery.**—As a canvas bag is used in a cell very like the Leclanché, I think you will succeed. The only objection is that canvas will be liable to rot.—GLATTON.

[60488.]—**Medical Battery.**—Yes; canvas or calico bags will do; but you must immerse the top portion in paraffin wax, as the salt creeps up and destroys the connections very quickly; that is a very serious disadvantage. Peroxide of manganese at 7lb. for 1s. 2d. is very cheap—too cheap to be good. It should be in small pieces about the size of a pea. You will find it advertised in the Sale Column every week. Remember that the oxide is about four times heavier than carbon.—C. D. R.

[60489.]—**Electric Lighting.**—How do you propose to drive the lathe? By foot? If so, the charging will never take place. You want a steam-engine.—C. D. R.

[60389.]—**Apparatus for Ringing Hand-bells.**—To MR. E. CONRY.—I am very much obliged for kind reply to my query, and should be very grateful for the sketch you kindly offer to give.—R. M. GREAVES.

[60491.]—**Time.**—"Chronos's" only reliable way of correcting the rate of his regulators is by means of a transit instrument. I should think that one of Mr. Clark's small window transit instruments, made by Mr. Frost, of 6, Westminster Chambers, Victoria-street, would be his cheapest method. By careful manipulation he would be able to get G.M.T. to a single second. Mr. Clark publishes simple tables of transits of stars for nearly every day in the year. These tables are simple, easy to work by, and thoroughly trustworthy, and give the transits reduced to mean time.—H. A.

[60492.]—**Mechanical.**—Write the numbers as a fraction, and reduce to its lowest terms. Thus:—$\frac{44}{28} = \frac{11}{7}$. The smaller number will be the revs. of the large wheel (= 7), and the larger number (11) the revs. which the small wheel must make before the same teeth meet again.—GLATTON.

[60492.]—**Mechanical.**—Range the numbers of teeth contained in the wheels in a row, and find the least common multiple. Divide this by the number of teeth to find the number of revolutions which will have to be made by the wheel containing that number of teeth before it is again in the same position as regards the other wheels, as at starting, thus:—

$$4\overline{)28 \cdot 44}$$
$$7 \cdot 11$$

$$4 \times 7 \times 11 = 308 \div 28 = 11 \text{ revolutions.}$$
$$308 \div 44 = 7 \quad ,,$$

This rule is correct for any number of wheels. Example:—

$$10\overline{)6\ .\ 50\ .\ 70}$$
$$3\ .\ 5\ .\ 7$$

$$10 \times 3 \times 5 \times 7 = 1050 \div 6 = 175 \text{ revolutions.}$$
$$1050 \div 14 = 75 \quad ,,$$
$$1050 \div 50 = 21 \quad ,,$$
$$1050 \div 70 = 15 \quad ,,$$

—LIBRA.

[60495.]—**Britannia Developer.**—I am an amateur in photos., and have passed through the "haze" which has troubled "Terranova," and so can sympathise with him. I am beginning now to get out of it. I do not strictly adhere to mixing up the formula given with these plates, which I use exclusively, but mix it up in small quantities as follows:—(A) Pyro. 25gr, brom. ammon. 45gr., water 10oz., nitric acid 2 drops. (B) Liq. amm. 3dr., water 10oz. For normal dev. equal quantities. My "haze" was caused by over-exposure. Put in smallest stop and give shortest possible exposure. Try again with same stop, lengthening exposure. Study Burton's "Modern Photography," a handy book for a beginner, 1s. "Set a stout heart to a stey brae," and go on. I sacrificed more than a half-gross of plates. They are now very cheap. Examine everything for white light. The cause may lie somewhere else than in developer.—R. B.

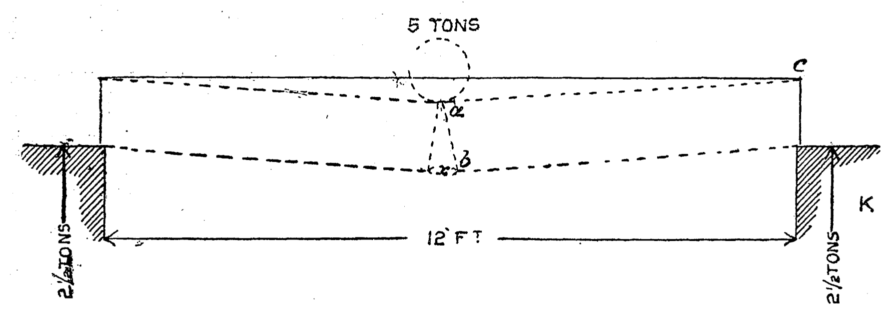
[60496.]—**Telephone Fixing.**—You do not take into consideration the currents that are constantly circulating through the different earth returns of other lines, beside the one you may speak of. These constitute the disturbing influence.—C. D. R.

[60496.]—**Britannia Developer.**—I have tried the plates in question with same results as "Terranova" mentions. I used usual pyro and ammonia, with bromide for development; also pyro with sulphite of soda and washing soda. I attributed the thinness of resulting negatives to the plates not being rich enough in silver. I never failed before to get density with other plates, such as Fry's, Edwards's, or Ilford's.—C. N. M.

[60497.]—**Acoustic Telephone.**—Your mechanical telephone, if properly constructed, should work well on four or even eight insulators. See that the wire is clear of everything in leaving diaphragm and through wall; also that it touches nothing except proper insulators till reaching other diaphragm. If there is a ringing sound when speaking, tighten up the wire till it ceases, and see that there is an equal tension throughout all the line. If your telephones are right, and you observe these conditions, you should converse easily several feet from instruments.—R. J. TAIT.

[60502.]—**Lattice Girders.**—For the span and load named by "Self-Taught," I would advise him to use a rolled girder, which can be got at any iron warehouse, and will cost much less than a lattice girder. A rolled girder 10in. by 4½in.

by 33lb. per foot would be quite strong enough; if, however, the lattice girder be a necessity, the strains on the top and bottom booms can be calculated in the following manner :



Assume a depth for the girder, say, 1ft. The load of 5 tons in the middle is divided equally between the two supports, and the reaction of each support upwards is, therefore, 2½ tons. In the imaginary bent lever, $c\ a\ b$, $a\ c$, multiplied by 2½ tons, the upward reaction of the support K is equal to $a\ b$ multiplied by the strain (x) on the bottom boom of the girder; that is to say:

$$6\text{ft.} \times 2\tfrac{1}{2}\text{ tons} = 1\text{ft.} \times x$$
$$\therefore x = 15 \text{ tons.}$$

The problem now is to find what size of iron will be necessary to withstand the strain of 15 tons. Wrought iron may safely be subjected to a tension of 5 tons per square inch, so that three square inches must be provided; Tee iron, 3in. by 3in. by ⅝in., will be sufficient. The strain in the top boom is equal in amount to that in the bottom one, but is a compressive strain. A better proportioned girder will be obtained by taking the depth of the girder as 9in. The calculation will then stand :

$$6\text{ft.} \times 2\tfrac{1}{2}\text{ tons} = \tfrac{3}{4}\text{ft.} \times x$$
$$15 \text{ tons} = \frac{3\ x}{4}$$
$$x = 20 \text{ tons}$$

which, at 5 tons per square inch, will require four square inches area; in this case Tee iron, 3½in. by 3½in. by ⅝in. would be suitable. The lattice bars should be 2in. by ½in. flat bars, riveted on alternate sides of the Tee iron. The above method of calculation is the one adopted by Sir John Anderson in his "Strength of Materials" (3s. 6d.), Longmans, a book I would strongly recommend to "Self Taught." Other books which treat on this subject in an elementary manner are Perry's "Practical Mechanics" (3s. 6d.), Cassell's; Campin's "Iron Bridges, Roofs, and Girders" (2s. 6d.), Crosby Lockwood, and Co. Humber's "Handybook of Strains" (7s. 6d.), is a useful book of reference for those who have already learnt the use of the formulæ and know the reasoning on which they are based.—Arthur Bowes.

[60503.]—**Photography.**—Mr. S. Bottone, replying to this query, is very inaccurate. He says the plates at 1s. the dozen are not usually good, but says for 1s. 6d. the dozen several first-rate makes can be had, including Marion's "Ilford" and Fry's "German." Now, in the first place, Marion and Co. neither make nor sell "Ilford" plates; but "Britannia" and "Ilford," "German" and "Britannia" alike are cheap plates at 1s. the dozen. That "Ilford" are very good, I can testify personally. "German," I hear are good, and the few "Britannia" I have used this year turned out well.—T. Perkins.

[60507.]—**Electrical.**—There is no such a thing as "an arc of ½in.," so I am rather puzzled to know what you mean. With a lever pivoted at one end, very near an electro-magnet, with poles about 3in. distant, and an armature about 3in. long, the upper end being ½in. from the upper leg of the electro-magnet, you could pull 3lb. easily with a single pint bichromate if your electro-magnet were about ½in. core, 8in. long, bent into the horseshoe shape, and wound with six layers of No. 20 d.c.c. wire. To fire gun, a specially-made fuse, such as Abel's or Statham's, would do without the coil.—S. Bottone.

[60507.]—**Electrical.**—You could not do it with any magnet that could be worked by any battery deserving the title "small." Three pounds is a heavy pull for any electro-magnet or solenoid to overcome. It could be done with one cell and an electro-magnet of very low resistance, but the cell would have to be a very large one. If a small battery be a *sine quâ non*, I should suggest using a lever with an iron armature on the end, made just as heavy as compatible with allowing the other end to remain in its normal position without any additional force being applied, and then arrange, say, three sets of three each of small electro-magnets, ½in. cores wound with ½in. thick layer of cotton or silk-covered No. 22, the fulcrum of the lever being midway, and the sets so arranged that the first one, on switching on the battery, should come into action and draw down the armature, say, ⅙in., thus bringing it within the range of the second set, the circuits of the first being carried through contact pieces on the lever itself, so arranged as to break contact for the first set and switch on the second set at the moment that the armature by meeting the cores of the first set, had come within range of the second set, the third set being similarly arranged with regard to the second. In this way I think you could lift 3lb. with a battery of not more than six moderate-sized bichromate or chromic acid cells, and I could give you a sketch of the connections and contact pieces, but the whole apparatus would be a complicated affair, depending for its working on exact and delicate adjustment, and any mechanical device would be preferable. In view of the fact that magnetic force diminishes in proportion to the square of the distance, you would, I should say, require, for a single magnet powerful enough to overcome 3lb. from the distance of ½in., a battery of about 20 cells, if the magnet were of fine wire, as is generally preferable, or a couple of small tanks if the magnet were low resistance. For any small battery, you would require to use a coil, sending its spark through some detonator fuse, as the fulminate of mercury or the Abel fuse, both of which have, I think, been fully described in back numbers.—E. Conry.

[60507.]—**Electrical.**—What is "an arc of ½in."? Before our electrical correspondents can give a proper reply it will be necessary to say how far the weight is moved and how far the armature moves in the same time. I think it would be well also if you could give more particulars, as ½in. is a long pull for a magnet (if you mean the armature to move so far), and I do not think any magnet of moderate dimensions could exert a pull of 3lb. at that distance. Of course, if you give the length of lever, the end of which moves ½in., the expression at the beginning of this reply will have some meaning.—Glatton.

[60508.]—**Aureolin.**—Field, in his "Chromatography," Salter's Edition (no date), though he describes the sources of the common and well-known colours, instead of doing so in the case of aureolin, gives two long puffs regarding its merits; an omission which is strange, considering that his work is published by one of the best known and leading artists' colourmen in England, to whom, if I am not mistaken, is due both the name and the introduction of this colour into use. E. A. Davidson, in his "Grammar of Colouring," Weale's series, says that aureolin is a nitrate of cobalt—a very pure and permanent yellow—but nothing regarding its preparation.—Eye-Witness.

[60509.]—**Gold from Quartz.**—Pulverise a pound of gold quartz into a fine powder; then wash it carefully in a clean dish. Let the coloured water run over the edge until all is washed away except a few grains of the heavier stuff, when, if there is any gold present, it being the heaviest, will remain along the edge of the residue. Gather very carefully, and extract any iron with a magnet. Weigh the gold, which will give so much to a pound or ton, as may be required. If there is no gold visible to the naked eye, try a magnifying glass.—J. A. Harrington, Artist and Gold Miner of California and South Africa.

[60511.]—**Boys' Marbles.**—From Holtzapffel's book, p. 1,078:—"These are principally manufactured in Germany: some are made of clay, covered with a glaze and baked, as in pottery; others are made of alabaster and marble; but the greater part are made of a hard stone found near Coburg, in Saxony. The stone is first broken with the hammer into small cubical fragments, and about 100 to 150 of these are ground at one time in a mill, somewhat like a flour mill. The lower stone (and), which remains at rest, has several concentric circular grooves or furrows; the upper stone is of the same diameter as the lower, and is made to revolve by water or other power." Extracted from Gill's description (see "Tech. Repos." for 1828, p. 219):—Without having very many to select from, I managed to secure three dozen, of which the biggest is 1·21in. diameter, and the smallest 1·70in. About two dozen are very nearly the mean of those two—viz., 1·19. Although they are obviously coloured artificially—some blue, some yellow or Indian red, and a few brown—I am nearly sure that they are not of clay, but of stone, as some of them, although for the most part duly spherical like the rest, have even as many as three decidedly flat places left on them, as if remnants of the shape in which they were originally chipped out. They are amply near enough to one size to satisfy my requirements, and I used them in preference to bullets, which would have been a warm job to make by the quarter-gross in the recent weather. The wooden ones that I supplemented them with were made to gauge without any difficulty, and without a spherical rest, which is a tool to be recommended for ball turning to those only who cannot use their fingers. With respect to shot boxing:

1. I reckon a box 8in. cube to hold, of 1in. balls, 212, piled chequerwise and layer on layer.
2. A box 8in. × 8in. × $8\frac{1}{10}$in. will hold five tiers of 49, and six tiers of 64 = 629.
3. A box 8in. × 8in. × $6\frac{21}{32}$in. will hold five tiers of 49, and four tiers of 64 = 501; or five tiers of 64, and four tiers of 49 = 516.
4. And a box 8½in. × 8½in. × $8\frac{1}{10}$in. will hold eleven tiers of 64 = 704, which is closer packing still than No. 2 in the proportion of 704 : 680 ±.

I have hardly given any attention to the subject, and my figures may be wrong.—J. K. P.

[60512.]—**Mathematical.**—

(1) $$a = x^2 + y$$

Transposing—

$$x^2 = a - y$$

Taking square root—

$$x = \sqrt{a - y} \quad \dots\dots\dots\dots \quad (a)$$

Next—

$$y = a - x^2 \quad \dots\dots\dots\dots \quad (b)$$

(2) $$b = x + y^2$$

Transposing—

$$x = b - y^2 \quad \dots\dots\dots\dots \quad (a')$$
$$y^2 = b - x$$

Taking square root—

$$y = \sqrt{b - x} \quad \dots\dots\dots\dots \quad (b')$$

Thus x is found in terms of a and y and b and y; and y in terms of a and x and b and x respectively.—R. E. F.

[60519.]—**Large Induction Coil.**—To S. Bottone.—Core, 1in. by 8in.; primary, two layers of No. 16 d.c.c.; secondary, 1lb. No. 36 d.s.c.; condenser, 50 sheets of tinfoil, alternated with paraffin paper, 7in. by 5in. This will give 1in. spark.—S. Bottone.

[60520.]—**Kauri Gum Solvent.**—Bisulphide of carbon, coal-tar naphtha, acetate of amyl, oil of turpentine. This latter is principally used, aided by heat and the addition of a little camphor.—S. Bottone.

[60520.]—**Kauri Gum Solvent.**—In making varnishes the kauri is not dissolved, but "run" (i.e., melted at considerable heat in a pot). The hot oil is then added. Considerable experience is required to be successful. You may dissolve kauri in methylated spirit by the application of heat and agitation after considerable time.—T. C., Bristol.

[60527.]—**Medical Coils and Paralysis.**—To Mr. Bottone.—(1) Yes. One electrode should be put in a foot bath of warm water and salt, in which the paralysed foot or feet are immersed, while the other is gently rubbed along the lower part of spine, and about the affected leg. (2) Current from coil is not constant, and therefore much more stimulating. (3) No.—S. Bottone.

[60528.]—**Photographic.**—I give the three following modes, which are all good: (1) Make a solution of silver nitrate in distilled water, say, 30 grains to the ounce. Place a few drops of this clear solution in a test glass. Allow the drippings from the suspected pictures to fall in this. If a white, curdy precipitate, rapidly turning yellow and then black, appears, the picture is not washed enough. (2) Make a thin starch paste; colour it blue by the addition of one drop of tincture of iodine to each pint of thin paste. Use as above. As long as hypo-sulphite is present, it will bleach the paste. (3) A dilute solution of Condy's fluid (permanganate of potash) is discoloured if hypo is present in the drippings.—S. Bottone.

[60528.]—**Photographic.**—Level the negative under examination on a levelling stand, pour upon it, film side upwards, enough distilled water to flood it; any hyposulphite that may be present will dissolve in the supernatant water, which can be tested afterwards as to its presence or absence. In the case of a print, allow it to be in contact with the distilled or ordinary water if free from organic or other oxidisable matter, for, say, twenty minutes or less. Take a few crystals of potassium permanganate dissolved in water and diluted to a light pink colour. If now a few drops of water from

the negative or paper under examination be mixed with the weak solution of permanganate, an instant decoloration ensues if only an infinitesimal amount of the hyposulphite be present. This is an exceedingly delicate test. Iodide of starch is also used; it is of an indigo colour, and becomes immediately colourless in solution with the slightest trace of a hyposulphite salt. This reagent can easily be prepared by the addition of the halogen iodine to a solution of starch paste. I dare say your mother would give you a lesson or two in starch-making if you do not already know.—A. TREYER EVANS, Monmouthshire.

[60528.] — **Photographic.** — Authorities differ much in the amount of time which should be allowed to wash out the hyposulphite of soda from negatives and prints; for the former, Abney considers six hours in running water not too long. Burton prescribes half an hour in running water; Hughes, three or four changes of water during one hour. For prints six to twelve hours is generally recommended; for my part, I give eighteen hours for prints, the water frequently changed, and often running, finishing up with three or four washings in boiling water. I may mention that prints so treated over thirty years ago, which have been kept in a book, are still unfaded and unchanged. As regards tests, Abney gives two to ascertain the presence of hyposulphite of soda in the water used for washing, and one for the same salt in the paper print. They are: 1, Potassium permanganate 2 grains, potassium carbonate 20 grains, water 1 quart; a few drops of this rose-coloured solution gives to a pint of pure water a pink tinge, to water with a trace of the hyposulphite a green one. 2, A piece of starch the size of a pea is powdered and boiled in two drachms of water till clear, to this one drop of a solution of iodine in alcohol is added, which produces a dark blue solution; two drops of this solution added to a small quantity of the wash water in a test tube will give, if free from the hyposulphite, a pale blue tinge; if the salt be present, the blue disappears and the solution becomes colourless. 3. A very weak solution of potassium iodide is brushed across the back of a print: a blue mark indicates the absence of the hyposulphite.—EYE-WITNESS.

[60531.]—**Lamp for Boiler.**—One of the many oil stoves in the market will not smoke if kept from a draught and the wick is properly trimmed. —T. C., Bristol.

[60531.]—**Lamp for Boiler.**—Get a Bunsen burner from any ironmonger's. With a single burner, I do not know that you could do much better than have a plain, flat-bottomed boiler, like a saucepan, only covered in closely.—E. CONRY.

[60535.]—**Coil to Give Half-inch Spark.**—TO MR. BOTTONE.—Should have a condenser consisting of about 50 sheets of tinfoil alternately with paraffined paper, 7in. by 5in.—S. BOTTONE.

[60536.]—**Wimshurst Influence Machine.**—TO "CARNFORTH."—The number of sectors to be used on a 16in. plate depends upon the results desired. If length of spark is wanted, then use 12 sectors, and let the length of sector be not more than 2½in.; the outer ends should not be more than a ½in. from the edge of plate. If freedom of excitement is desired, then use 16 or 18 sectors, and let the sectors be nearly 4in. long; this also gives greater quantity of electricity, as a greater breadth of the plate is brought under electrical excitement. He should look up your earlier numbers for the details of construction. The issue of 14th November, 1884, contains every detail he can wish of a very good form of machine. The pamphlet by Mr. Gray, which contains a reprint from your pages, may be obtained from the publishers, Messrs. Pewtress and Co., Little Queen-street, Holborn.—J. W.

[60539.]—**Valve Gear of Marine Engines.**—Yes, cams are by no means new or unknown for working the cut-off in these engines, although they are not general. Usually the cam is a casting, having several steps or cams side by side, so that a roller, which works in the end of a lever, may, by means of a screw, be shifted sideways on to any one of the cams required to be used. I think some of these are figured in "Browne on the Screw Engine."—T. C., Bristol.

[60544.] — **Microscopical.** — (1) In working with a camera lucida, one of the best plans is to use two lights, one to illuminate the object, and the other the paper. A candle does perfectly as the second source of light. In your case the paper is probably too strongly illuminated.—PLAYFAIR.

[60545.]—**Photo-Micrography.**—If you know anything of photography, nothing can be easier. Shall be happy to give you working details if you intend trying.—S. BOTTONE.

[60545.]—**Photo-Micrography.**—All you require besides the camera and the compound microscope are a good paraffin lamp and reflector and a condenser. If your microscope stand is so constructed that you can turn the tube down to a horizontal position, put the eyepiece end into the hole of the camera (it must be a long-bodied one) intended for the lens, and make the junction light tight with a black cloth. Arrange all the apparatus on a kitchen table in the following order:—Camera, microscope tube, object-glass, slide, condenser, lamp, reflector.—B.SC., Plymouth.

[60548.]—**Copper Boiler.**—You do not say what form the boiler is. If cylindrical, you do not require cross stays; and if square the boiler is not sufficiently stayed, and consequently is very weak. Send full particulars, especially as to form of joints and workmanship. Anything above 5lb. would drive the engine—that is, it would go round; but 30 to 40lb. is usual for driving if used for anything.—T. C., Bristol.

[60549.]—**Telegraph Connections.**—TO E. CONRY.—I have sent in diagram and description of what you ask; but am rather afraid it is too late for the issue; if so, it will be in next week's number.—E. CONRY.

[60550.] — **Chemical.** — If Mr. T. Morris evaporates his mixture of cuprous cyanide and caustic potash to dryness, and fuses the residue at a low red heat, he will obtain a mixture of metallic copper, cyanide of potash, and cyanate of potash. To reduce the last-named compound, and so increase the yield of cyanide of potash, an addition of charcoal dust previous to the process of evaporation and fusion will be required. The above procedure is, in my opinion, the most practical solution of Mr. Morris's query; but he may expect a yield of cyanide considerably under theory, the moisture unavoidably present in this particular case tending at a red heat to its ultimate decomposition to carbonate of potash.—NORMAN MCCULLOCH.

[60551.]—**Reed Organ.**—If "G. D. G." intends to build a reed organ on the suction principle, I should advise him to get the American organ cavity boards and reeds, as they are made expressly for the suction principle. One of C scale is most suitable for pedals; but the majority of the cavity boards are of F scale. There is sometimes a difficulty in procuring those of C scale. I don't exactly know the reason; but probably there are more made to F scale. For the pedal bass you can purchase a set of large pedal bass reeds in the tubes. Fix this on the back of the soundboard, and have a set of suitable pallets actuated by the pedal levers; but I know of a far better plan than this if he likes to go to the expense of it. There is no necessity of having steel vibrators for the 4ft. set, as brass is quite good and durable enough for all practical purposes. The specification you name is a very good one; but the addition of an 8ft. solo set in the treble would somewhat improve the arrangement. The 8ft. solo set should be of three octaves; the vox humana is a mechanical arrangement, superior, in my opinion, to the ordinary tremolo. What "G. D. G." refers to is evidently the voix celeste. The celeste, or wavy effect, can be produced without having one of the sets out of tune. It is obtained by a different mode of conducting the air to one of the sets, which causes the reeds to sound a trifle flatter than the other. Another stop of a different name is used to conduct the air to the reeds in the usual way, by which means the reeds are brought again in tune with the other sets when the full power of the instrument is required. This is the best form of the celeste; the other method (which, unfortunately, is much too common) is greatly objected to by the best musicians. To get the reeds to sound the nearest approach to the pipe organ is no easy matter. To accomplish this desideratum, the reeds require to be voiced by an artist; to voice a set of reeds properly requires a certain degree of artistic skill, which can only be acquired by constant practical experience in the art. In a general way, the quality of tone from any reed organ, whether constructed on pressure or exhaust principle, depends almost entirely on the voicing of the reeds. Unless "G. D. G." can get an artist to voice his reeds, I am afraid he will be obliged to remain satisfied with the ordinary quality of tone which is found in the generality of reed organs constructed on the suction principle. Further information, if requested.—G. FRYER.

[60553.]—**Wimshurst Influence Machine.**—I shall be glad in the course of a week or so to give you, and other readers who may be interested, the chief working particulars for an eight-plate machine to be built within a glass case. It is, of course, a matter of choice only as to how many of the plates shall be used; two plates answer, while from eight plates the quantity is four times greater. The increased number of plates simply means a proportional increase in the number of parts and in the results. Some of the straight jars used by confectioners answer very well for Leyden jars, but others will not answer. It depends entirely upon the quality of the glass. I have seen large numbers of Leyden jars from Germany, made of beautifully clear and white glass, yet they were absolutely useless, for electricity passed through the glass as freely as through metal. For electrical work, always test the quality of glass before adopting it for use.—J. W.

UNANSWERED QUERIES.

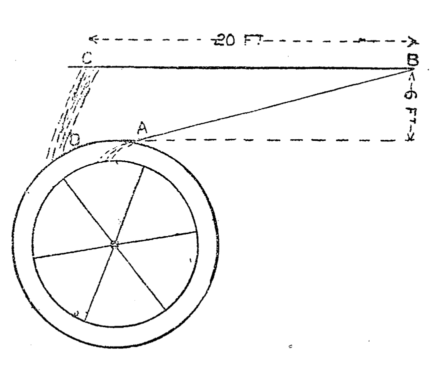
The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

60023. Pitch Circles, p. 491.
60039. To Mr. Stretton, 492.
60042. G.E.R. Locos, 492.
60057. Arc Lamp, 492.
60058. Fall of Potential, 492.
60059. G.N.R. Locos, 493.
60069. Railway Signal, 493.

60249. Brakes, p. 587.
60251. Dipping Pewter Goods, 587.
60269. Range Finder, or What? 588.
60272. Tuning English Concertina to Equal Temperament, 588.
60275. New Banjo, 588.
60278. Grape Sugar, 588.
60290. Bottle Brush, 588.
60291. Blue Bricks, 588.

QUERIES.

[60560.]—**Water Wheel.**—Water is run on to a water wheel by a trough, A B, with an inclination of 6ft. in 20ft. Would it be more effective if the trough were level, as C B,



and the water allowed to drop as at C D? If so, why? A full explanation, with difference shown, if any, will greatly oblige—JAS. JONES.

[60561.]—**Polish.**—I have stained some ordinary deal with ebony stain. Can anyone give me a good recipe for a good and cheap polish, as I do not wish to varnish? One that will do for any stain will be very useful to me.—COLOMBO.

[60562.]—**Current Quantity.**—Will some one of our electrical experts kindly say what surface of zinc in an exciting liquid will give me one, two, three, or more ampères? I wish to calibrate an ammeter by increasing the active surface of zinc in any form of cell, having no other means of doing so.—C. R. N.

[60563.]—**Lathe Speed Pulleys.**—I am making alterations to my 4½in. lathe that will necessitate new pulleys on the crank shaft. Will some kind fellow reader advise me as to the most useful ratio between mandrel and crank? Would 7 to 1, 3½ to 1, and 2 to 1 be advisable, or what are better? At present my mandrel pulleys are 5in., 3½in., and 2in. respectively in diam. I should like one length of gut to suffice for the three speeds. I have no back-gear. Is there any royal road to changing the gut from one speed to another? I find a difficulty with the grooved pulleys, as the band has to be so tight on the small diameters.—T. G., Birmingham.

[60564.]—**Timber Truss.**—Will any reader kindly inform me of any method of calculating the strength of a timber truss, such as used at Marac by Col. Emy, for the roof of a shed, or the title of any book with such information in it?—CREOLE.

[60565.]—**Mastic Varnish for Oil Painting.**—Will some correspondent kindly inform me how to prepare mastic varnish for oil paintings, which will not "bloom."—J. K.

[60566.]—**Relief in Photo. Negatives.**—When a dry plate is developed, the gelatine often stands up in relief, but dries down quite flat. Is there any method of drying the plate and preserving the relief?—SEPIA.

[60567.]—**Broken Backbone of Bicycle.**—Having a second-hand bicycle to repair which had been patched at the top of the backbone by an unskilled blacksmith, I would feel much obliged if some brother artisan would give me a few hints how to fix it firmer, as there is a disagreeable jerk when ridden. Would brazing do? It is hollow iron.—J. THOMSON.

[60568.]—**Bleaching Greasy Silk.**—Could some of the readers of the "E. M." kindly inform me how spirits of salts is applied in the bleaching of greasy silk after it has been scoured with soda or alkali? Also if there is a better and cheaper bleacher for the purpose, and, if so, how is it used?—AMATEUR.

[60569.]—**G.E. Locos.**—Can anyone tell me what class of engine No. 538 is, dimensions of cylinders and wheels, weight and tractive power?—F. THOMAS.

[60570.]—**Burning Oil.**—Now that such strides have been made in the burning of mineral oils in the production of such burners as the Kosmos, Mitrailleuse, &c., I propose altering my gas pipes to burn oil as above. Now I wish

to ask some of "ours" to help me to convert my existing gas pipes, $\frac{1}{2}$in. iron, into reservoirs for oil, my object being the great saving I shall effect, as I find oil is so much cheaper than gas, even in London, where gas is so much cheaper than in the country. I do hope some help will be extended to me, as I know a great many are interested in light just now.—OIL v. GAS.

[60571.]—**L. and N.W. Locos.**—What class does No. 2082 belong to? Is she one of the Compounds? How many "Dreadnoughts" do the L. and N.W. now possess?—REINDEER.

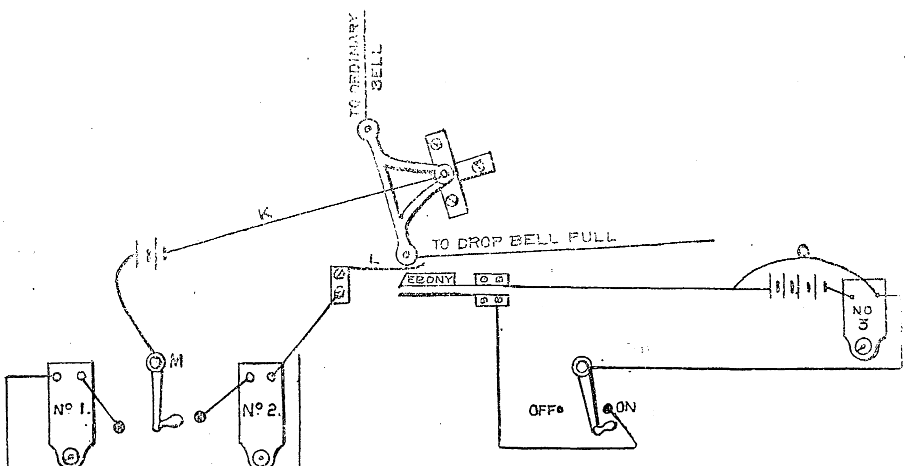
[60572.]—**L. and S.W. Locos.**—(1) What are the dates of Gaul, Dane, Prince, Princess, Undine, Stentor, and Castleman, and what is the diam. of their driving wheels and their weight when empty? (2) Can anyone give me particulars of No. 521 class, built by Dübbs and Co.?—REINDEER.

[60573.]—**Lighting School Room.** — Will some kind friend inform me of the best way of lighting a schoolroom and removing the products of combustion by means of pipes leading into the open air? The Wenham burner is good, but too expensive. The albo-carbon light is very bright, and I should like to know whether a pipe running horizontally just above the ceiling with a funnel-shaped opening fixed about 18in. above the gas flame would carry off the vitiated air?—LUX.

[60574.]—**Astronomical Photographs.**—I would feel much obliged if Mr. Franks, Mr. Clapham, or other corresponding friends of the "E. M.," would kindly say where photos. of the "Orion Nebula" by Mr. Common, of the "Pleiades" by the Brothers Henry, also of the moon, or any other astro. photos. can be obtained, with the cost, if not trespassing on your advertisement privileges? I am sure there are many others besides myself who will like to have a copy of these latest triumphs of photography, if moderate in cost.—S. R. C.

[60575.]—**Bichromate Battery.**—Will Mr. Bottone, or some other worthy friend kindly give instructions for making a cheap bichromate battery, such as would work medical coil, described on page 52, No. 1121? Would retort carbon do, and how can I fix binding screws to same, as I find it very hard to cut?—AMATEUR.

[60576.]—**Faulty Bell.**—I have fixed some electric bells, and one that is shown at No. 3 in sketch is always uncertain in action. It is fixed in a yard, but under cover.



Sometimes it rings well, and at others, without any apparent cause, jibs. It will be seen in sketch to make contact through spring L pressing on a piece of ebony that is attached to the upper of a pair of brass springs that have pieces of platinum soldered to them to insure perfect contact. N is a switch to throw bell in or out; O third wire for continuing ringing. This has a battery of four cells; sometimes it stops for a day or two, and then rings allright the next. The battery seems allright. Have coupled direct to bell, and it rings sometimes and sometimes moves armature a little, and another time draws it to magnet and remains there. Connections seem allright. The other bells, No. 1 and No. 2, ring allright; but No. 2 is fixed in surgery, and gets badly corroded. These make contact through bell crank, which works as a copper pin, and presses on L when ordinary bell is rung. M, switch to either 1 or 2 bell. These are rung by a 2-cell battery; both are Leclanché with porous pots. What is the cause of bell not ringing, and No. 2 corroding?—BILLY.

[60577.]—**Apples.**—Can any of our readers tell me what is the best method of preserving apples, as I have a considerable quantity which I wish to preserve during winter?—DESIDERATUM.

[60578.]—**Lathe.**—Will some reader please tell me the use of a broad one-grooved pulley, about 8in. diam., which runs loose on crankshaft of my lathe close to flywheel? Also, can I make the thread in wooden chucks with an ordinary tap, as I do not understand the chaser, being a beginner? If not, how can I make or procure one to suit mandrel nose?—BEGINNER.

[60579.]—**Lathe.**—My lathe bed, 2ft. iron, is untrue towards poppet end of bed. It runs up hill suddenly within 3in. of end; remainder of bed fairly true. Would it be safe for me to attempt to true it up a bit?—BEGINNER.

[60580.] — **Paquelin's Thermo-Cautere.** — Will any reader kindly give a description, with drawings, of the internal or heating arrangements of Dr. Paquelin's thermo-cautère? I wish to know particularly how the platinum parts are arranged and heated. Would it be difficult to make, as the price charged seems out of all bounds?—A VET. SURGEON.

[60581.]—**French Button Lens.**—(Page 88, letter 26300). What is it—its advantages, form, and disadvantages? If achromatic, its anatomy—i.e., how built up?—A COUNTRYMAN.

[60582.]—**Wood Bits.**—Will someone kindly say if the Morse drill with lip and spur is any use for boring $\frac{1}{2}$in. holes through $1\frac{1}{2}$in. ash? Have tried Jenney's twisted auger with screw joint; but they spring and do not clear very well when the lathe is running to draw the wood back. I have a lot to bore in lathe, and want to hold work in hands and feed up and withdraw.—C. B.

[60583.]—**Bicycle Making.**—I have searched for a long while, hoping to find something on the above, similar to "J. H.'s" excellent articles on machine tools. Should feel grateful (like many more of our readers) if some of our Coventry subscribers would give us a few hints, or failing that, makers of rough materials would find it to their advantage to do so during winter months, when amateurs are busy.—C. B.

[60584.]—**Blueing Steel without Heat.**—Will some reader be good enough to give me a recipe for blueing steel without heat?—SNIPE.

[60585.]—**Laying in Cold-Water Pipes.**—Would some reader say what kind of clay or loam it is that is used for putting round the flange of pipes for running in lead in joints, and if it is used in oil to prevent the blowing of the metal when poured in? I have seen the clay used, which appears to be very much tougher than any ordinary clay.—FORCE PUMP.

[60586.]—**The Wimshurst Influence Machine.**—TO MR. WIMSHURST.—I have just finished a 17in. influence machine, and I cannot get it to work at all; all the sparks I get are a few on the brushes. Should the brushes be connected with each other by the steel spindle? I have made the plates of ebonite instead of glass. Would that have anything to do with its not working, and could you suggest any place where I have made a mistake.—INDUCTION.

[60587.]—**Poise.**—I have bought a pair of calipers with wheel tester, and find they are not drilled. Would "A. F. W.," or "Alfojoe," kindly recommend a way to do them so as to have holes in line? Also say if it is necessary to jewel them. If so, should prefer to buy them finished.—A GOOD TOOL.

[60588.]—**Verge Watch.**—Would "A. F. W.," or any other of "ours," kindly help me with the above? I have had it to pieces and cleaned it, and now it gains very much. The balance only turns about $\frac{1}{2}$in. The full length of hair spring is in use. The banking is on the edge of the cock, and when the balance is turned as far as it will go for the pin on one side, the train runs, but not on the other. Will shifting the potence slip correct this? If 'scapement wants closing, would turning a little off shoulder of pivot at wheel end and bringing follower up do it?—A. B. C.

[60589.]—**Laminated Armature.**—TO MR. BOTTONE.—I am building a dynamo same as described in your book, but should like to fit it with armature that will run continuously without heating injuriously. Will you please inform me what kind I can make without infringing patent rights? Can I get the punchings, to buy, anywhere, or can they be easily cut out? Should they be kept together by an iron rod, or is brass better, and should they extend the whole breadth of the field magnets, and the wire on the ends be outside same? Can the armature be bought to fit dynamo mentioned above without the other parts? In reply to a recent query, you said the field magnets could be excited by a magneto machine, but I suppose you meant one fitted with a commutator. Would such a machine (with magnet about 6in. long) light a 2c.p. lamp? Can an incandescent lamp not be lighted unless a commutator is used?—D. R. W.

[60590.]—**Microscopical.**—Would any of our micro. readers kindly state if they think it possible to resolve Surirella gemma with a $\frac{1}{8}$ objective (130° aperture) and a Kelner (C) orthoscopic eyepiece used as a condenser? I have tried this with six different stops, but failed to bring out the dotting. Having succeeded in resolving the diatom by using the same objective with direct light from a bull's-eye condenser upon the microscope slightly tilted, I am surprised that the Kelner arrangement, so highly spoken of by Beale, should fall short in this case. Any suggestions from others who may have tried this diatom with an objective of same power and aperture will be acceptable.—A.M.I.C.E.

[60591.]—**Hardening Spring Steel.**—Would any reader tell me if there is any other way of hardening spring steel besides rubbing it with a stick?—E. HOARE.

[60592.]—**Setting Axle.**—Would anyone inform me the way to set an axle? I have seen them set on a board, but I believe there is another way of setting them.—E. HOARE.

[60593.]—**Share Certificates.** — Can any correspondent kindly inform me whether in insuring certificates of shares in a limited company (A) certificates should be issued to parties who have signed articles of association, but have never taken up their shares, (B) to parties who have paid deposit upon application, but have not paid the sums demanded upon allotment.—SECRETARY.

[60594.]—**Model Yacht.**—I have worked out a drawing of a fast 10-ton model yacht. Will some brother yachtsman kindly give me directions how to build it? Its measurements are 41in. by $7\frac{1}{2}$in.—AMATEUR YACHTSMAN.

[60595.]—**Geometrical.** — Would any kind reader state, giving a diagram in illustration, how the latter part of the following deduction may be solved? Find a point such that the perpendiculars let fall from it on two given straight lines shall be respectively equal to two given straight lines. How many such points are there?—NOVICE.

[60596.]—**Pump.**—Could any of our readers please tell me what is the best material to use in making a pump for pumping vitriol? I have tried one made of lead, but in packing the bucket it does not stand. It must be strong; it is wanted to lift or force the acid about 25ft. high.—T. E. F.

[60597.]—**One Side of Room Dark.**—Owing to the position of adjoining property, one side of the living place of my house is thrown rather dark. The only window we have is in the left-hand corner of the room (standing with your face to the fireplace), and from this window an abundance of light strikes in straight across the hearth and on to the wall opposite. From the cause first mentioned the other part of the room is somewhat darkened, and it is impossible in the present structural condition of the house to put in another window. Could not the light referred to be utilised, by deflection or otherwise, in making the other part of the room light? If any student of light, or any of your practical readers, could inform me of, or suggest, some simple plan that would remove the darkness in question, I should be grateful.—DARK ROOM.

[60598.]—**Etching applied to Die-sinking.** —Is this practicable so as to get raised lines on a steel die? If so, a few hints as to procedure might be useful to many besides—BOSWORTH FIELD.

[60599.]—**Pinion Wire.**—How is the pinion wire made, and is it likely to be as accurate as hand-made pinions with regard to dimensions, pitch, depthing, form of teeth, &c.?—BOSWORTH FIELD.

[60600.] — **Musical Intervals — Deschanel's "Light and Sound."**—In the book above mentioned, on page 899, I find the following words, which are mysterious to me, and should be glad if any of your correspondents would fully and clearly explain: "The interval from Re to Mi, or from Sol to La, is represented by the ratio 10-9, and is called a minor tone. The interval from Mi to Fa, or from Si to Do_2, is represented by the ratio 16-15, and is called a limma. As the square of 16-15 is a little greater than 9-8, a limma is a little more than half a major tone."—R. R. R.

[60601.]—**Battery.**—I want to deposit copper, 5-16in. in thickness on a surface measuring 11in. by $10\frac{1}{2}$in. What size battery, and which would be economical to use, and how long would it take to get that thickness?—F. BROWN.

[60602.]—**Aquarium.**—Is there any way to preserve animalcula, &c., alive in a small aquarium for microscopical purposes? I have made several attempts with and without water plants; but after a few weeks everything has died, both plants and animals, and it seems so cruel to waste life in such a reckless way that I shall not attempt it again, unless there is some way of enabling the beautiful and innocent little creatures to enjoy life. If they can be supplied with food and oxygen, they ought to be as happy in a small quantity of water as in a large pond where they must be surrounded by innumerable enemies.—G. H. S.

[60603.]—**To Mr. Bottone.**—Many thanks for your answer. Kindly give me the full details of a magneto machine—after your own smallest size. I am making small dynamo armature of the cog pattern, but a mistake has been made in the number of teeth or sections. It has thirteen instead of twelve. Will this matter, as I have fitted the ring?—A. S. J.

[60604.] — **Resistance Coils, or Wheatstone Bridge.**—Will Mr. Bottone, or some kind reader, instruct me how to use the resistance coils or Wheatstone bridge, giving an example?—GRATEFUL.

[60605.] — **Domestic Electricity.** — The apples, plums, pears, and other fruits in my garden have tempted thieves to rob me much of late. I want to protect my garden by having connections from the different parts to an electric bell and battery in the house. Also to have a guncotton cartridge or a detonating rocket so arranged as to go off if a certain inner line of wires was invaded, and thus alarm the neighbourhood and make it warm for thieves. Can any of our ingenious electricians tell me how to do this? How to insulate and secrete the wires and contacts, and how to get or make the detonator? I have bells and battery.—ELECTRO-DETECTOR.

[60606.]—**Screw Thread on Thin Brass Goods.**—Will any of your correspondents kindly inform me how I can compress a screw thread on articles made of thin sheet brass? The method is used by makers of common paraffin lamps and cheap brass work. The thread is not cut as with a chaser, but forced on in some way.—M. J. S.

[60607.]—**Polishing Photo. Frame.**—I have made a fretwork photo. frame of (No. 20 gauge, 7in. wide) brass, and should be glad if anyone would kindly give me any information as to the best way to polish same, and, when polished, how I can preserve it from getting tarnished?—PRACTICAL.

[60608.]—**Torpedo Defence.**—Will any of "ours" kindly send me particulars of how nets are hung round men-of-war, &c., for protection against torpedoes? Also say how the nets are made, and what sized meshes, &c.; also what distance the nets are from the ship.—COMMUTATOR.

[60609.]—**To "R. N.," "Ingeniero," &c.**—Would any of these be good enough to say whether a condenser

outside of boat is capable of supplying boiler of high-pressure engines successfully as in C.S.C. engines, and if boiler will supply a good head of steam running at full speed continuously with natural draught? I understand the Admiralty adopt this method of condensation for their steam pinnaces, but that it has not come up to their anticipations, and as I require to run a boat in salt water, the purport of my original query with respect to small launch engines is embodied in the above questions.—C. S. C.

[60610.]—**Fluorine.**—I lately saw it stated that this element has been isolated. It would be interesting if some chemical reader would be good enough to supply information of the process by which this has been done, and to describe the element.—L.

[60611.]—**4in. Achro. Objective.**—Will someone give me some advice? I am trying to make a 4in. achro. objective for telescope; but with all the care I can use the glass (the convex) will get slightly more curved at the peripheral portions than at the central, and with the flint the middle seems to get slightly shorter, or, in other words, paraboloid. My discs are 43in. in diam., and my polishers are 7in. in diam. I have not used any mechanical appliance; but would like to have some advice as to making and using one; also in making polishers. A few hints on the manipulation of the polishers will be greatly appreciated. I understand the principles of refraction, correction of the chromatic aberration, and have my glass well enough figured to show some close doubles quite distinctly; yet they are surrounded by a mist. — R. GABRIEL.

[60612.]—**Camera Obscura.**—I am about to make a camera obscura (not a photographic one); the size internally 24in. by 30in., and the height 30in. I understand how to get about it so far, but am not sure about the lens and the length of the focus. Will Mr. Lancaster, or any other reader, kindly say what diam. of lens and length of focus is required to cover the object on paper the above size, 24in. by 30in.? Also the price I ought to give for the lens? Full particulars will oblige. I am only in doubt as to this, because I do not want to complete the outer case and find myself perplexed by the use of improper lens.—G. H. L.

[60613.]—**Sanitary.**—Will some correspondent kindly inform me the mode of working of Doulton's automatic flushing siphon, as I have lately fixed one, but cannot understand how it works?—COUNTRY BRICKLAYER.

[60614.]—**Electro-Motor.**—I am much obliged to Mr. Bottone for his reply to my query No. 60483. I have a small shunt-wound dynamo, laminated armature, 4in. by 1¾in., wound with ½lb. No. 20, and about 5lb. No. 20 on the fields. Could I make use of this as it is, and what number of cells would it require? or if I rewind it, what amount and size of wire should I put on? I may say the dynamo will run two 22-volt 10c.p. lamps in parallel arc.—H. T. BURBURY.

[60615.]—**Paring Machine.**—Should be glad if any reader would give me some information as to how the knives of a paring machine used in the shoe trade to pare the edges of boots and shoes are tempered. Also if potass is used in the process, and how to tell when the knives are tempered enough, for if they are too hard they break in all directions, as they are worked by steam going about 2,000 revs. a min.—SHOE PARER.

[60616.]—**Legal—Marriage.**—An Englishman marries; his wife leaves him and goes to America, and there obtains a divorce. Does that act on her part legalise a marriage which the Englishman may afterwards contract with a third party?—SUBSCRIBER.

[60617.]—**Electric Light.**—To "EVELINE."—In an answered query on page 18, No. 1, Vol. XLIII., you described a battery that would give a constant current for ten hours, and one charge would last four months. Would you kindly tell me the size of the batteries that will do that? I want to light a 10c.p. lamp six hours at a time every night.—SCOTIE.

[60618.]—**Tainted Lard.**—I have some American lard in buckets, which is turning yellow, and is not sweet. Will someone give me a simple method for restoring its sweetness and colour?—COUNTRY GROCER.

[60619.]—**Cornwall.**—Is there a work published giving history of old Cornish families? I am acquainted with Gilbert's, which is a history of places.—T.

[60620.]—**Electric Bells.**—What is the best gauge of silk-covered wire to use for coils to ring a heavy 6in. bell, and how can I fix same to doors and windows that when opened bell rings, and does not cease on closing door or window. A sketch would greatly oblige.—T.

[60621.]—**Leclanche Batteries.**—Will some of "ours" kindly give details of a good method of making the agglomerate blocks for the Leclanché batteries? Can the terminal not be put on the top of the blocks instead of putting a plate between them?—GREEN.

[60622.]—**Astronomical.**—Will someone kindly inform me why the aperture in the revolving upper disc of a planisphere is oval instead of circular? I bought one the other day, and the stars shown in the oval space correspond exactly with those on the semi-sphere of the globe as elevated above the horizon for the corresponding place, day, and hour; but if the one be spherical, why is the other not circular? Also possibly the same correspondent can give particulars of the companion to Alpha Arietis mentioned in Proctor's "Half-hours with the Telescope," as I cannot find distance from primary or position angle either in the said work, in "Webb," in "Chambers," or in Sadler and Clarke's "Star Guide." Am I correct in thinking I see it at about an angle of 80°, and rather distant?—AL FARAD.

[60623.]—**Dynamo.**—To I. LOW.—Many thanks for your reply *re* Potential, which is just what I wanted. May I trespass on your kindness still further by another question or two about dynamo machines? This time (1) what do the makers mean when they say of a shunt-wound dynamo that it will give, say, 100 volts and 200 ampères? According to my limited experience of shunt-wound machines, although the capacity in watts remains constant so long as they are maintained at a given speed, but those watts may be made up in many different ways, according to the resistance placed in the external circuit and the consequent amount of current diverted round the shunt—*e.g.*, that the same machine giving, say, 1,600 watts can be made to make it up by 40 volts and 40 ampères or 80 volts and 20 ampères, or 20 volts and 80 ampères (if the capacity of the armature will give 80 amps. without burning). I have taken the figures at random, merely as illustrations. What resistance of external circuit do the makers reckon for, then, when they give a certain fixed capacity as 100 volts and 200 ampères in describing a machine? Again (2), given a shunt-wound dynamo of absolutely unknown capacity, which it is desired to test. If I understand rightly, many of these machines, especially of the better class, will produce more current than the insulation of the armature coils will bear without burning, if the external resistance be reduced sufficiently low. How can one ascertain them by calculation the lowest point to which it is safe to reduce the resistance of the external circuit (as by switching in more lamps in parallel) without burning the armature? I have seen a shunt-wound dynamo pull up the engine and throw its strap when suddenly short-circuited. I suppose, in this case, it had not time to burn before the strap went off and the speed slackened, but that it would have burned if the engine could have kept it going. (3) I have seen some formulas for the proportion which the resistance of the external circuit ought to bear to the joint resistance of shunt and armature in order to get the highest percentage of efficiency out of any machine. I suppose this is reckoning the resistance of the incandescent lamps when hot; and how is this measured? Is it by deducting some general percentage from the cold resistance, as, say, one-third, or something like that? (4) Is there any general average of resistance for arc lamps when alight, or must the resistance of each particular sort be measured or got from the makers? If you, or any other gentlemen who contribute to the ENGLISH MECHANIC, could enlighten me on these heads I should be much obliged.—TORBAY.

[60624.]—**Cement or Varnish.**—Can any friend say if there is a cement or varnish that would cement small pieces of metal, and that would stand a heat of 80° C.? If so, particulars will oblige.—METAL.

[60625.]—**Astronomical.**—To "F.R.A.S." OR OTHERS.—What is the explanation of the fact that sometimes when there is only a part of moon distinctly visible there is to be seen the remaining portion, thus making up the complete disc faintly visible, this fainter portion appearing smaller in diameter than the crescent? I have been told that it is due to "earth shine;" but if so, why is it that we are not always able to see the whole disc more or less brightly illuminated?—VORTEX ATOM.

[60626.]—**Forming Accumulators.**—To "SIGMA."—In writing upon this subject in your very valuable book, I see you mention certain periodical intervals of rest which it is necessary to give accumulators when forming them, such intervals increasing in duration as the formation proceeds. Would you kindly tell me how I can judge when these intervals become necessary, and the period requisite to allow for each, so that I may know when to leave off reversing, and when to again commence in each case?—TORBAY.

[60627.]—**Turning Cotton and Paper.**—What is the best tool for turning cotton and paper, and what is the best speed?—G. H. B.

[60628.]—**Battery Resistance.**—To S. BOTTONE.—In answer to query 60190, you say: "It is by increasing the size of the negative element that decreased battery resistance is obtained." Why so?—LONDINIENSIS.

[60629.]—**Tortoises.**—What is the proper food for water tortoises? Do they hibernate?—THE BARD FOR EVER.

[60630.]—**Portable Engine.**—What will be a suitable size of cylinder for a portable boiler, barrel 36in. by 19in. with 23 1¾in. tubes and a firebox shell of 28in. by 14in. by 21½in. breadth?—W. J. J.

[60631.]—**Hydrostatics.**—To "M.I.C.E., BRISTOL," OR OTHERS.—A friend has asked me if I can tell him what shape to make a floating body so that "the areas of the submerged part shall vary as the squares of the distance submerged—that is to say, if I have a body submerged to a depth of 1in., and the part under water has an area of 4 sq. in., if I push it down another inch I want the area submerged to be 16 sq. in." Can you kindly assist me?—TORBAY.

[60632.]—**Spiral Steel Springs for Electric Lighting.**—Will some one kindly oblige through the "E.M." how the small spiral steel springs are made, similar to those used in the frictional electric gas-lighting machines? I cannot manage to harden them enough. I make them red-hot and throw them in water; and have also tried oil, but they do not seem to cool quickly enough towards the centre.—P., London.

[60633.]—**Magic Lantern.**—I have a lantern with 3½in. conden., with Argand fountain lamp (burning camp. sperm oil). I find the light inferior for some subjects, especially plain photos, if subject be dark; also corners are dim if mask be square. Would a more powerful lamp remedy both defects, or would I require a larger conden. for latter? My screen is 7ft. square. About what candle-power does the above lamp possess? What would be needed to exhibit with above lantern on 7ft. screen successfully? What kind of lamp would any reader recommend?—B.

[60634.]—**Safety Lamps in Mines.**—I, in common no doubt with all colliery viewers, have taken considerable interest in the recent experiments with safety lamps at Leigh, in Lancashire, conducted by Mr. Morgan before an audience of pitmen; but I cannot help thinking it is a pity that fuller details were not given of the apparatus and methods used in the testing. It certainly is a somewhat rude awakening, following so close upon the recently-issued suggestions of the Royal Commissioners, and to be calmly told in a newspaper report that the whole of the lamps recommended by them were easily exploded in a few seconds by Mr. Morgan seems a pretty rough comment upon their labours which have extended over so many years. In conclusion, I would ask for particulars of the testing, velocity of current, gas used, &c. Also, is the "Morgan" a gauze lamp? If so, it seems a long way behind the McKinless lamp, which quite does away with that uncertain abomination.—HENRY PALMER.

[60635.]—**Legal.**—When money is lent on the security of a policy of life insurance, what is necessary, in point of law, to make good the claim of the lender on the policy? Is simple possession of the policy sufficient? Should the borrower's receipt or I.O.U. make particular mention of the policy as being the security on which the money is obtained? Can the lender claim the possession, or the production when desired, of the receipts of the periodical premium to be paid to the Insurance Company, so as to be satisfied that the policy has been duly renewed? In case the interest on the loan be unpaid for any term after becoming due, can compound interest be claimed, or only simple? It is not intended to advance more than 7-10 or ¾ of the amount of the policy.—SOUTH-WEST.

[60636.]—**Painting Magic-Lantern Slides.**—To "M.I.C.E., Bath."—In No. 1084, p. 369, in answer to query on above, you recommend Judson's dyes. In making a selection of eight or ten colours, would you state what ones to take? Also, about how they would require to be diluted with water?—B.

[60637.]—**Flats for Reflectors.**—I have read the remarks of Mr. Holmes on the above subject, and would like to ask him if he has tried the following plan of arranging the mirrors:—Tube to be enlarged a little on the eyepiece side, so as to admit of the plane being so placed that it will not cut off any of the rays to the large mirror. Then, if adjusted to working order, the plane would receive the rays at an angle, but would be so arranged as to reflect them at the same angle through the eyetube and lenses. We should thus use the whole mirror, as we now use a side aperture, and have the advantage of all the surface of speculum, while the definition of star discs and rings, &c., would be exactly as in a refractor. The only question seems to be, Would the angular reception and reflection of the rays by the plane cause any distortion? It is evident that if this plan would work we could have, say, a 6ft. focus in a 3ft. tube by having the plane large enough, and this without stopping any light from the large mirror.—F. T.

[60638.]—**Photo. Lenses.**—To MR. S. BOTTONE AND MR. W. J. LANCASTER.—1. Acting upon instructions given in No. 1117, p. 561, I found that the distance between two points with string 10ft. long was 10ft. What "angle of view" has my lens (roughly)? How is it found out by this method? 2. In No. 1083, p. 342, "S. B" says: "I shall be happy to write a few letters on the gelatine process if the same would be acceptable to your readers." I think this would be acceptable to not a few, judging from the queries that appear from time to time in "E M." Will "S. B." make good his offer? 3. From Mr. Lancaster's reply to query on above in No. 1121 p. 69, I am led to understand that wide-angle lenses cannot be used successfully unless the camera has swing back, rising and falling front. Has Lancaster's "Instantograph" got all these? Can a wide-angle lens quarter plate (90°) be used with a half-plate instan.?—B.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 6, and unacknowledged elsewhere:—

J. RESIDE.—T. D. Cook.—A. J. Pool.—Rev. G. C. Bruton.—S. Williams.—J. Mallins.—W. A. McClintock.—One Anxious to Learn.—Sam Roe.—T. Wood.—C. W.—Kent.—Delta.—W. W.—Vulcan.—Spes.—X. Y. Z.—Spencer.—A. O. H.—A Four Years' Subscriber.—E. Conry.—A. Stanley Williams.

B HISCOCK. (The Superintendent, Steam Reserve Office, Chatham, will give all particulars about engine-room artificers. Candidates must have served a regular apprenticeship.)—ROBT. RUDGE. (How would you mix? Soak the glue in water, and when soft pour off the water and melt; then add the glycerine and whiting; stir well, and pour out into shallow trays, removing bubbles by drawing a piece of stiff paper over the surface.)—D. CAMPBELL. (We believe the composition is pressed into frames and retained in them until dry. See Hints Nos. 4 and 5 above.)—E. H. BARNSLEY. (See indices. Vol. XLI. pp. 527, 549, and even recent numbers; pp. 20, 43, 70, 72, 92, this volume.)—OLD FOSSIL. (For preparing skeletons see p. 419, No. 1059.)—R. G. LEWIS. (A "kilo" is a French weight (kilogramme), and is equal to 2·2lb. avoirdupois. A kilolitre is a dry or fluid measure equal to 220 gallons.)—C. N. (Perhaps you will understand it, if for "flask or retort" you read crucible. Glass is not mentioned. 2. Yes, "a part each." 3. The paper has not yet been published in full.)—EXAMINARI. (You should read "Darwin on Earthworms," but you will find mention of both in textbooks of zoology and in special articles in our back volumes, and in the *Transactions* of the Zoological Society and Royal Microscopical Society.)—N. Y., PLYMOUTH. (A "saturated" solution of anything is a solution in which no more of the salt or other substance can be dissolved. 2. It is simply too old. No use for toning;

but as the gold is still there, it can be recovered. 3. Take the pictures the size you require. See indices for many articles about lantern transparencies.)—J. J. W. (We do not know a book devoted to that branch of the subject; but it is mentioned in most textbooks, and there is something about it in back volumes.)—PATENT. (A string of questions without a signature, which have all, however, been answered many times. Revised rules with a pattern drawing have been issued by the Patent Office, and can be obtained at most of the large post-offices, where forms of application are sold, or from Mr. Reader Lack, Sale Office, 38, Cursitor-street, Chancery-lane, E.C.)—JACKAL. (Directions for cultivating mushrooms have been frequently given. See p. 31, No. 1016, for instance.) All that is wanted is a bed of horse-droppings which have been turned over two or three times to sweeten, and have been packed together tightly so as to retain a gentle heat of about 70° Fahr. for a long time. A bed of this, which need not be more than a foot deep, is "spawned" by inserting pieces of the "bricks" or cakes, and is covered with about 2in. of maiden loam. Those who wish to cultivate mushrooms had better procure Mr. Wright's book from the *Journal of Horticulture* office, 171, Fleet-street, E.C.)—TRIANGLE. (We have no knowledge of "examinations held on Patent Laws." To what do you refer?)—ANXIOUS BUT HOPEFUL. (The "proper course" to pursue would be to consult a medical man. The advice previously given seems to have been quite sound, but as she has not "grown out of it," it would be advisable to seek further advice.)—A SUFFERER. (Blood out of order: a little potash would probably help to eliminate them; but it would be advisable to consult a medical man, and give him an idea of your diet.)—DESIDERATUM. You should clean thoroughly, bring to a high polish, and then lacquer.)—TORNATOR. (It is some time this month, and the articles must be sent to the Mansion House. Write to the Secretary of the company there, and he will send you the rules.)—F. C. (Carbolic acid sprinkled about will, as a rule, drive them away.)—J. J. (Donaldson o/a the "Construction of Water Wheels," Spons, 125, Strand, W.C., will possibly suit.)—H. E. SMITH. (Macgregor's "Gas-Engines," published now by Whittaker and Co., White Hart-street, Paternoster-square, E.C., describes the modern engines. 2. Nicholson's "Manual of Bookbinding," Spons, and the back volumes for many useful hints.)—TEETOOTALLOR. (Friar's balsam is a compound tincture of gum benzoin, usually with liquid storax and balsam of tolu. If it has that effect on you, better consult a medical man, as it may be injurious.)—PRACTICAL JOINER. (Yes; a foot lever will give ample wind for a small organ if the bellows feeder is large enough.)—A. B. C. (There are several books in which the parts are described; but for practical information you should look through the back volumes, commencing with Vol. IX. A useful little work on Voicing can be had at Willis's, 29, Minories, E.)—SAPO. (Directions have been frequently given; but if the pictures are valuable, better intrust their cleaning to an expert. You may, however, safely use a sponge and soft water, or, if the picture is very dirty, take it out of its frame and lay a wet, clean towel over its face for two or three days, damping occasionally. That will soften the dirt, which can be removed with a sponge. Repeat if necessary. Unskilled hands should never use ammonia, spirits, &c., or anything that will dissolve the varnish.)—B. B. (It involves a rather elaborate calculation, and as put, it is necessary to know how much the pipe can stand. Eytelwein's formula raises the diameter of the pipe in inches to the fifth power, and multiplies that by the head of the water in feet. That is divided by the length of the pipe in feet, and the square root is found. That multiplied by 4·71 will give the cubic feet of water discharged per minute.)—ONE IN A FIX. (You will find an illustration of a loud-speaking telephone in No. 1,051, p. 229, and several others in back volumes.)—SCRIBE. (Maxton's "Manual of Engineering Drawing," Crosby Lockwood and Co., is a useful work. Messrs. Cassell publish a series of drawing text-books for various trades, which we should think you could find in some of the large booksellers in Glasgow. You would then be able to see yourself whether they suit your wants.)—W. VANSTONE. (Kindly look through the index published in No. 1,121, and the indices of the four or five previous volumes. Dimensions, &c., of many different sizes of dynamos have been given in nearly all recent volumes.)—W. J. JOHNSON. (See Hints No. 5 above. About 2in. diameter by 3in. stroke will do; but in order to calculate the best dimensions it is necessary to know the pressure of the steam and the number of revolutions desired. The question will be inserted.)—A LEARNER. (The velocity of sound in air may be taken in round numbers at 1,200ft. per second, and in water at 5,000ft.; but it varies with the temperature and the initial strength of the sound.)—EDWIN. (Mechanical devices of the kind are often used in America; but as a rule the action is transmitted only over a few yards. It may be done by electricity, by hydraulic, or by pneumatic means. In the first case the wheels of the vehicle would depress a lever and so make a contact, and the circuit being completed a magnet would release a catch and the door would swing open either by gravity or in consequence of the action of a spring.)—H. J. H (No one knows. Various theories have been propounded; but the following is, perhaps as feasible an explanation as any. The nerve filaments of the perceptive layer of the retina have their long axes directed to the centre of the eyeball, and naturally refer the impressions made upon them to the direction from which the light proceeds. The inversion of the retinal image is thus probably self-correcting, and is aided by experience, for some have asserted that the human eye, when first stimulated by light, sees objects in the inverted position.)—PIONEER. (Photo-lithography, or one of the zinc "process" blocks. The latter if you require explanatory text printed with them.)—W. J. C. (You will find a great deal of information about the electric light in the last six or seven volumes; but before any one can answer such a query, the size of the room at least must be stated.)—A. J. G. (Recipes for invisible inks and sympathetic inks have been given many times in back volumes, and are to be found in most of the cyclopædias, &c. We answered your query last week on p. 120, col. 1. Marks made with a solution of chloride of cobalt appear when the material is warmed and disappear as it cools.)—YNIS. (We have no space to give lists of books on this and that subject, however willing we might be. You should procure the booksellers' catalogues, or such a general catalogue as that issued by G. Philip and Son, 32, Fleet-street, E.C. The lectures referred to are not published except on special occasions.)—G. H. B. (We do not suppose there is such a work; but many books contain a chapter or two on the subject. 2. Presumably you mean in the compressed state. It is more of a matter for experiment than anything else, but the question will be inserted.)—STRIS. (You do not require both rum and eau de Cologne. Sir E. Wilson's recipe for preventing hair falling off was 8fl. oz. of eau de Cologne, 1fl. oz. of tincture of cantharides, and half a fluid drachm each of the oils of rosemary and lavender. A more simple wash is made by infusing 2oz. of rosemary tops in a pint of boiling water, and adding 2fl. oz. of rum.)—A DUTCH SUBSCRIBER. (There are several patterns in the market, but they all act either by worm and wheel, by ratchet and pawl, or by eccentric motion. Why not purchase one, and examine the parts?)—OLD SUBSCRIBER. (The question is so limited in interest—concerning only designers of screw-propellers—that we must refer you to Mr. Froude's papers published in the *Transactions* of the Institution of Naval Architects, especially for 1878.)—SEDGLEY. (You can see an illustration of the sun-and-planet motion in many of the books, or in Nos. 565, 566, if you have them, for they are out of print. It consists of a spur wheel keyed on the shaft in place of the crank; the piston-rod carries another spur wheel fixed to it, and connected by a link to the shaft. The wheel on end of piston-rod revolves round the shaft, and as it is in gear with the wheel keyed on the shaft, it compels the latter to rotate.)—F. WRAY. (Rather troublesome; but the only way is to heat to a red and let it cool slowly—leave in the fire, and allow the latter to die out.)—DE CAPO. (Rub the steel with the stone always in one direction.)—EXCELSIOR. (The papers can be obtained of the Secretary of the Association, 22, Albemarle-street, London, W. We have not space to publish half of them, nor are the majority worth the space.) 21. (The only thing to do is to repolish.)—WOOL. (The method of dressing skins for mats has been given several times. See No. 919, p. 203, for instance.)—BARIUM. (See indices. Miller's "Chemistry," in three vols., Longmans, covers the ground; but there are lower priced works. Carpenter's "Animal Physiology," Bohn, but procure the publishers' lists.)—BEGINNER. (Some are merely roller presses, others a bit of steel brazed on an iron base. Dissolve white Castile soap in methylated spirit (2 or 3gr. to the ounce), and brush that on before using the burnisher. Illustrations in the lists of the dealers.)—F. P. S. (All you want is the lamps, which you can buy, and a suitable battery. Perhaps that illustrated on p. 561, last volume, will answer your requirements; but at any rate, you will find all the information needed in any one of the last six volumes.)

USEFUL AND SCIENTIFIC NOTES.

SPEAKING of copper solder and colouring, an American paper says that "when copper is soldered and the solder to be coloured like the surrounding copper, this can be done by moistening the solder with a saturated solution of vitriol of copper and then touching the solder with an iron or steel wire. A thin skin of copper is precipitated, which can be thickened by repeating the process several times. If a brass colour is desired, a saturated solution of one part of vitriol of zinc and two parts of vitriol of copper is used on the previously coppered solder and the latter rubbed with a zinc wire. To gild the soldered spot, it is first coated with copper in the manner indicated above, and then with gum or isinglass and powdered with bronze powder. The surface is obtained, which, after drying, can be very brightly polished."

A NORWEGIAN engineer, Herr W. C. Möller, has made some important discoveries as to the buoyancy of reindeer hair and skin. He has found that a reindeer skin weighing $1\frac{7}{10}$kilogrm., rolled up and with the hair outwards, will support for ten days the same weight as an ordinary cork lifebelt. Moreover, the reindeer skin has the advantage of warming a person if formed in the shape of a lifebelt and worn round the waist. He has also constructed collapsing boats, sledges for rescuing people from drowning in the ice, &c., from reindeer skin, and lifebelts filled with reindeer hair equal to those of cork. Herr Möller further finds that a suit made from reindeer hair, weighing only $\frac{1}{2}$kilogrm., will save a man from drowning even if it has been in the water for some time. It can be made in any thickness, and is warmer than other materials. He is confident that suits made from reindeer hair will in time supersede those made from oilskin. The life-saving establishment of Gothenburg has already procured several of these articles.

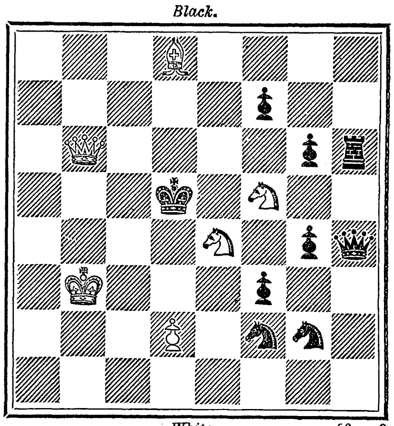
THE production of kainit and karnallit has begun at the Vienenburg potash mines. About 1,000 centners of karnallit are sent daily to Aschersleben by rail. The railroad junction to the mines is nearly completed.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXII.—BY C. PLANCK.

Black.



White. [6 + 9

White to play and mate in three moves.

This problem is from the forthcoming joint collection, of which there was a notice in a recent number. It is the last three-mover in Solution Tourney.

SOLUTION TO 1010.

White.	*Black.*
1. P-Q 7.	1. Anything.
2. Kt or B mates.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,010, by G. T. Stringfellow (but variations not given), Isca, A. Dean, I. M. Brown, A Beginner, "——," J. Mackenzie, A. Bolus, Avon, J. A. M., and E. P.; to 1,009, by M. Blackmore (3). J. A. M. (second solution, but omitting defence, 1. B-R 4), T. W. Shawcross (ditto), G. T. Stringfellow (ditto), A. Bolus (ditto), A Beginner (2).

A. BEGINNER.—You appear to be right in thinking that 1,010 can also be done by 1. Kt-K 7. Another B P at K R 2 avoids this, we think.

AVON.—If in 1,009, 1. $\frac{\text{Q-Kt 6}}{\text{Kt-Kt 6}}$, 2. $\frac{\text{Kt-K 7}}{\text{B-R 4}}$, 3. $\frac{\text{Kt-B 6 (ch)}}{\text{K takes Kt}}$

J. W. SHAWCROSS AND A BEGINNER.—If in 1,009 1. Q-Kt 4, we see no mate after 1. $\frac{}{\text{Kt. K 5}}$. With regard to 1. Q-Kt 6 or R 7, see notice above to Avon.

J. MACKENZIE.—It is too late to join this Tourney, which is now all but concluded. We shall start another in two or three weeks, and due notice will be given of particulars.

LINK.—Both your attempts at 1,009 seem to be answered by 1. B-R 4.

WHITE PAWN.—If in 1,010, Kt-K B 7 (ch), Kt takes Kt, and there is no mate. You must give Black his best play always.

G. T. STRINGFELLOW.—If 1. B-Kt 6 how do you proceed if 1. $\frac{}{\text{Q Kt-K B 6}}$? You have in your third attempt 1. Q-R 5, which is impossible.

E. P.—If 1. $\frac{}{\text{Kt moves}}$, 2. Kt-K B 7 would not be mate without the R.

W. H. S. M., and Black Pawn are thanked for game and problem.

THE next problem (a two-mover) completes Tourney B.

SOLUTIONS to 1,011 will be acknowledged in our next.

The English Mechanic
AND WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 15, 1886.

NOTES ON THE CHAMBER ORGAN.—VI.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

IN the preceding article I said as much as space permitted on the subjects connected with the Great organ department, and my present duty is to treat of the remaining departments of the Chamber Organ under similar conditions.

Choir Organ—Expressive.

This department is, as before explained, of less size and importance than the Great organ. I have suggested that only about one-third of the manual speaking stops should be apportioned to it, and that its stops should be less powerful in tone, generally speaking, than corresponding ones in the Great. The chief office of the Choir organ is of an accompanimental character; but this consideration, though steadily held in view, must not interfere with the appointment of the department as a self-contained and perfectly balanced division. In an instrument of about fifteen or sixteen manual speaking-stops, the Choir should contain either five or six stops; namely, three or four unisons, one register of 4ft. pitch, and one of 2ft. Of the unisons, one should be an effective solo reed, preferably the Oboe; one a soft-toned stop, of the *Dulciana* species; and one a bright, string-toned register. If there be four unisons, the fourth should be a quiet, flute-toned stop of the *Lieblich-Gedact* species. When space is limited—and it almost invariably is so in ordinary apartments—it will be found impossible to carry all these unisons down to CC without a break of some sort. Both the Oboe and *Lieblich-Gedact* can be easily accommodated; but the other unisons, which, in their perfect form, must have pipes of 8ft. speaking-length at their CC notes, will, in all probability, require to be carried down from about Tenor C in stopped pipes. This, of course, is much to be regretted; but the conditions imposed on Chamber Organ building are frequently very exacting and inconvenient. Let the stops be carried down as far as possible in true form, and, unless they have both to be grooved into one bass, let them be broken on different notes, so as to cover as much as possible the transition when the full Choir is drawn. But even if they have a bass in common, there is no reason why each stop should not take it up on different notes. The string-toned stop should be carried down, if possible, to Gamut G, the bass pipes being stopped, and of the Quintaten species. The soft-toned unison may be broken at Gamut B flat, the bass being inserted in small-scaled pipes of delicate intonation. The practice of breaking more than one stop at Tenor C, or any one note, in the same instrument, is to be condemned, and should never be adopted.

The register of 4ft. pitch may be a delicately-voiced, half-covered wood stop, which, in combination with any of the unisons, will be perfectly adapted for accompaniment; or, in combination with the reed, will produce a pleasing quality for solo or melodic playing. An Orchestral Flute, 4ft. is a very serviceable stop in this department; but if inserted here it must be omitted in the Great, for the duplication of any stop is not a proceeding to be contemplated for a moment in a small Chamber Organ.

The Super-octave in this department should be of very soft intonation, yet bright and telling. It may either be of the Piccolo type or the so-called *Gemshorn* character. Whichever of the two may be selected, it must be voiced to a softer tone than the Super-octave in the Great, and otherwise kept as distinct in character as possible.

I may just mention a fact which may be of interest to those readers who are contemplating the acquisition of a Chamber Organ on a more ambitious plan than that implied in the foregoing notes—namely, that a through (8ft.) metal or wood stop, in imitation of the orchestral violoncello and of quiet intonation, can be added to the Choir department, but located outside the swell-box, with the most satisfactory results. It will be to this department what the Principal (8ft.) is to the Great organ, and will add immensely to the resources of the instrument, and facilitate the production of numerous striking orchestral effects. The space required for such a stop is not very great, and its external position will not in any way affect the dimensions of the swell-box.

In the remarks on the Great organ, I have alluded to the desirability of inclosing the Choir stops in the same swell-box in which one-half of the Great stops is placed, pointing out that it is unnecessary and undesirable to occupy valuable space, to increase mechanical appliances, and to add the difficulty of operating on three Expression levers, by introducing a distinct swell-box for the Choir department. Practically, there is no evident disadvantage in the proposed arrangement, for it is only on extremely rare occasions that the presence of an independent Choir-Swell, if I may be allowed to use the compound, appears desirable. Even on such occasions, the exercise of a little ingenuity on the part of the performer overcomes all difficulties which may present themselves.

When the Choir Organ is used alone, of course no inconvenience is experienced in its management. When used as an accompaniment to certain solo stops in the Great, the worst that can happen is that the accompanimental stops will have exactly the same kind and degree of expression imparted to them as may be deemed appropriate for the solo register. This, however, only follows when both the accompanimental and solo stops are in the same swell-box; when the solo stop is in the back swell of the Great department, the organist can impart expression to either the solo or accompaniment at will, or to both simultaneously, by the use of the two Expression levers.

By referring to the list of Couplers, given in Article II. (Aug. 20, 1886), it will be observed that I recommend three which connect the Choir to the Great—viz., Unison, Sub-octave, and Octave couplers. With this complete system of coupling, the Choir becomes a very important department in the tonal structure of the instrument. When the Unison coupler is drawn, the entire organ becomes a grand Swell, if both Expression levers are used simultaneously, and the hands are confined to the Great keys. If the levers are operated upon singly, the organist can produce some striking effects by swelling the tones of the back division of the Great, or the combined tones of the full Choir and the front division of the Great, at his pleasure. By drawing the Octave coupler, any desired degree of brightness can be added to the Great department, through the introduction of registers of 4ft., 2ft., and 1ft. pitch; and this coupling does in no way interfere with the predominant unison character of the Choir department as commanded by its own clavier. A similar advantage accrues to the Great by the coupling of the Choir in the sub-octave. If a unison, octave, and super-octave stop are drawn in the choir, the Sub-octave coupler adds a 16ft., 8ft., and 4ft. series to the combination in the Great; and this series can be adjusted to any desired strength by the Expression lever. Pages might be written in addition to what has just been said, and what has previously been written, on the countless effects to be obtained by the joint manipulation of the stops and couplers; but the remarks made must suffice for the present purpose. Any reader who may feel curious to realise what can be done with a divided Great of ten stops and a choir of five or six stops, and the three manual couplers, should take a pen and paper and work out the sum of the possible combinations for himself. I promise him a slight feeling of surprise. After he has arrived at the end of his task, I feel certain he will agree with me that a Chamber Organ of, say, sixteen manual speaking stops, is by no means an insufficient or paltry instrument; and that it will take some patience and ingenuity on the part of an organist to get to the end of its resources.

Solo-Organ—Expressive.

As three manuals have been mentioned in an early article, it is probably expected that I should say a few words on the subject of the most desirable arrangement of the contents of the instrument, when it embraces Great, Solo, and Choir departments.

Firstly, then, if the number of manual speaking stops is sixteen, the apportionment should be as follows:—Great organ, seven stops; Choir organ, five stops; and Solo organ, four stops.

Secondly, there will now be no department *divided* in the manner previously recommended in connexion with the two-manual instrument; and each of the three departments should be inclosed in a separate swell-box commanded by a distinct Expression lever. The levers should be ranged, side by side, in this order from left to right—Great, Solo, Choir. This order is desirable because it allows a single foot to open the Great and Solo or the Solo and Choir swells simultaneously. The convenience of this arrangement is too obvious to require comment.

Thirdly, the Solo organ should comprise important orchestral-toned solo registers, such as the Clarinet, Orchestral Oboe, Violin, Violoncello, and Orchestral Flute. The Trumpet should retain its place in the Great, while the Vox Humana may be relegated to the Choir department. The apportionment of the stops in the three manual departments will probably always be a matter in which individual taste will exercise controlling power; but an apportionment which will secure the greatest range of effects in each department, and the maximum of solo and accompanimental combinations on the different claviers should always be aimed at.

Fourthly, under no conditions whatever should the Solo be uninclosed, for the nature of its stops imperatively calls for expression of the most effective description. When there are the three departments—Great, Solo, and Choir—and space for the accommodation of two swell-boxes only, the Great and Choir, or the chief portion of both, should be inclosed in one swell-box, and the Solo stops in the other. The only department which (in a Chamber Organ) can be left entirely uninclosed is the Choir. When uninclosed, its stops should be voiced in the most delicate manner, so as to yield tones of the softest and most winning character. It should occupy a front central position, so that its sounds may be distinctly heard at their best, and devoid of any muffling or acoustic deflection. In this position the Choir may be made an effective feature in the design of the instrument. When so placed, and entirely uninclosed, the Choir department should contain no stop of an essentially solo character, simply because a solo stop without expression is objectionable. The non-expressive Choir must be accepted from first to last as an accompanimental department; or, generally, as a subdued normal

organ, suitable for rendering quiet passages which do not call for special effects of light and shade.

Pedal Organ.

There can be no question that one of the chief difficulties, if not the chief difficulty, in connection with the appointment of the Chamber Organ is the furnishing of an adequate Pedal department. As I have before said, there is almost always a difficulty in finding sufficient floor-space and height for the accommodation of open stops of 16ft. speaking length; yet without one stop of this class, the bass of the instrument will lack the desirable dignity, and its chief element of grandeur. Every endeavour should be made to include such a stop in the tonal scheme. In *ensemble* playing—that is, when the Organ is used along with the pianoforte, violin, and other instruments—the effect of the open 16ft. stop is magnificent, and singularly impressive. It has one disadvantage, however, in an ordinary room, which must be mentioned—viz., its tendency to cause most unpleasant vibrations in doors, windows, and certain articles of furniture, and, indeed, in portions of the organ itself. Such vibrations should be listened for, and then carefully cured. They generally proceed from some looseness in the articles affected, which a little alteration removes. For further remarks on this important stop, the reader may refer to the opening paragraph of the preceding part of these Notes.

With reference to the covered stop of 16ft. tone, almost invariably found in the Pedal, or forming the entire Pedal department of the ordinary Chamber Organ, little need be added to what has already been said. As the longest pipe of this register does not exceed 8ft. 6in. in total length, and need never be more than 8in. by 7in. in external dimensions, the stop can be easily planted so as to form effective features in the general design. I may just mention, by way of illustration of my meaning, that at the sides of the salient portion of my own Chamber Organ are ranged the twelve lower pipes of the Contra-Basso, while the central space, between the angle towers and above the key-case, is occupied by the fifteen following pipes of the same stop. All the pipes are thus used, with the exception of the three higher ones, as integral parts of the external design. Of course all the displayed pipes are most carefully made and richly decorated. It is a matter of wonder to me that ornamental wooden pipes have not been more frequently introduced in the external designs of organs. It is not too much to say that no cylindrical metal pipes, however well decorated, could produce a better result in the front of my organ than that produced by the row of square wood ones there introduced. When the so-called *Bourdon* occupies so exposed a position, it can be voiced to yield the round "velvety" tone which is so desirable in the bass of a Chamber Organ, while its totally unshaded position allows it to be regulated to the greatest nicety, and its tones to be heard at their full value. Such stops are too often packed away within closed cases, or crowded into recesses or confined chambers, so that their tones are little better, as heard in the room, than the buzzing of a score of humble bees; unless, indeed, they are voiced unduly loud and coarse.

When a soft-toned, open, cylindrical metal Octave of the Gamba, Violoncello, or *Dulciana* species is introduced in the Pedal department, the lower octave or so of pipes may be used in towers, or in any other features of the external design, as taste may direct. The remaining pipes can easily be placed behind. As before remarked, an Octave stop may be borrowed from either the open or covered 16ft. stop, by means of an Octave coupler, with the addition of a higher octave of pipes.

In approaching the question of a reed stop for the Pedal department, it is desirable to consider the advisability of rendering it expressive. If the drawing-room or music-room has anything like a spacious organ chamber, there will probably be no difficulty in planting the reed pipes together at one end of it, and inclosing them with a front, provided with louvres, tuning shutters, &c. If an ordinary striking reed is adopted, this inclosing will have a beneficial effect, by toning down to a considerable extent the unpleasant buzz of the larger tongues. The free reed, on which I commented in the preceding article, is sufficiently soft and clean in tone to remain uninclosed; but, of course, it would be rendered more effective if made expressive. As it would be inconvenient in an instrument already provided with three Expression levers—Great, Solo, and Choir—to add a special lever for the Pedal swell, I should recommend the coupling of the Solo and Pedal swell actions to the central or Solo lever. In instruments with only two Expression levers (for the manual departments), a third may be added for the Pedal reed, if thought desirable, otherwise the latter may be combined with the lever attached to the back division of the Great organ.

Much more might be said on the important questions I have so briefly touched upon; but I must rest content with the sketch of my plan of Chamber Organ appointment already given. In my next article I shall hastily speak of certain remaining matters worthy of consideration by Chamber Organ builders, professional and amateur.

(*To be continued*).

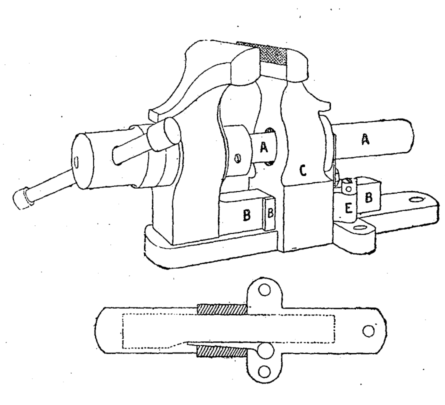
THE IRON AND STEEL INSTITUTE.

The autumn meeting of the Iron and Steel Institute was held in London this year in order that members might take the opportunity to visit the Exhibition, and also that many Colonial iron and steel workers now in this country might attend the meeting. The President, Dr. Percy—the formal business having been disposed of—announced that Mr. Daniel Adamson, of Manchester, had been nominated by the council as the next president, and the selection was thereupon unanimously confirmed by the meeting. A report on the iron-making resources of the British colonies has been specially prepared by Mr. P. C. Gilchrist and Mr. E. Riley for the benefit of members, who found it to consist of nearly 140 pages full of valuable information. The president, in delivering his address, referred to the early history of chrome steel, an alloy which is said by an American Company to exceed in tenacity all other kinds of steel when cold. He exhibited a piece of an American ploughshare which appeared to have been made by casting steel of some kind upon both surfaces of a plate of malleable iron, thus producing a superior implement to anything made here. The specimen had been submitted to a distinguished American metallurgist, who thinks it probable that it was produced in one of the South-Western States. Dr. Percy then referred to what is known as Mitis iron and steel, which contain small quantities of aluminium or aluminium alloys (see p. 50, Vol. XLIII.), and to the extraction of aluminium by the electric method (see pp. 71, 451, Vol. XLIII.). From the statistics of the Bessemer steel manufacture in the United States it appears that the capacity for producing it is largely in excess of the demand. In this country a similar condition prevails in connection with the production of both iron and steel; but the president appealed to the iron and steel makers not to be discouraged by the statistical statements he had made. A paper on the "Erosion of Gun Barrels," by Sir F. Abel and Col. Maitland, was read, in which the effects were attributed to the co-operation of three causes—namely, a softening, or perhaps fusing, of the surfaces of the metal by the heat of the exploding powder, an increase of that effect by the action of sulphur on the heated metal, and the mechanical action of the rush of gases, vapours, and liquid products on the softened or fused surfaces. Test experiments have been made at Woolwich with barrels supplied by different makers, but the results were widely different. Col. Maitland considers that the more steel is worked under the hammer the better it resists erosion; but Capt. Noble, F.R.S., finds from some experiments he made that the erosion is less the milder the steel. The subject becomes of increasing importance now that guns so large as the 16¼in. breech-loading 110-ton are coming into use. Barrels of manganese-bronze and of cast iron have been tried, but in the case of the latter the erosion was greater than with steel. The experiments are not yet completed, and the paper itself has been prepared only at the request of the president. Mr. Gilchrist gave a description of the "paper" he had prepared in conjunction with Mr. Riley, and in the afternoon those gentlemen escorted a party round the Colonial and Indian Exhibition. On Thursday Sir Henry Bessemer read a paper on some early forms of converters used in his process, his object being to save would-be inventors from racking their brains in working out problems which have been solved long ago. In the course of his remarks Sir Henry Bessemer stated that the addition in suitable quantity of molten malleable hematite iron to white or grey foundry iron produced practically a new metal, well deserving the attention of the intelligent ironfounder, who, with a small converter, could produce enough malleable iron to mix in a large charge of foundry pig for the production of girders, columns, engine framing, cylinders, &c., of a quality and strength far superior to any that could be produced from foundry iron alone. Mr. J. Hardisty, of Derby, read a paper on "Modifications of Bessemer Converters for Small Charges," in which he pointed out that although it might appear that the making of steel in small quantities was a step in the wrong direction, yet the difference in cost of production between the small and the large converters was not so great but that some firms had found it cheaper to use the small fixed converters than to purchase the ingots from others. The small converter, it seems, from the general opinion elicited in the discussion, will produce excellent steel, but at a slightly greater cost than the regular Bessemer converter. Mr. F. Siemens, by way of supplement to a former paper on a method of working regenerative gas furnaces by employing radiant heat alone within the heating chamber, read a paper on "Combustion," in which he stated that complete combustion is impossible whenever the live or active flame is allowed to come into contact with any solid surface, and such solid surface will always suffer by the mechanical and chemical action of the flame. Mr. Siemens thinks that radiant heat has always been a useful factor in heating operations whenever the constructiou of the furnaces allowed it to have full play; but he believes that sufficient attention has not been paid to the very detrimental effect on combustion itself, as well as on the work done, when the radiative power of the flame is interfered with in such a way that it could not be developed to its fullest extent. On Friday Mr. F. W. Harbord, of Bilston, Associate of the Royal School of Mines, read a paper on "The Removal of Metalloids in the Basic Siemens Furnace," which he said had been accomplished, the process being a thoroughly practical method of dephosphorising. The removal of the impurities in proportion to the oxidising nature of the slag is very marked, and soft steel of the finest quality can be obtained. Mr. Harbord thinks that by using an excess of oxide of iron, with a fair proportion of lime to fix the phosphoric acid, molten iron may be taken direct to the Siemens furnace, and the metalloids removed in a much shorter time than at present. The time thus gained would compensate for the extra cost of basic linings, lime, and ore—perhaps more than compensate, as the slag produced would be free from phosphorus, and could be used in the blast furnace. It appeared during the discussion that others had succeeded in making some excellent metal in open-hearth furnaces with basic linings; but as to the economy of the process there is still some doubt, as there is also as to the statement that the slag is free from phosphorus. Amongst the other papers read was a rather important one by M. F. Gautier, of Paris, who described a method of casting chains in solid steel,

adopted by Messrs. Joubert and Leger, of Lyons. Owing to the difficulty of welding the links. makers of chains have not been inclined to adopt steel, while to cast them it is necessary to have a quick method of moulding, and a metal quite solid and absolutely without blow-holes. The method adopted combines chilled casting and instantaneous removal from the moulds; the chain is then finished, annealed, and hardened in oil. M. Gautier considers that the process opens up a new field for the successful employment of the highest qualities of steel, and if better chains can be made with a lesser weight of metal, it will undoubtedly be an important improvement. Steel chains were cast some years ago; but the price has always prevented their introduction. M. Gautier also read a paper on "Silicon in Foundry Iron," in which he stated that French ironfounders, working with an average of 2 per cent. of silicon in their metal, produced sound castings quite free from blow-holes. The use of ferro-silicon is, in fact, becoming general in the French foundries, for it is found that silicon precipitates the combined carbon of white pig in the form of graphite, and so produces the grey pig-iron preferred by the founders.

ASHFORTH'S PARALLEL VICE WITH TAPER MOTION.

AN improved vice of the parallel type, having also a taper motion, has been recently patented by Mr. J. T. Laycock Ashforth, of Bruce Works, Sheffield, the special features of which are clearly delineated in the annexed engravings. The back jaw and body of this vice are made in one solid forging, by which great strength is obtained. The front or movable jaw and slide are also made in one solid forging; consequently, there are no bolts to give way nor lose. The parallel motion is the same as in vices of the old construction, being obtained by means of the box and screw marked A in sketch, the slide B moving in a slot or hole in the body of the back jaw C, of which the sides are perfectly parallel, thus



keeping the front jaw quite true in its working backwards and forwards. The taper motion (which is the great feature in this vice) is obtained by releasing the thumbscrew D and taking out the wedge E, which causes one of the sides of the slot or hole in the body of the back jaw C to become taper, thus imparting a taper motion and grip to the front jaw, and permitting it to close firmly on any taper article, and so hold it securely without fear of slipping.

THE AMATEUR WORKSHOP.—XXVII.

Self-acting Lathes.—(*Continued.*)

THE arrangements for screw-cutting which lie beyond the actual rest itself are here illustrated, and will prove the subject matter for our discussion. Postponing the treatment of the principles involved in screw-cutting until after the description of the mechanism involved therein, we note in the views two distinct trains of gearing—a simple train (Fig. 296) and a compound train (Fig. 297)—the connection between which and the headstock on the one hand, and the leading screw on the other is apparent, the wheels, marked A in each case being drivers, and those marked B driven. The wheel marked C in Fig. 296 is an idle, intermediary, or stud wheel, whose sole function is to cause the leading screw to revolve in the same direction as that of the headstock mandrel.

Taking the leading screw first in order, its outline is shown in Fig. 298, and a full-sized sectional view of two kinds of threads in Fig. 299. This is made of steel. The section of the thread is, in the first case, square, having top and bottom rounded; in the second (and, as I think, preferably) a compromise between the square and angular forms, as affording a better contact or bite between it and the clasp nut when the screw wears with use, and preventing the grinding of the points of the thread in the bottom of the nut threads, which is a cause of wavy markings on turned work. The right-hand of the screw has its bearings in the bracket (Fig. 300), which is bolted to the facing prepared for its reception on the front of the lathe bed, and the left-hand end has its bearing in a similar bracket, Fig. 301, but which has an additional flange cast with it to take the rocking plate D in Figs. 296, 297, and in Fig. 302. The left-hand end beyond the bearing has a shouldered and turned portion provided with a sunk feather, over which fits the particular change wheel of the train which has to go on the leading screw for cutting its special thread. The rocking plate, Fig. 302, has two radial or curved slots, by means of which it is rendered capable of slewing movement, the slewing being necessary for the accommodation of wheels of different diameters between the fixed centres of the mandrel and of the leading screw, and also two parallel slots for carrying the stud or studs which become the bearings of the intermediary wheels. This plate is of cast-iron, having the slots cast in the mould, and both faces should be planed true. The studs are shown in Fig. 303. They differ only in length, one being for the wheel of a single train, the other being long enough to take the two wheels of a compound train. They are each seen to consist of a central bolt or stud shouldered and flattened to slide in the slots of the rocking plate, in which slots they can be tightened in any position; and to be encircled with a freely-revolving sleeve furnished with a sunk key for the reception of the change wheels, the key and sleeve being of corresponding sizes with the left-hand end of the leading screw, and with the tail end of the mandrel, so that the wheels are interchangeable on the mandrel, studs, or leading screw alike.

The change-wheels will be bought both cheaper and better than they can be made. They are of what is termed diametral pitch—that is, the pitch is not given in tooth centres, but in a number which has a constant ratio to the diameter, the numbers ranging usually from 6 to 14 pitch, 6 pitch being the largest, equal to about $\frac{1}{2}$in. full, 14 teeth being the smallest, equivalent to 3-16in. full. With wheels of diametral pitches the diameters are not given, but the pitch number and the number of the teeth instead. To deduce the diameter, it is only necessary to divide the number of teeth by the pitch, as 60 teeth of 12 pitch $= \frac{60}{12} = 5$in., the diameter of that wheel. These wheels usually number 22 to the set, arranged either as 6 from 20 to 25, rising by one tooth each, 15 from 30 to 100, that is rising by five's, with one 40 or 60 wheel extra; or else 21 wheels rising from 20 to 120 by five's, with one 40, or 60 extra. For cutting special threads others are added with advantage, but most threads can be cut with these alone. A set of 12 pitch $= \frac{1}{4}$in. full, will be most suitable for a 4in. lathe, and will cost about 17s. as rough castings. They will have to be bored, and their feather-ways will be filed or slotted, and if the ends of the teeth are lightly turned, it will improve their appearance.

The essential work of the guide or leading screw is not plain turning, although used for that, but the cutting of screw-threads, for which it performs the function of a constant or primary factor in relation to screw-threads of any pitch. The leading-screw here shown, in common with almost all lathes of small size, has four threads to the inch $= \frac{1}{4}$in. pitch. Large lathes have two threads only $= \frac{1}{2}$in. pitch. Some lathes have threads of $\frac{3}{8}$in. pitch. Through the intervention of the change-wheels, the varying rates of scores of different screw threads are cut with a guide-screw of constant pitch. Thus the lathe mandrel and the leading screw are essentially two parallel revolving spindles, the motion of the latter being derived according to some definite ratio from the former. If one be revolved at precisely the same rate as the other, and a cutting tool be traversed in the slide rest against a piece of work running in the lathe, a thread will be cut on the latter of precisely the same pitch as that of the leading screw, and the direction of the thread will be right or left-handed, according as the spindles revolve in the same or in opposite directions—that is, according to what idle wheels are placed in the train. In each of the Figs. 296 and 297 the leading screw is seen to travel in the same direction as the lathe, and the screw itself being right-handed, the saddle travels towards the headstock, and cuts a right-hand thread. By inserting an extra wheel in either train the direction would be reversed, and the screw being cut would be left-handed.

We have imagined the elementary spindles to have equal rates of revolution, but it is now easy to see that by combining the change wheels in certain aliquot or numerical proportions, the screw rates to be cut can be made aliquot or numerical proportions of the rate of the leading screw. Of course when cutting a thread of equal pitch with that of the guide, the wheels on the mandrel and on the guide-screw must be of equal size (usually two 40's, two 60's, or two 90's). But, suppose instead of having wheels of the same diameter, we put wheels of unequal size in their places—say, for example, one of 40 teeth on the mandrel, and one of 80 on the leading screw, and that the leading screw is of $\frac{1}{4}$in. pitch. Then, while the mandrel makes one revolution, the leading screw will make half a revolution only, and travel the saddle half the pitch, equal $\frac{1}{8}$in., and the screw cut will be $\frac{1}{8}$in. pitch. Reverse the wheels, putting 80 on the mandrel and 40 on the guide-screw, and the result will be that the mandrel revolving once will turn 40-wheel round twice, and travel the saddle $\frac{1}{2}$in., cutting a $\frac{1}{2}$in. screw. Hence the fundamental rule; that the same ratio must exist between the change wheels as between the pitch of the guide-screw and the pitch of the screw to be cut. Also, that for cutting threads finer than the thread of the leading screw, the smaller wheel will be the driver (or on the mandrel), and the larger the driven (on the guide-screw); but, for cutting threads coarser than those of the leading screw, the larger wheel will go on the mandrel, and the smaller be the driven.

Thus far we have considered a simple or elementary train; but the same reasoning applies to a compound train, the principle remaining unaffected. The difference in a simple and a compound train is this:—That in the simple train two wheels only (one driver, and one driven) are essential, the idle wheel counting for nothing as regards velocity ratio, being a carrier of motion only; in the compound train there are two (or more) drivers, and two (or more) driven. The necessity for the compound train lies in the impossibility of effecting a very great difference in speed with a single pair of wheels within the compass of the centres of the lathe-mandred and the guide screw. Then, the drivers being multiplied into each other, and the driven into each other, their *products* are divided, and the rate so obtained is the same as that which subsists between the guide screw and the screw to be cut. Neither, having two drivers, does it matter at all which of the two goes on the mandrel, and which on the stud; nor, having two driven, does it matter which goes on the stud and which on the guide-screw, the essential being that one driver shall be on the mandrel, one driven on the guide-screw, and a driver and a driven on a stud common to both, which is pinched in the rocking-plate.

Since the same ratio must exist between the change-wheels as between the pitch of the guide-screw and that of the screw to be cut, the obtaining of any factor in the series can be effected by the rules of proportion. But it is usual to obtain the wheels directly by placing the number of threads in the guide-screw for a numerator, and the number in the screw to be cut for a denominator, and adding a cipher to each to obtain the requisite number of teeth, thus:—Having to cut a screw of eight threads

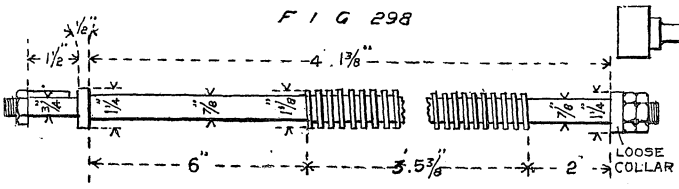
FIG 298


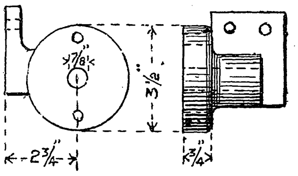
FIG. 301.


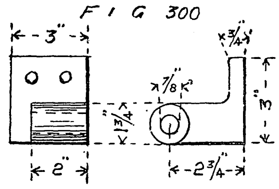
FIG 300


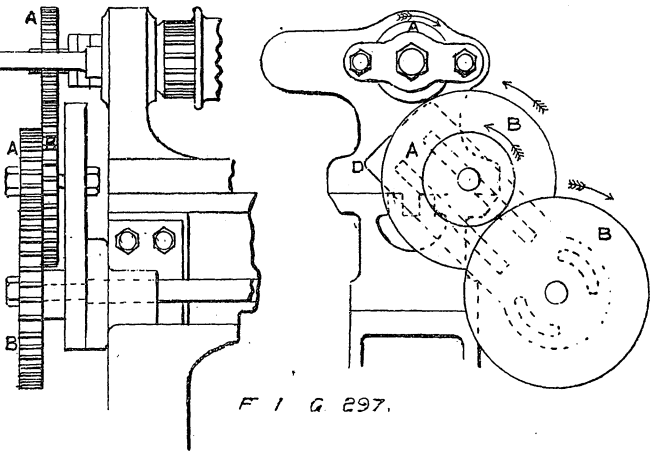
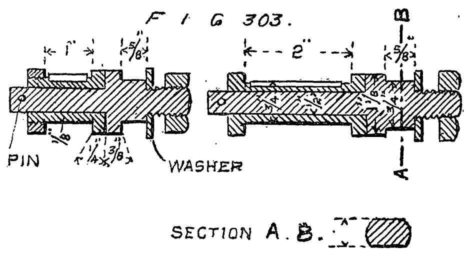
FIG 297.


FIG 299


FIG 303.


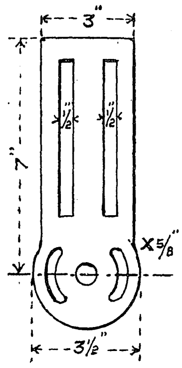
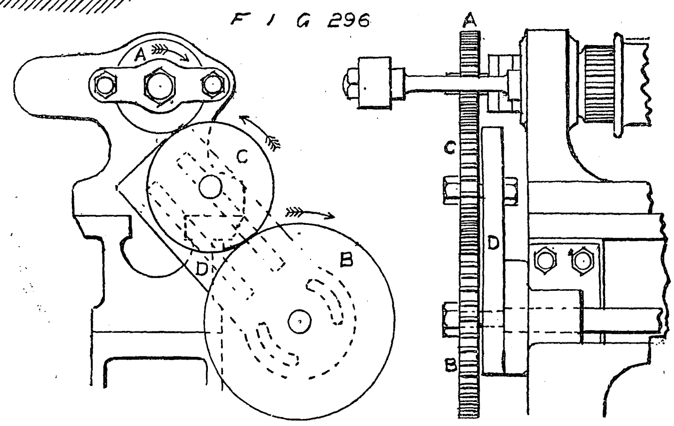


FIG 296


to the inch on a lathe whose guide-screw is 4 to the inch, we get $\frac{4}{8}=\frac{40}{80}$; and 40-wheel goes on the mandrel, and 80 on the guide-screw, therefore, the numerator of the fraction always represents the guide-screw and the driving-wheel, and the denominator the screw to be cut and the driven wheel. When we get beyond ten or twelve threads per inch, the number of the larger wheel becomes too large, and recourse is had to the compound train. Say we want to cut a thread of 18 to the inch, with a leading screw of 2 to the inch, the fraction would stand $\frac{2}{18}=\frac{20}{180}$. But then we have not got a 180 wheel, and if we multiply each by a number to bring in a large wheel, say, $\frac{2}{18}\times 5=\frac{10}{90}$, we find we have not got a wheel so low as 10. Looking up a compound train, we can say $\frac{2}{18}=\frac{20}{180}=\frac{4\times 5}{12\times 15}$ $=\frac{40\times 50}{120\times 150}=\frac{40\times \overset{25}{50^*}}{120\times \underset{75}{150^*}}$, and 40 and 25 drivers, and 120 and 75 driven, will cut the thread, and they are wheels in the standard set. Or, $\frac{2}{18}$ $=\frac{2\times 1}{6\times 3}=\frac{20\times \overset{30}{10^*}}{60\times \underset{90}{30^*}}$, and 20 and 30, and 60 and 90, will cut the thread, and numerous other combinations could be obtained by the same method, of taking either aliquot parts or multiples of the numbers first obtained, taking care to reduce or increase both drivers and driven in the same proportion.

To cut fractional threads, it is necessary to reduce the compound number to a simple fraction. Thus, say, we take a thread of $6\frac{1}{2}$ to the inch, and a leading screw of four to the inch, this equals $\frac{4}{6\frac{1}{2}}$, multiply this by the denominator of the fraction 2; $=\frac{4}{6\frac{1}{2}}\times 2=\frac{8}{13}=\frac{80}{130}$ $=\frac{40}{65}$, which are wheels in our train. Or, taking a thread of $6\frac{3}{4}$, and a leading screw of two to the inch, $=\frac{2}{6\frac{3}{4}}\times 4=\frac{8}{27}=\frac{2\times 4}{3\times 9}$ $=\frac{20\times 40}{30\times 90}$; also wheels of the set. The pitches selected for illustration have each been finer than that of the leading screw, so that in each instance the smaller wheels have been the drivers. Taking, now, a pitch coarser than that of the guide screw, say, containing $1\frac{1}{2}$ threads per inch, the guide-screw being four to the inch, we have $\frac{4}{1\frac{1}{2}}\times 2=\frac{8}{3}=\frac{80}{30}$, 80 being the driver and 30 the driven.

To cut millimètre pitches in a lathe with an English leading screw, the wheels are obtained in the following manner:—The mètre is assumed to be equal to 39·375, or $39\frac{3}{8}$in. A pitch of one millimètre, therefore, is equivalent to 1,000 threads in $39\frac{3}{8}$in. In the same length of leading screw having four threads to the inch we have $39\frac{3}{8}$in. × 4 = $157\frac{1}{2}$. or 157·5 threads of $\frac{1}{4}$in. pitch. Hence the ratio between the two is represented by the numbers $\frac{157\cdot 5}{1000}$, which reduced to its lowest denomination becomes $\frac{157\cdot 5}{1000}$, divided by $2\cdot 5=\frac{63}{400}$, so that $\frac{63}{400}$ is a constant fraction to be borne in mind for lathes having a guide-screw of four to the inch, and from which the ratios for lathes having other threads can also be deduced. Requiring to cut a thread of 1m.m. pitch we write down $\frac{63\times 1}{400}=\frac{63}{400}=\frac{7\times 9}{20\times 20}=\frac{70\times 90}{200\times 200}$ $=\frac{35\times 45}{100\times 100}$, whence we require a pair of 100's for driven. If we want to cut a screw of 6m.m. pitch we set down $\frac{63\times 6}{400}=\frac{378}{400}=\frac{6\times 63}{20\times 20}=\frac{60\times 63}{200\times 20}$. 200 is too high, so we substitute 50 and 80 driven, and $\frac{60\times 63}{50\times 80}$ will cut a thread of 6 m.m. pitch. These are fine pitches, and the small set of wheels are the drivers. Taking a pitch coarser than the guide-screw, say ·10m.m. $\frac{63\times 10}{400}=\frac{630}{400}=\frac{63\times 100}{50\times 80}$, and the large wheels are the drivers. When working out these ratios we shall find that a 63-wheel is absolutely necessary to cut millimètre pitches with two drivers and two driven wheels only. With trains of six or eight wheels, the 63-wheel can be done without, at least, in many instances.

To cut millimètre pitches in lathes, having leading screws of other rates than four to the inch, suitable ratio numbers must be taken. With guide screws of $\frac{1}{4}$in., $\frac{3}{8}$in., and $\frac{1}{2}$in. pitch the relations would be: $\frac{63}{400}$, $\frac{63}{600}$, $\frac{63}{800}$ respectively, and these would be constant for those leading screws. These three ratios correspond with $157\frac{1}{2}$ threads of $\frac{1}{4}$in. pitch in the mètre, 105 threads of $\frac{3}{8}$in. pitch, and $78\frac{3}{4}$ threads of $\frac{1}{2}$in. pitch, and the numbers 63, 400, 600, and 800 are the numerator and denominators respectively for leading screws of $\frac{1}{4}$in., $\frac{3}{8}$in., and $\frac{1}{2}$in. pitch. Taking an example in each case, let us say we want to cut a thread of 5m.m. pitch, with either one of these leading screws; then the equations stand: $\frac{63\times 5}{400}$ $\frac{63\times 5}{600}$, $\frac{63\times 5}{800}$.

Taking them in succession—

(1) $\frac{63\times 5}{400}=\frac{315}{400}\times 10=\frac{63\times 50}{100=40}$

(2) $\frac{63\times 5}{600}=\frac{315}{600}\times 10=\frac{63\times 50}{75\times 80}$

(3) $\frac{63\times 5}{800}=\frac{315}{800}\times 5=\frac{63\times 25}{50\times 80}$

these being single examples only selected from many possible combinations of wheels.

The precaution should always be adopted of proving the correctness of the calculation for driving and driven wheels before proceeding to cut the threads. And first, when the screw to be cut is of finer pitch than that of the leading screw:—multiply the driving wheels together, and also multiply the driven wheels together, divide the latter product by the former, multiply the result by the pitch of the leading screw expressed as the number of threads per inch, and the quotient equals the number of

* Denotes cancelled figures.

threads per inch required to be cut. In other words, expressive of the fundamental principle, the ratio subsisting between the driving and the driven wheels is the same as that subsisting between the guide screw and the screw to be cut. Taking the example given above of 18 threads to the inch, with a leading screw of 2 to the inch, we have 40×25 drivers, 120×75 driven $= \frac{120 \times 75}{40 \times 25} \times 2 = 18$ threads. Also $6\frac{1}{2}$ threads with a leading screw of 4 to the inch $= 40$ driver, 65 driver $= \frac{65}{40} \times 4 = 6{\cdot}5$. Taking again a pitch of 6m.m. as just now instanced with a leading screw of 4 to the inch, our drivers are 60×63, and driven $50 \times 80 \therefore \frac{50 \times 80}{60 \times 63} \times 4 = 4{\cdot}2328$, and a pitch of 6m.m. is contained 4·2328 times in an inch; but in proving millimètre pitches it is simpler to adopt the principle just now stated, that the ratio subsisting between the drivers and the driven is the same as that subsisting between the guide screw and the screw to be cut, in its more direct form. Thus the pitch of the guide screw is reduced to its equivalent in millimètres in order to be a factor, and a constant ratio of the same nature as that of the screw to be cut. Thus a leading screw of $\frac{1}{4}$in. pitch is equivalent to $\frac{63}{400} = \frac{400}{63} = 6{\cdot}3492$; one of $\frac{3}{8}$in. pitch $= \frac{63}{600} = \frac{600}{63} = 9{\cdot}5238$, one of $\frac{1}{2}$in. pitch $= \frac{63}{800} = \frac{800}{63} = 12{\cdot}6984$; the numbers 6·3492, 9·5238, 12·6984, representing the number of millimètres in $\frac{1}{4}$in., $\frac{3}{8}$in., and $\frac{1}{2}$in. respectively, and the ratios of the driving and driven wheels must correspond with the ratios subsisting between these numbers and those of the screws to be cut. Taking the screw of 6m.m. pitch, as instanced above, with a leading screw of four to the inch, and 60×63 drivers, and 50×80 driven, we have, taking the ratio direct— $\frac{60 \times 63}{50 \times 80} = {\cdot}945$, and also $\frac{6}{6{\cdot}3492} = {\cdot}945$, or $\frac{50 \times 80}{60 \times 63} = 1{\cdot}05$; and $\frac{6{\cdot}3492}{6} = 1{\cdot}05$, or $\frac{60 \times 63}{50 \times 80} \times 6{\cdot}3492 = 6{\cdot}0$; by which methods the ratios are apparent by inspection, without the necessity of bringing into inches. In all screw cutting the fundamental principle of ratio or proportion must be borne in mind, and no matter how obtained, if the ratios of driving and driven wheels, and of guide screw and screw to be cut are identical, there is no risk in proceeding with the work, provided, of course, that the drivers and driven are in their right places. Thus, a thread of 6m.m. pitch is finer than one of $\frac{1}{4}$in. pitch or 6·3492m.m.; hence the smaller wheels 60×63 are the drivers, and 50×80 the driven. But if we had a pitch of, say, 10m.m., the conditions would be reversed, thus:—

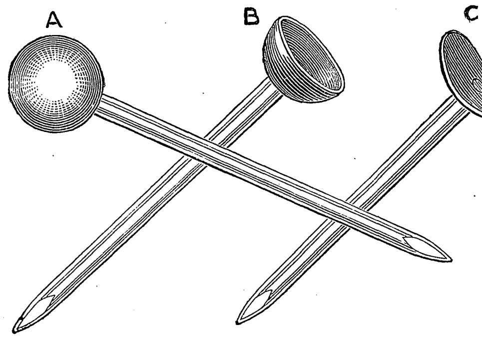
$$\frac{63 \times 10}{400} = \frac{63 \times 10}{20 \times 20} \times 4 = \frac{63 \times 40}{20 \times 80};$$

equivalent to $\frac{20 \times 80}{63 \times 40} = {\cdot}634$, and $\frac{6{\cdot}3492}{10} = {\cdot}634$, showing equal ratios, and 63×40, the larger wheels, the drivers.

(*To be continued.*)

SCIENTIFIC COOKERY.

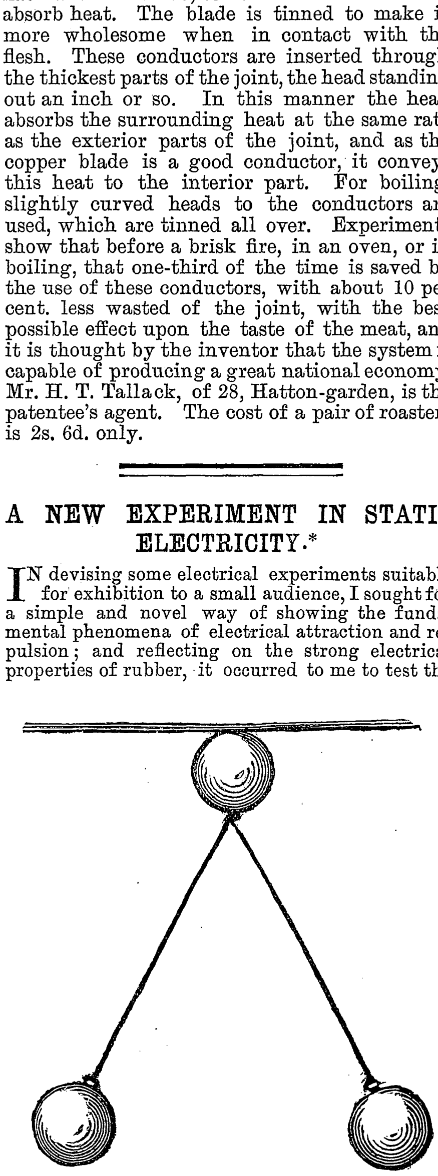
MR. W. F. STANLEY has invented a new form of heat conductor for cooking the interior parts of joints of meat, poultry, or fish simultaneously with the outer parts. Flesh is known to be a very bad conductor of heat, therefore in all methods of cooking now in use if the exterior parts are perfectly cooked, the interior parts are found to be much overdone, with corresponding loss of the nutritious juices of the flesh. The object of this invention is to provide means by which the interior parts may be cooking simultaneously with the outer parts. This is effected by metallic conductors which conduct the exterior heat to the interior parts, and thereby produce a great saving of fuel, time, and food, besides which the juices of the meat are conserved so that the cooked meat is much more palatable and wholesome. The forms of heat conductors that have been found



by experiment most effective for roasting and baking are pointed blades of copper, upon which are fixed rather large globular heads of malleable iron, which conductors are now made. The iron head is left covered with its natural black oxide, to be in the best state to absorb heat. The blade is tinned to make it more wholesome when in contact with the flesh. These conductors are inserted through the thickest parts of the joint, the head standing out an inch or so. In this manner the head absorbs the surrounding heat at the same rate as the exterior parts of the joint, and as the copper blade is a good conductor, it conveys this heat to the interior part. For boiling, slightly curved heads to the conductors are used, which are tinned all over. Experiments show that before a brisk fire, in an oven, or in boiling, that one-third of the time is saved by the use of these conductors, with about 10 per cent. less wasted of the joint, with the best possible effect upon the taste of the meat, and it is thought by the inventor that the system is capable of producing a great national economy. Mr. H. T. Tallack, of 28, Hatton-garden, is the patentee's agent. The cost of a pair of roasters is 2s. 6d. only.

A NEW EXPERIMENT IN STATIC ELECTRICITY.*

IN devising some electrical experiments suitable for exhibition to a small audience, I sought for a simple and novel way of showing the fundamental phenomena of electrical attraction and repulsion; and reflecting on the strong electrical properties of rubber, it occurred to me to test the



possibilities of the common toy rubber balloons, as they seemed to offer the advantages of large exciting surface and small weight, both of which are important desiderata in experiments of this kind. A trial proved them particularly adapted to striking and interesting demonstration. My first experiments were made with the ordinary grade of toy balloons, which have a red-stained wooden mouthpiece containing a "squawker," well known to small boys and adults who have been harassed by their intermittent squawking. These common balloons may be procured at almost any toy store for a few cents each.

They are inflated with the breath and tied at the end with silk or thread, when they may be pushed off the tube. If one of these inflated balloons be thoroughly stroked with a cat's skin, it becomes strongly electrical, and will fly to the body or adhere to the hand if held over it, or it may be rapped up to the ceiling with a small stick.

Its adherence to the ceiling is remarkably persistent. I have repeatedly had balloons remain in such positions for more than four consecutive hours. Numerous instructive experiments may be made with them singly or in combination, and the few here described will suggest others. Their strong attractive force implies, of course, strong repellent force. If two are suspended by threads of the same length, and excited with the cat skin, they will be pushed apart two or more feet, the distance depending to a great extent on the length of the suspending threads. If the hand be now brought between them, they will be attracted to it, and if it be suddenly withdrawn before the balloons have touched it, they will bound away from each other almost as if they had struck a wall.

A very pretty experiment is illustrated by the engraving. Two of the balloons are hung with equal threads to a third, the threads being of such length that when the third balloon is against the ceiling the others may be conveniently reached. The third balloon is now excited, and put against the ceiling by means of a long stick. If properly done, the attraction is amply sufficient to support the two other balloons. These latter are now excited, care being taken not to pull the supporting one away from the ceiling; and as their mutual repulsion forces them apart and they float airily around each other, the whole group affords a demonstration of both the attractive and repellent forces of electricity so striking that it can hardly be appreciated until it is seen. If a strip of hard rubber be electrified with the cat skin and put between the suspended balloons, they fly still further apart, and one of them may be chased around, or made to rise vertically by a little dexterity with the rubber strip. By arranging, say, half a dozen balloons in the form of a hexagon horizontally on threads strung across a room or on a suitable light frame, it is quite possible that another balloon could be suspended in mid-air by the combined repulsion of the group when in a good state of electrical excitement. This would be a very effective experiment, although it has not yet been tried.

There is a choice among the balloons of different grades for these experiments. The cheaper kind I have found almost unexceptionally satisfactory, but it seems impossible to electrify the better ones, which are heavier and more highly coloured. Probably the colouring matter gives them more or less conductivity, so that the charge excited on them easily flows off. It may be, however, that by thoroughly extracting the colouring matter with alcohol or otherwise, they may be made available for electrical purposes, in which case their larger size might make them specially desirable in some experiments. It should be added that, like most experiments with statical electricity, these succeed only in cold weather.

* By H. A. DOTY, in the *Scientific American.*

RECENT RESEARCHES ON FRICTION AND THE ACTION OF LUBRICANTS.—II.*

By PROF. HELE-SHAW.

THE mechanical tests by which the nature of lubricants are examined are effected with a class of apparatus called "testing machines." These machines are of quite modern invention, but many of them have been invented, and a large amount of ingenuity and skill has been displayed in their design. It is by means of these machines that our knowledge on the effect of the three last variable conditions — viz., pressure, velocity, and temperature, on the amount of sliding friction, as well as of the nature of the materials has been obtained, and therefore a brief explanation of the principle of action of a few of them may be given. Perhaps the simplest tester is the pendulum machine of Bailey's in which an upright support a, a, Fig. 1 (page 125), carries a pendulum bc suspended at the point b. This pendulum is con-

* A paper read before the Liverpool Engineering Society.

nected at the point e to a sliding block f, which rests on a smooth plate carried by an arm from the support. When the pendulum is started swinging, it will come to rest in a longer or shorter time, according to the nature of the lubricant, a sample of which has been previously placed on the plate on which f slides. The foregoing tester is the only one in which reciprocating motion is employed; in all others there is continuous rotary motion of the parts in contact. One of the earliest and simplest of these is the machine of Ingram and Stapfer, in which a shaft shown in section a (Fig. 2, page 125) is kept in continuous rotation at about 1,500 revolutions per minute. There are two levers $a\,b\,c$, $d\,e\,f$, which are respectively weighted at the points c and f, and supported on the frame of the machine at a and e. Thus considerable pressure is produced at the points b and d upon the brasses which fit the shaft A. A thermometer t attached to the upper brass measures the rise of temperature produced. The quality of a lubricant is estimated by noting the number of revolutions for which a given quantity of it, when inserted between the brass and shaft, can enable the latter to be turned. Neither of the foregoing machines measure directly the resistance of friction, but rather the nature of the lubricant; the machines of Crossley, Thurston, Woodbury, and Riehlé all measure the frictional resistance. Valuable results have been obtained by Mr. Woodbury with his machine, which consists of an upright vertical shaft, driven by a belt, and carrying on its upper end an annulus upon which the lubricant is placed. On this annulus rests another, the required pressure between the two being obtained by means of a loaded frame, which is hung by means of a pivot upon the vertical shaft of the upper annulus; the latter is prevented from turning by a spring dynamometer, which thus serves to measure the frictional resistances. This machine is fully described in the "Transactions of the American Society of Mechanical Engineers," Vol. VII., page 136. The testing machine of Professor Thurston is, perhaps, the most convenient and complete, and withal one of the most simple of any yet invented. It consists essentially of a loaded rod A B (Fig. 3, page 126), suspended to a rotating shaft A, carried by a support A D, the friction at the point of suspension causing the rod to be carried out of the perpendicular to an extent depending on the friction at that point. This deviation is shown by a pointer E on the index C C, and thus the frictional resistance of the lubricant which is used in the bearing is directly measured. Not only can the pressures on the bearing be varied by tightening up a spring in the rod A B, but observations on the rise in temperature, and its effect upon the friction, can be made by means of the thermometer. The machine can also be used to test the effect of changes in velocity on the frictional resistance and the durability of any lubricant. By means of these machines and others, various experimenters have examined, with reference to their lubricating powers, the nature of probably all substances used, or likely to be used, as lubricants, with the object of determining the so-called co-efficient of friction. It has, however, been found that there are innumerable co-efficients for any one substance depending on the particular conditions of the experiment, and an account of the effect of these conditions must now be given, instead of any attempt to give even an abstract of the results themselves. One fact has clearly been demonstrated, and that is, that the friction diminishes with the fluidity of the lubricant. Mr. Woodbury, however, in a recent paper remarks, this "does not warrant any extreme position in respect to the use of these oils, except for light pressures, because under all circumstances the film of oil must be thick enough to keep the surfaces of a journal from actual metallic contact. In the severe work of heavy pressure a viscous oil must be used, in order to retain its place upon the bearing surfaces in sufficient thickness to prevent the irregularities on the journal from colliding. In some places it has been found that the use of an extremely thin oil resulted in the diminution of the friction of the machines at the expense of more rapid wear of the journals." The use of testing machines is fortunately not now limited to scientific investigators, but is becoming more and more common with those who use lubricants in any quantity, as by far the best test of the quality of the lubricants. In America some large railway companies are annually saving considerable sums of money in this way, and in this country some companies are following their example. It is, however, a suggestive fact that, throughout the whole of Liverpool, which is probably the most important steam shipping port in the world, the author has not been able to hear of a single company which subjects the lubricants used on their steamships to any kind of scientific test. Before leaving the subject of the nature of the surfaces in contact, the most important question as to why the co-efficients vary so greatly must be alluded to. Long ago it had been suspected by Hirn, and perhaps by others, that the friction of well-lubricated surfaces — that is, of surfaces "floating" or immersed in lubricant, would obey the laws of fluid friction, and the surfaces with an extremely small quantity of lubricant between them would obey the laws of solid friction, while surfaces with a moderate amount of lubricant would obey laws partaking of the nature of those of both solid and fluid friction; now, solid and fluid friction differ, essentially, in fact, are quite of an opposite nature. Those of solid being expressed, as previously mentioned (page 101), by the formula

$$F = \mu R$$

Those of fluid friction by $F = f\,S\,V^n$.

Where f is a so-called co-efficient of fluid friction, S = extent of surfaces in contact, V = relative velocity of motion, and n some quantity which lies between 1 and 3. That is, the friction of fluids is *independent* of pressure, and *does* vary in some way with the velocity and extent of surface in contact. Thus it was to be expected that the friction of lubricated surfaces would exhibit great variation according to the mode of lubrication. Until quite recently, however, this matter has been entirely ignored, and it has been reserved for various experimenters, Marcel Deprez, in France, but chiefly Thurston, in America, and Beauchamp Tower in this country, to definitely establish the existence of what Hirn called "immédiat," or solid, and "médiat," or fluid, friction, as occurring between the same pair of solid surfaces, according to the quantity of lubricant between them, and causing very different frictional resistances. Thus Mr. Tower says that his results, "generally speaking, were so uncertain and irregular that they may be summed up in a few words. The friction depends on the quantity and uniformity of distribution of the oil, and may be anything between the oil bath results and seizing, according to the perfection or imperfection of the lubrication. The lubrication may be very small, giving a co-efficient of $\frac{1}{100}$, but it appeared as though the friction could not be diminished, and the friction increased much beyond this point, without imminent risk of heating and seizing. The oil bath probably represents the most perfect lubrication possible, and experiments show that, with speeds of from 100ft. to 200ft. per minute, it is possible to reduce the co-efficient of friction as low as $\frac{1}{1000}$. The extent to which friction depends on the quantity of lubrication is shown in a remarkable manner, in one particular set of experiments, which proved that lubrication could be so dimished that the friction was seven times greater than it was in the oil bath, and yet that the bearing ran without seizing."

II.—*The variation of effect with pressure.*—The simple law which states that the resistance of friction varies directly as the pressure between the surfaces in contact is sufficiently true for practical purposes in the case of solid surfaces. It is not, however, absolutely true even in this case. Thus Prof. R. S. Ball found that a modification of the law was required, and that in certain experiments made by him a more correct form of representing the results was $F = x + y\,R$. The values of x and y in the case of pine sliding on pine being $F = 1{\cdot}44 + 0{\cdot}252$ R. This shows that the resistance of friction was proportionately higher at low pressures than that at higher ones, there being probably some effect due to a partial adhesion of the surfaces. For lubricated surfaces the results obtained by varying the pressure are extremely hard to bring under any definite law. Thus take as one example of hundreds which might be selected from published results. In Prof. Thurston's book on "Friction and Lubrication" (page 188) are some results of experiments, in which, with a constant velocity of 30ft. a minute, when the pressure was

200lb.	per sq. in.	the	coefficient	was	·01
150	"	"	"	"	·0035
100	"	"	"	"	·0025
50	"	"	"	"	·0035
4	"	"	"	"	·05

the temperature being the same in all these cases. These figures afford a good illustration of the erratic nature of the results which every observer who works at the subject finds himself obtaining. Although a very probable reason for this has been already pointed out, as applying to particular experiments, the average results of different workers should be, and indeed are, in accord even when not extending over the same range of conditions. Thus Prof. Thurston considers that the general result of his experiments on lubricated journals points to the friction under ordinary conditions varying inversely as the square root of the pressure. And though the results of Mr. Tower on the one hand, which extend to much greater pressures (up to 625lb. per square inch) do not definitely obey this law, still they tend in that direction. The same may be said of Mr. Woodbury's results, which are, on the other hand, for very low pressures, the resistance increasing in a much less ratio than the pressure. For instance, at 500 revolutions per minute and 80° F., with pressures of 1lb., 2lb., 3lb., 4lb., and 5lb. per square inch, the corresponding total resistances in his machine were 3½lb., 5lb., 6lb., 7·17lb., and 8lb. The general conclusion, which is the result of our increased knowledge of the effect of pressure, points to the great importance of securing perfect lubrication. When this is done the resistance of friction, instead of increasing, as the hitherto received theory would assume, with heavy loads to a point at which great loss of work would take place together with immense wear, only increases but slowly. That this is often done in practice, no doubt, accounts for the great loads actually carried by journals and bearings of various kinds, notwithstanding the rules and formula in text-books and manuals.

III.—*The variation in effect due to velocity.*—Since the time of the experiments of Morin, the friction of solid surfaces has been usually considered to be nearly independent of their velocity relatively to each other. No doubt this is the case, for the range of velocities, over which the experiments were made, as shown, on the one hand, by the uniform motion of the sledge at different velocities, but otherwise similar conditions, and on the other by the parabolic form of the time curve when the motion was allowed to accelerate. The lowest velocity, however, used in these experiments, was about ·01ft. per second, whereas Prof. Jenkin and Ewing have obtained results with velocities as low as ·0002ft. per second. This was done by employing the inertia of a cast-iron disc, 2ft. in diameter, and ¾in. thick, supported by means of a spindle only, 0·1in. in diameter at the ends, upon bearings of various substances (square and not circular in the cross section of the opening). The disc was set in rotation, and a siphon recorder, actuated by a pendulum, was employed to trace curves upon a band of paper fastened round the rim. The form of the curves enabled the rate at which the disc had been gradually brought to rest by the motion of the bearings to be determined. From these curves the friction itself could be estimated down to the above-mentioned low velocity of $\frac{1}{5000}$ft. per second. The general results of these experiments show that, "omitting the doubtful cases of oiled steel and wet agate, the co-efficient of friction remained entirely unaffected by changes in velocity, except where the bearings were made of wood, and that even in these circumstances no change of the co-efficient could be detected so long as the surfaces were dry; but when oil or water was present the co-efficient of friction increased in a very marked manner as the velocity diminished, this increase in the co-efficient of friction taking place under a limit of velocity of about 0·1ft. per second." The authors, after remarking that these are precisely the same cases in which there has been found to be a marked difference between the static and kinetic values of friction, whereas in the other cases no difference at all was found by Coulomb and Morin, say, "in fact, out of all the cases which we have examined, the only ones in which there is known to be a marked difference between the friction of rest and that of motion are those in which steel slides on oiled or wetted surfaces of wood, and in these cases, and these only, we have detected a very considerable increase of friction at low speeds."

(*To be continued.*)

THE LOCOMOTIVE OF THE FUTURE.

THE following remarks of Mr. J. Coleman, made in an address to the American Master Mechanics' Railway Association, will interest many readers who study the locomotive question:—What is a boiler? It is merely a thing to absorb the heat, says Mr. Coleman. The bottom of a pot over a fire is the best boiler surface in the world. Now put a cover on the pot, with a pipe extending from it, and you will have a second form of boiler. The next step is the old, plain cylinder boiler, which is a plain, cylindrical pot over a fire. Why don't everybody put them in? Because it is too expensive. That is all there is to the whole subject, as I understand it. We have found in mills, just as I think we should find if we looked at railroads, that everybody is inclined to put in a great deal too small boiler power, and too small furnace; and in sugar houses you will see that illustrated, where they will carry 16" fires on their grates. In fact, they force their fires, just as they do on steamships and locomotives. And we have found that as we could persuade mill owners to put in more boilers, and extend the fires so they could burn slowly and give time for this process of combustion to take place in the furnace, because it is a thing that requires time, or else it requires an intensely hot furnace, and even then it requires time, we find that when we can persuade them to do this, we get better results. And in the ordinary locomotive practice, when I find particles of coal hitting me when I am riding in the cars, I do not think that process is properly carried out; and when I see dense volumes of smoke coming from the stack, I do not believe it is carried out; and when I smell the gas that comes up I do not believe it is properly carried out. My point is this:—That as we have gone slowly, taken things deliberately

in mills, we have saved money. I have, in many cases, put in large sets of boilers in sugar houses and the like, where we have saved them a thousand tons of coal in a year out of four thousand, and sometimes out of three thousand.

Now, coming to the locomotives. I think if we examine the locomotive carefully, it will strike us as a little curious that the best locomotive that I remember reading of in this country weighed about 14 tons. I forget the exact dimensions of its furnace; in fact, I don't think they were given, but judging by the cut I should say the furnace was about 2½ft. or 3ft. square. We have gone on increasing the weight of our locomotives until some are as large as fifty tons. We have increased the locomotives over three times; but I will ask you if the furnaces have been increased in proportion? I do not think they have. The furnaces are, some of them 6ft. or thereabouts long, and 35in. or 36in. wide, more or less. So that, compared with the old size, you have increased them nothing like in the proportion which you have increased the size of the engine. I had always supposed, as most people who are outside of the railway profession do suppose, that there was something occult and mysterious in railway engineering—that nobody could understand it except those who were bred to the business. Perhaps it is so; and we outsiders may be considered very conceited if we know much about it. I think that the position I have taken was fully proven by some experiments that I have already detailed to the New England Railroad Club, that I tried for the Italian Government, during three weeks, in pulling freight trains up grades that were 100ft. to the mile, and it was with an engine that was built by the Reading Road. We took that engine down there, and we scraped the coal dust up in the yards, which they cannot burn at all on their European roads. We had to compete with the best engines on the Continent — the French, the Belgian, and the Austrian engines. We scraped the coal dust up, pressed it into cakes, and got just as good a result with that coal dust as we got from the best coal. We also used five kinds of Italian lignite, which was only half the combustible value of coal. We pulled the heaviest freight trains that they could pack on to us.

We started up this grade, and we found that we could scarcely crawl. Our engineer got very nervous and furious over it. They had already screwed the brake down upon us. We were going slow enough, so that he could get off and feel of the wheels. We pulled the train to the top of the hill, but we were blowing off steam furiously all the time that we were drawing that load up. When we got up the station the inspector-general came to me and said: "Signor, I congratulate you on having a superb machine here." And I thanked him. One of his engineers came to me and said: "Do you know what you have done, sir? Do not tell that I have informed you, because, if you do, I shall lose my place. You have pulled 50 per cent. more than the maximum load of one of our 40 ton engines." I said to the inspector-general: "If you choose to go on with this sort of procedure you can; but you won't get that steam down; that is what you tried to do—to stall us on the grade, and publicly disgrace us."

There was carried out on that machine exactly the proper principles. I won't say it was carried out in a proper manner; the mechanical details may be wrong; they may be improved; there is no doubt of it, because, as you know, one does not always succeed the first time; but the result was that we fired up in a way that I never had seen anything like before in my life. Our fireman used to level up his fires at the station, get everything in readiness, and he was leaning over his tender, smoking his pipe, between the stations. Once in a while he pulled the door open, put a shovel full of coal into the hold, and went on. The whole secret of it was the enormous area of the grate, which, if I remember right, was about 7ft. by 9ft., and we carried a thin fire, so that we got just the modicum of air that was necessary for the coal. That is one of the particular points. Of course you will readily see that there is a certain amount of gas in a certain amount of coal; and if the air gets through the coal, through the interstices between the coal, and if you keep packing on, you will by and by block that passage to such an extent that you won't get air enough. Therefore, we find that with a very fine dust coal, we must run a very thin fire; if we go to chestnut coal, we make a little thicker fire; if we go to stove coal, we make it 6in. thick, and so on; but for ordinary stove coal, or a little larger, we have always found that you should never make a fire over 6in. deep if you want to get a good result. The locomotive of the future has got to be changed in some way to keep up with the times. Here is the freight traffic of the country doubling up every ten years. The trains are following each other, one after the other, in rapid succession. What are you going to do? Are you going to double, treble, or quadruple your tracks, or what are you going to do? We are also obliged to constantly economise in the method of conducting this traffic.

It seems to me there are two or three things that have got to be done to the locomotive of the future. We have got to burn a great deal less coal for the steam we make, and after we have made that steam we have got to use it up a good deal more thoroughly. It seems to me that it is obvious that we have, one of these days, got to put in the compound engine which is used to day in the steamships, and we shall probably get the same results. If we have got steam strong enough to drive another engine, let us put another engine there. A way out of this difficulty about the furnace seemed to me to be shown in an engine which I saw on the Providence and Bristol road the other day, made by the Mason works of Taunton—that is, the possibility of making an engine upon the idea of a wide firebox which will overlap the drivers. It was a very ugly-looking affair; but "the proof of the pudding is in the eating." Mason, in putting the wheels under the tender, brought his weight upon his drivers—that is, his engine, as I look at it, is with the pivot under the tender. The whole weight of his machine is upon his drivers, and his drivers are far enough ahead, so that he can do as he chooses with his firebox. If he chooses to spread out wide, he can do it with perfect ease. It seems to me that in these two or three directions it is for you to consider that this matter of combustion must be met; and there is no possible way to meet it except to spread out. You cannot get more by deepening, because you don't have half, nor a quarter, the good that you should obtain from the coal that is burnt now by packing it up in a small area. So that the object of my somewhat rambling remarks would seem to be this:—That the locomotive of the future, as it looks to an outsider in various parts of the world, and looking at steam engineering in all its phases, must be changed in the direction of the spreading out of the furnace.

A LOOK THROUGH THE GREAT OBJECT-GLASS.*

By PROF. C. A. YOUNG.

THE object-glass of the great Lick telescope is now practically completed, and only awaits examination and approval by the experts who are to be appointed by the Lick trustees to test it. As all our readers probably know, this enormous lens, by far the largest ever made, is 36in. in diameter, and has a focal length of 57ft. It is composed of two lenses, of which the front one (outside) is an equiconvex lens of crown glass, while the other is a concave lens of flint glass: one side of this—the one next the eye—is very slightly concave, in fact almost flat; the other, next the crown-glass lens, is considerably concave, the curvature being somewhat deeper than that of the crown-glass surfaces. The inner surfaces of the two lenses are separated by a clear air-space of about 6½in., and there are perforations in the steel cell which allow a free circulation of air between them. The glass discs were made by Feil, of Paris, and they have been figured and worked by our own Clarks at their modest but famous establishment in Cambridgeport.

Through their courtesy, the writer had the privilege of looking through this most powerful of all existing telescopes a few evenings ago, in company with some of his astronomical friends, and although the state of the air was not all that could be desired, and the moonlight interfered somewhat with the view of faint objects, yet the experience was something to be long remembered.

The instrument is mounted on a temporary stand, first erected for the testing of the 30in. Poulkowa glass, which, until within a week or two, was the largest in existence. In constructing this mounting, the Clarks, however, had also the Lick instrument in mind, and proportioned the parts accordingly. A huge pyramid of brickwork rises some 30ft. from the ground, and bears on its sloping top a sort of cast-iron saddle with the bearings of the polar axis, which is 10in. or 12in. in diameter, and some 12ft. long. It carries at the upper end the declination axis, of about the same dimensions as itself. The tube of the telescope, an immense cylinder of boiler-iron, 42in. in diameter, and nearly 60ft. long, is secured to one end of the declination axis, as near the pier as possible; and the other end of the axis, protruding awkwardly, is loaded with counterpoising weights.

As we came into the garden where the instrument is placed, the great tube towered high and white in the moonlight far above the surrounding trees and buildings, directed towards the bright star Alphacca, the gem of the Northern Crown. At the lower end, two or three men were sitting around; and one was lying on the ground, craning his neck to look into the eyepiece, which came a little too low to allow the use of the chair. The observer was Mr. Alvan G. Clark, the youngest member of the firm, and the one who at present does most of the purely optical work. He was trying to see how the figure of the lens had been affected by the delicate work of the last two or three days. The other on-lookers were George Clark, his older brother, the mechanician of the firm, and the venerable Alvan Clark, sen., their father, with one or two of the most trusted workmen of the establishment. Before long we were joined also by Professors Pickering and Langley.

In a few minutes the glass was turned to a neighbouring star, γ Coronæ, which is an exceedingly close double, its components not being more than about ¼″ apart. Although the roughly mounted telescope vibrated a good deal in the breeze, and the air was rather unsteady, so that the star blazed and danced about; yet under a power of about a thousand the two components were distinctly separated with a fine dark line between them. I had seen the object just as plainly with a different instrument not very long ago, but not so impressively: the stars had no such brightness. In fact, the Lick object-glass gathers in from any star nearly two and a half times the light collected by the Princeton glass, the areas of the lenses being as 1,296 to 529.

Everything about the image showed that the figure of the lenses is excellent, and the aberrations nicely corrected. Nobody but a Clark would think he could improve it "just the least bit."

Then we turned to the great cluster in Hercules, and wished that for a few moments we could extinguish the moon. For although the telescope resolved the cluster in a marvellous manner, and showed its own optical excellence in the pefection of the images, yet the moonlight and the haze robbed the object of its glory. The blaze and glow of the innumerable stars upon the black background of a darker night were missing.

The instrument was next directed upon ζ Herculis, an interesting and rapidly moving binary; and then upon the great white star Vega, or α Lyræ, at that time nearly in the zenith, and admirably adapted for testing purposes. This defied the moonlight: one understood now what Herschel meant in speaking of Sirius coming into the field of one of his great reflectors "*like sunrise.*"

And yet, when the glorious star was passing through the field, one could see at the same time, and without any need of hiding the large luminary, the delicate companion discovered by Winnecke long ago with the old Poulkowa telescope: hitherto it has been possible to see this, even in the very largest telescopes, only when the great star was put out of the field. Of course we do not refer to the old and well-known companion, easily seen in all telescopes of any size above 4in. In the great telescope, that was about as bright as the polar star to the naked eye. Nothing was seen, however, of other little stars that have been reported by certain amateurs as visible in this field of view.

On withdrawing the eyepiece, and placing the eye in the focus of the great lens, one could examine it critically for every vein and flaw and air-bubble. It is rare that one finds a pair of discs so perfect. Under the trying test, one could indeed make out a few little wisps of veiny structure, and one small dark speck that was easily visible; but there was nothing that could do any mischief to the image of a star.

ε Lyræ, the exquisite double-double very near to Vega, was next looked at; the only notable thing being that certain little stars between the two pairs, which in instruments large, but not *so* large, are rather hard to see even in a dark night, were easy and almost conspicuous, notwithstanding the moonlight.

The "Ring-nebula" was very pretty; but a mere pale ghost of what it would have been on a moonless sky.

α Herculis showed its contrasting colours finely; and by putting the large star out of sight, we could see a little companion which Mr. A. G. Clark has just discovered. It is in the *n.p.* quadrant, and about 10″ or 12″ distant from the larger star of the pair. Probably it can be seen by some of the other large telescopes under favourable conditions; but it is certainly a full magnitude smaller than Winnecke's companion of Vega.

A number of other objects were looked at; but nothing that calls for special notice here.

The elder Clark remained present during the whole evening, and, despite his eighty-three years, examined every object, even when the position required was such as to cramp and try younger limbs and muscles. His eye seems to have lost little of its original keenness, though trembling hands and easy weariness no longer permit him to do much actual labour. But what a step from his first 3in. glass made for Dr. Wells of Salem (in 1850, I think) to this great 3ft. lens!

Towards midnight, when the time came to leave off work, the telescope was turned vertically, object-glass down, and strapped tightly to the pier:

* From the *Popular Science News*, Boston, Mass.

in this position the lens was about 18in. from the ground, on which was a floor of heavy plank. A sort of low baggage-truck was then rolled under the telescope, and, by a stout screw underneath, the floor of the truck was raised until it touched the cell which holds the lenses. On loosening the screws which hold the cell to the tube, the weight of the object-glass, about 750lb, settles down upon the truck, and when everything is clear, three men haul it away along a plank-walk, and store it, with its sixty thousand dollars burden, in the little fire-proof building where the grinding and polishing are done.

While the making of the great lens has gone on thus rapidly and successfully since the crown-glass disc was received, only about a year ago, the opticians have just met a serious set-back in the matter of the "photographic corrector," which was to go with it, and fit it for astronomical photography. The disc out of which this lens was to be made was received from Feil last spring. Examination by polarised light showed that the glass was under a severe internal strain, due to insufficient annealing; and the Clarks at once notified the maker of the fact, and told him that they feared the disc would not bear working. The maker, however, thought otherwise, and directed them to proceed at his risk, which they did. The upshot of it was, that a few days ago the disc burst into three pieces while on the grinding-tool; and so, of course, that part of the work will have to be postponed until a new disc can be obtained; how long that will take, no one can predict with certainty.

This will not, however, delay the erection of the instrument. Its mounting is already well under way in the shops of Warner and Swazey, at Cleveland; and, unless there is some unexpected delay about the observatory building and dome, there is every reason to expect that within a year from now this monstrous piece of astronomical artillery will have opened fire upon the heavens from its chosen mountain-top. We may well hope that under the able direction of Prof. Holden, it will prove effective.

USEFUL AND SCIENTIFIC NOTES.

THE Chicago Academy of Sciences has been presented with the bones of an elephant supposed to be the *Elephas primigenius*, by Dr. E. W. Andrews. The remains were discovered in the eastern part of Washington Territory. Among them is one animal of enormous size which is quite as large as Ward's Siberian Mammoth. Its tusk is 10ft. in length, pelvis 63in. in length, and the longest rib found 54·6in. long. No complete skeleton was found.

Light and Slack Coupling.—Some interesting experiments have been made in the United States to test the effect of open and close couplings upon the ability of a locomotive to start a train. This has been a matter of hot dispute for a good while, and it is strange that the matter was not long ago determined by actual experiments. At Burlington it was found that the locomotive could start level 49 loaded cars close coupled and 48 with ordinary link and pin coupling. Afterwards, on the grade, the engine started 38 cars with each method of coupling. The general results seem to establish the conclusion that the loose slack of open couplings is of no advantage in starting a long and heavy train, and that the draw-bar springs give all the slack that is needed. This is opposed to the results of English experience, which shows that slack in the couplings is essential to the starting of heavy trains.

PROF. DR. MEIDINGER states that Prof. Poleck has discovered that timber procured for him purporting to be winter-felled wood, was in reality raft timber floated down the river, and he has ascertained that timber which has been thus immersed is no longer liable to the attack of dry rot. So much so is this the case that in Alsace it is customary to specify that only raft timber shall be employed. The water slowly dissolves out the albumen and salts, and thus deprives the fungus of the nutriment needful for its development. A French savant has found by experiment that whereas fresh sawdust, when buried in damp earth, rots away in a few years, sawdust which has been soaked for some time in water, and has been thereby deprived of soluble matters, will remain in the ground under similar circumstances wholly unchanged, and only slightly tinged on the exterior with earthy matters dissolved from the soil.

CHLORIDE of tin as a disinfectant is recommended by Dr. Abbot as being more active than zinc chloride, copper sulphate, zinc sulphate, or ferric sulphate, spores being killed after exposure to one per cent. solution for two hours. It is cheap, tolerably safe, and will not corrode lead pipes. It is advised, when required to be kept, and to prevent formation of insoluble oxichloride, to mix it with an equal quantity of ammonium chloride.

SCIENTIFIC SOCIETIES.

WESTERN MICROSCOPICAL CLUB.

THE members of this club met recently at the house of W White, Esq., of Cambridge-gardens, Notting-hill, to listen to the exposition on the subject of "Alkaloids," given by Mr. A. W. Gerrard, F.C.S., of University College. Mr. Gerrard defined alkaloids as bodies containing carbon, hydrogen, and nitrogen, and, in some cases, oxygen also. They all have an alkaline reaction, and form compounds with acids. On heating them strongly they burn away entirely, leaving no residue. With certain group reagents, such as Meyer's solution, phosphomolybdate of sodium, &c., they all give definite reactions. Most of them are extremely poisonous, bitter, and acrid. Mr. Gerrard then gave an individual account of many of the chief alkaloids, tracing their derivation, history, and properties. A new one that he had just discovered was ulexine. It is present in the seeds of the furze known as gorse and whin. It is not present in the furze tops, hence the immunity of the cattle who are sometimes fed upon these. It is a poisonous principle, having a paralysing action, and it may, perhaps, prove of service in nervous disorders. This alkaloid is very soluble in water, and gives, with ferric chloride, a distinctive dark red colour, by means of which as little as the hundredth of a grain may be recognised. Some of the various alkaloids present in opium were next referred to, especial attention being given to morphine, the distinctive tests of which were well shown. Cocaine, which has of late made such a stir in the medical world, received Mr. Gerrard's attention. Its power of obliterating all sensation from the mucous surfaces of the mouth, tongue, and eye was practically tested by some of the members present. As evidence of its increased use a grain, some few months ago, cost wholesale 30 pence; now it can be had for 2d. At present we have no distinctive colour reaction for cocaine. Mr. Gerrard then graphically described his isolation of the alkaloid pilocarpine, and the trial of its production of profuse perspiration upon himself. One-third of a grain will produce a profuse perspiration lasting for hours; but if during this time 1-25th of a grain of atropine be injected into the patient's system, the perspiration is almost immediately stopped. Pilocarpine has a reverse action to that of belladonna, so that the one acts as an antidote to the other in cases of poisoning by either. Physostigmine, and its preparation from the Calabar bean, so celebrated from its use as a fetish ordeal amongst some African tribes, were then described. A minute portion placed in the eye contracts the pupil to a mere pin's point in size, while atropine, on the other hand, expands the pupil.

Gelsemina gives the same chemical reactions as strychnia, though its compounds do not. The pods of strophanthus, a new drug from Central Africa, were next shown. The seeds bear a beautiful feather-like appendage, and yield strophanthin, a glucoide stated to be superior to digitaline for use in heart disease, not being cumulative in its effects. It is strange that brucia, like the poison curare, may be swallowed in safety, though a mere trace kills if injected into the blood. A rapid glance was given at some of the numerous and useful alkaloids extracted from the cinchona barks, quinine naturally demanding most attention. The exposition of Mr. Gerrard was well illustrated by specimens of the alkaloids, their salts, the plants from which they are obtained, and by practical demonstrations of their leading reactions and microscopical appearance. A discussion followed. Dr. Thudichum referred to opium-smoking, stating that it was the morphia volatilised which produced the characteristic effects. In his opinion, pilocarpine, gelsemina, and strophanthine were too uncertain and poisonous in their action to be practically useful. In regard to aconitine, Dr. Thudichum knew of six different varieties as sold, possessing different chemical reactions, and varying in destructive power from 1 to 700; so that it is pretty certain that so far pure aconitine is little known.

THE meteor which fell near Claysville, Washington county, Pa., September 14, 1885, was found recently by Professor J. Emerick, of William and Mary College. The stone was found imbedded at the base of a hill. It weighed about 200 tons, but was cracked into pieces by contact with a stratum of limestone. Its composition was chromium, nickel, aluminium, copper, magnesium, tin, and other metals and metalloids. It contained 87 per cent. of iron in a metallic state. Its specific gravity was 7,412. Its elevation above the earth's surface was established at 52 miles, its path nearly horizontal, its flight between five and ten seconds, its visible path 150 miles, and its velocity 15 to 20 miles per second.

SCIENTIFIC NEWS.

THE following elements of Comet Finlay have been received from Boston, U.S., and are given in Dun Echt Circular No. 126: T = 1886, Nov. 20·99 G.M.T.; $\pi - \Omega$ 301° 25′; Ω 51° 26′; i 3° 19′—mean equinox 1886; log. q 0·05865. Ephemeris for Greenwich midnight reads Oct. 15, 17h. 55m. 36s., S. Dec. 26° 43′; brightness increasing. The comet is probably identical with 1844 I.

Dun Echt Circular No. 127 contains a code telegram from Dr. Krueger, of Kiel, which announces that a comet was discovered by Hartwig (presumably of Bamberg), on Oct. 5, G.M.T. 16h. 2m., R.A. 10h. 37m. 24s., N. Dec. 1° 3′.

Minor planet No. 260 was discovered by Dr. J. Palisa, of Vienna, on the 3rd inst. It is the fifty-fifth planetoid discovered by that indefatigable observer.

Chemical science in Canada has sustained a serious loss by the death, at an early age, of Prof. H. A. Bayne, Ph.D., of the Royal Military College, Kingston, Ontario. Dr. Bayne was a native of Nova Scotia, and graduated in Arts at Dalhousie College, Halifax, afterwards studying under Wiedemann in Leipzig, Bunsen in Heidelberg, and Dumas in Paris.

The town clerk of Stafford announces that Mr. C. L. Wragge, formerly of Oakamoor, Staffordshire, and now of the Torrens Observatory, near Adelaide, South Australia, has made over absolutely to the Corporation of Stafford the collection of natural and other objects and curiosities which has been for some time in the custody of the corporation. The collection is to be known, as heretofore, as the Wragge Museum, and the donor reserves to himself the position of honorary curator, with power to appoint one of his sons to succeed him. The honorary curator is to have free and unrestricted access to the collection at all reasonable times, and the corporation undertakes to keep it in good order and condition.

It is stated that Sir Henry Roscoe, owing to his Parliamentary duties, will resign his position at Owens College, Manchester; but it is hoped that if he is compelled to give up the work of personal teaching he may still be able to deliver the most important portion of the course of lectures, and at least retain his official connection with the Victoria University.

The specifications of the patents of the Volta Graphophone Co. of Alexandria, Virginia, have been recently published. Those relating to the reproduction of sound are numbered respectively 6027, 6042, 6047, and 6062, all bearing date May 4, 1886. We have already given an account of the graphophone in No. 1116, page 529, and also of the other inventions of Messrs. Bell and Taintor on page 341, last volume. The first specification relates to the production in a solid substance of inequalities corresponding to the forms of sound vibrations, and reproducing the sounds from the wax record. These sounds are transmitted through a tube to a double earpiece combined with a mouthpiece which includes the nose of the user. No fewer than 113 claims are appended to this specification. The second invention relates to a means of causing the "record" to act directly upon a gas or liquid, in which it induces sonorous vibrations. The third invention relates to a method of reproducing the sounds by the aid of magnetism, a copper electrotype being taken of the wax record. The fourth specification describes an invention in which the record is a glass disc coated with a sensitive film, and the sounds are transmitted and recorded by radiant energy.

An electric log for the use of ships has been recently described as a novelty. We described one in No. 775, for Jan. 30, 1880, and we believe Kelway's was invented before that date.

The heat-indicating paint to which attention has recently been drawn is not altogether new, for it appears that something of the kind was patented in the United States by Profs. G. F. Barker and Alfred M. Mayer in 1873. They used the double iodides of mercury and copper, of mercury and silver, and similar compounds

having the property of temporarily changing their colour when exposed to certain temperatures.

According to Mr. J. R. Wigham, the lighthouse at Tory Island is to have a triform lantern with six lenses in each tier, the lenses being nearly 6ft. square and of longer focus than any hitherto constructed. These lenses will transmit about twice as much light as any now in use, and with one of Mr. Wigham's large gas burners the resultant beam will be equivalent to about four million sperm candles, the illuminated surface of the lantern being 18ft. in height by 6ft. broad. The light at Tory Island, which is off the north coast of Ireland, will thus be the largest in the world.

The Midland Railway Company are, it is stated, about to adopt cast steel disc wheels with flanges cast on, for their new coaches and waggons.

Dr. Alex. Edington, assistant to the professor of surgery at Edinburgh University, says that a jelly derived from Irish moss is much less opaque than agar-agar and more nutritious, and is therefore to be recommended as a culture medium for micro-organisms capable of withstanding high pressure. He macerates 2oz. of the finest selected Irish moss in 18oz. of water, and after leaving it for a night, keeps it in the steam steriliser at about 212° Fahr. for an hour and a half, stirring occasionally. It is then strained through a felt bag two or three times, when the jelly thus obtained will be found on cooling merely to gelatinise, yet able to withstand a temperature of 87° Fahr. before liquefying; but if it is evaporated, it is found to be capable of withstanding a temperature between 122° and 131° Fahr. before liquefying. In this state, if a test-tube be filled with it, it is found to present the appearance of water with only a slight degree of haziness. In order to render this more nutritious, and so better fitted for the requirements of the growth of the generality of micro-organisms, the materials recommended by Dr. Klein may be added —namely, beef peptone and ordinary cane sugar. Add to the jelly 2 per cent. of the former and 1 per cent of the latter, and the result is a jelly almost as bright as nutrient gelatine and infinitely more so than agar, while the simple method of preparation and the price have much to recommend it.

Mr. George P. Merrill, in the *American Journal of Science* for September, has a note on the composition of certain "pliocene sandstones" from Montana and Idaho. A microscopic examination discloses the fact that the stones consist largely of minute flakes of pumiceous glass. The specimens are fully described, and we are informed that in Kansas and Nebraska these dusts are collected and sold as "diamond polishing powders," and are used in the preparation of the "scouring soap" commonly called geyserite.

Dr. Von Holst says that nitro-glycerine is very useful in heart-disease, especially where there is no serious organic change. In angina pectoris the drug gives relief and sometimes produces a permanent cure, and he recommends it in preference to camphor or musk where weakness of the heart threatens immediate danger. He uses a 1 per cent. alcoholic solution, and administers from one to six drops three times a day.

The "Programme" of the Franklin Institute of the State of Pennsylvania for the session 1886-7 shows that the managers are determined to place it in a foremost position as a teaching institute as well as a library, which latter we may note is exclusively scientific and technical in character. Besides the classes held at the institute, there is a course of lectures on a variety of subjects of a scientific character, which are delivered during the winter months.

The excellent "Illustrated Handbook of Victoria," issued in connection with the Colonial and Indian Exhibition, is being distributed to every institution, society, and library in the kingdom, in order that information as to that important colony may be within reach of all. It is well printed and freely illustrated.

The Halifax Co-operative Society have decided to light up their very extensive shops and workrooms by electric light, and have entrusted the work to Blakey, Emmott, and Co., Limited, of Halifax.

The London Stereoscopic Company have recently brought out the "Exhibition Album," containing the principal prize photographs shown at the Amateur Photographic Exhibition, held under the company's auspices in May last. It will be remembered that this exhibition was given in aid of the Princess Frederica's Home for Women. Unfortunately, although the exhibition was a great success as far as the work shown went, no profit was made, and the Stereoscopic Company found themselves out of pocket. However, rather than disappoint the charity, the directors voted the home a handsome donation. As to the album, it is hard, where all the work is so good, to single out pictures of any one exhibitor; but we think it may be fairly conceded that Lady Roscoe and Dr. Alabone divide the honours. The Stereoscopic Company certainly deserve the support of all amateur photographers. There is little doubt that by their system of gratuitous instruction, practised at the company's studios, they have done much to foster the pursuit amongst amateurs.

USEFUL AND SCIENTIFIC NOTES.

A New Lantern.—Mr. W. C. Hughes, of Brewster House, Kingsland, has constructed a fine optical lantern for vertical and horizontal projections, for Prof. W. Lant Carpenter, B.A., F.C.S., of the School of Electrical Engineering, as a gift to the Royal Victoria Hall, Waterloo-road, for the purpose of illustrating science lectures. The first experiments were made with the new lantern on Tuesday evening last week, before an appreciative and crowded audience, consisting principally of the working classes from the surrounding neighbourhood. The experiments were most brilliant and successful, and Mr. Carpenter and Mr. Hughes were loudly applauded for the magnificent results obtained by each experiment, such as the decomposition of water, the chemical action of certain fluids on stagnant and impure water, together with magnetic and electrical forces, shown by the aid of the instrument on a disc 24ft. to 30ft. in diameter, at a distance of over 80ft., from the balcony of the great theatre to the stage, was considered by experts present a remarkable projection. When it is remembered that much of the experimental apparatus thus magnified and defined through an erecting prism, and by means of reflected light, which loses 50 per cent. of its potency, the difficulties with which Mr. Hughes had to contend will be readily understood.

The Kinetic Theory of Gases.—In a communication to the Physical Section of the Paris Academy of Sciences recently published, M. Hirn presented a copy of a new work entitled "Modern Kinetics and the Dynamism of the Future," the object of which is to show that the modern kinetic theory of gases, and the other like theories which pretend to explain the phenomena of the universe by the invisible movements of matter, are incorrect. M. Hirn has published a series of studies relating to this subject; but the book in question contains in clear and popular language all the arguments which "henceforth," to use the author's words, "render unsustainable the kinetic theory of gases." M. Hirn remarked to the members of the Academy that he did not flatter himself on being able to convince all of what they ought to have been themselves convinced of for a long time, because *à priori* conceptions have great vitality; but he expressed the belief that time would cause to disappear from modern science the kinetic theory of gases, as an error as monstrous as others which have been relegated to the limbo of the past.

TWO of the largest castings in the world are said to be at Nara and Kamakura, Japan, the one at the latter place being 47ft. high, and the other, at Nara, being 53½ft. from the base to the crown of its head. The statue at Nara is supposed to have been erected in the eighth century, but it was destroyed and recast about 700 years ago. In endeavouring to recast it several mishaps occurred, and when at last success came, some thousand tons of charcoal had been used. The casting, which an American contemporary says is an alloy of iron, gold, tin, and copper, is estimated to weigh 450 tons.

MR. E. D. WASSELL, of Pittsburg, Pa., has invented a new process of welding steel, by which steel bars of any content of carbon can be piled and welded together. The *Engineering and Mining Journal* says he has demonstrated this by making a homogeneous weld of a pile made of bars containing 0·65 per cent. of carbon, and the carbon reduced to any point desired; that is to say, steel of 0·65 per cent. can be reduced to 0·10 per cent. carbon while in the solid form without remelting.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

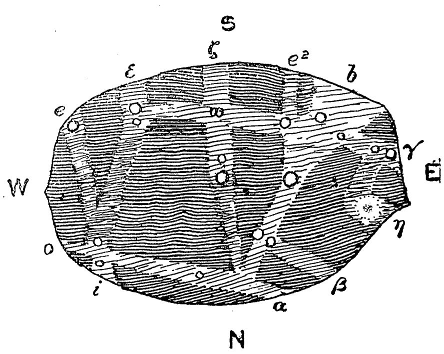
All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

PLATO.

[26359.]—ON p. 107 (letter 26309) Mr. Arthur Mee gives an interesting view of the curious interior of Plato. The objects there shown are the spots 1, 3, 4 and 17, and the sector and streaks e, a_o, β, ε, and ζ. At the time of this observation, the declining altitude of the sun on Plato made it difficult to distinguish distinctly the fainter detail on the floor, particularly on the eastern part, which, for several days before sunset has a whitish appearance, rendering it hard to distinguish the outlines of the streaks there. A few days earlier, Mr. Mee would doubtless have seen more of the



spots and light streaks. The inclosed drawing of the markings in the interior of Plato may be of interest. It was made on the night of September 16th last, 14h. 15m. to 14h. 45m., by means of a 2¾in. refractor and a power of 102. The 18 spots there shown were all quite certainly seen, as were also the streaks.

With reference to some of the markings, I should like to make a few remarks. On the streak ε two spots are shown, Nos. 12 and 14, and from these a light streak of considerable breadth runs northwards to spot 13, situate at the streak i. This is streak g^2, which was discovered, or rather rediscovered, on November 1st, 1873, by Mr. H. Pratt. Somewhat strangely, it appears to have escaped detection during the close and continued scrutiny which the floor underwent in the course of the years 1869—71. Of late years this streak has always been an easy feature to see at any time, except close to sunrise or sunset, and it is in fact the westernmost of the four light streaks shown in the first edition of Beer and Mädler's map. We have here then an object which evidently, from the small amount of detail seen by them, a bright and conspicuous feature in the time of Beer and Mädler, afterwards faded away so much as to elude detection during the celebrated survey of 1869—71, and has since resumed much of its former consequence. And this apparent alteration cannot be due to changes in appearance caused by differences of illumination or libration, since the streak is now plain from near sunrise to near sunset, and whether libration is north or south, whilst under any condition in 1869—71 it was not visible at all, or, at least, was not seen.

The bright, fan-shaped marking radiating from spot No. 4, known as the Sector, has of late years assumed a very complex structure, though in 1869—71 it was mostly seen of an almost uniform tint. Some of the differences in brightness are shown in the sketch.

The streak C^2, shown connecting the two streaks γ and η, is worthy of remark. The first indication of its existence occurs in a drawing by Mr. T. P. Gray, made on Jan. 12th, 1881. It is now nearly always visible, and it is not a difficult object. A continuation of it northwards to the north border was detected by the writer with only 2¾in. aperture, and afterwards confirmed with 5¼in.

Spot 12, the northernmost of the two shown on streak ε, has increased much in plainness during the last few years. Its visibility in 1869—71 was only ·026, whilst in 1879—82 it had increased to ·351; 1·000 representing the brightness of spot No. 1. **A. Stanley Williams.**

PLATO.

[26360.]—In reply to Mr. Mee (letter 26309), I regret to be unable to respond to his request respecting this formation, my last drawing being dated 29th December, 1881. On that occasion five of the principal spots on the floor (those shown in his sketch and one near the N.E. wall) were seen as crater cones with a 4in. Cooke achromatic. About forty in all have been observed and verified by subsequent observers. Though most of them are very difficult objects, Mr. Mee ought to see many more than four with his $8\frac{1}{2}$in. Calver, especially as he seems to be remarkably successful as regards the light streaks. Under good conditions, I have seen sixteen light spots on the floor at the same time with a $3\frac{3}{8}$ Cooke. **T. Gwyn Elger.**

Kempston, Beds, Oct. 7th.

POLARISATION OF LIGHT—ACTION OF LIGHT ON THE EYE.—V.

[26361.]—Polarisation may be described as being "the diminution of the brightness of a reflected or refracted ray, which is due to the variation of the angle at which the ray falls upon the surface.

Thus described, it may seem to be a very unimportant matter; but still it gives rise to most surprising phenomena. We might illustrate, as follows, the general effect of diminution of light. If a sheet of white paper is painted with different shades of Indian ink, its whiteness is only partially visible, and more so in some places than in others, owing to being only partially seen through the films of ink which cover it, thereby producing every variety of picture.

In explaining polarisation by the undulatory theory, we suppose that the diminution of brightness is due to the diminution of the intensity of the vibrations which cause it to be visible, and it becomes necessary to inquire in *what direction* these vibrations take place.

Newton teaches that, when a wave is passing through any elastic medium whatever, the displacement of vibrating particles from their place of rest is wholly in the direction in which the wave moves—that is, the vibrations are wholly longitudinal. But modern writers teach that, in the case of light, they are wholly at right angles to the direction of the wave—that is, are transversal.

These two doctrines, as they stand, are wholly irreconcileable, and so, if modern teaching is strictly true, Newton must, for once, have been caught tripping in his treatment of forces.

It may, however, happen in this case, as it does in most others, that a view put forth by able men has a great deal of truth in it, but is found afterwards to need some modification, as happens in geology, &c.; and so most likely it will come to pass, sooner or later, that mathematicians will admit that there are not only transversal vibrations, but longitudinal ones also, as happens more or less in every other case where there are transversal vibrations.

Now, according to Newton and to all dynamical principles, a central force, considered as a point acting upon another point, can only cause motion in the direction of the line joining the two points; so that when the motion is a *vibration*, the particle in motion always vibrates backwards and forwards in the direction of the force; that is, the vibrations are wholly longitudinal. But, in matter of fact, the motion of a point of ether is not produced by the action of a single point only upon it, but of every point in the source of light from which a line can be drawn to it, and its whole motion is the united effect of all these.

Now, in the case of the sun for example, if it were perfectly spherical, and its activity uniform all over its surface, there would be nothing but longitudinal motions produced; but as these things are not so, the motion will not be wholly in the direction of the sun's centre, but may be resolved into three, one of them in that direction; that is, a longitudinal motion, and two others at right angles to it. The case may be compared with the motion of the moon when we take into account the non-sphericity of the earth.

It will be asked then, "How is it that writers have come to the conclusion that there are only transversal vibrations"? If they had used only dynamical considerations, they would, doubtless, have come to the same conclusion as above; but instead of this they reason as follows:—"It is easily shown from certain facts which are observed in the polarisation of light, that in common light transversal vibrations exist, and that when these cease, light is no longer visible; *ergo*, they are the only ones which exist."

The minor premiss is here certainly true; but we may demur to the conclusion. In the next letter we shall try to establish, by experiment, the view as to vibrations above proposed. In the mean while we may say that the way in which light acts upon the eye is as follows:—When a ray enters the eye it falls upon the retina at right angles, or nearly so, and, therefore, the transversal vibrations have the effect of a *friction* upon the retina; but in order that friction may take effect it must be accompanied by pressure upon the surface to make it effectual, and this is just what the longitudinal vibration supplies. Each kind of motion, therefore, has its use in causing vision, and perhaps if either of them were withdrawn we should see no light.

And this will, perhaps, explain a fact well known to star-gazers, that it is easier to see faint stars with averted vision than with direct. The account usually given, and which naturally suggests itself, is this—that in averted vision the ray falls upon a more sensitive part of the retina. This, however, implies that the parts of the eye which are not commonly used are better adapted for acute vision than those which are—an arrangement very unlike the usual operations of nature. We might, therefore, suggest that when there is averted vision the ray falls obliquely upon the retina, and the longitudinal vibrations may be resolved into others parallel and perpendicular to the normal, of which the latter will have a frictional effect, increasing the effect of the transversal vibrations which naturally exist. **W. G. Penny.**

(*To be continued.*)

CONCERNING CHAMBER ORGANS, AND HARMONIUM PLAYING.

[26362.]—I have read our good friend "Uranium's" able letter (26336) with much pleasure and interest, and it is gratifying to find that there are so many points of hearty agreement between us. That he should agree with all my statements and opinions, would be to expect too much from human nature. I, for one, am thankful for small mercies. The greater part of "Uranium's" remarks require no comment from me; and I can only recommend his views to the best consideration of the readers of the English Mechanic.

On the question of cost, as raised by "Uranium," I greatly fear he has placed it far too low. A first-rate organ builder would never undertake to construct a chamber organ of eighteen speaking stops, on the lines laid down in my "Notes of the Chamber Organ," for twice the sum named. The cost of the pipe organ will always militate against its free introduction in private houses, at least in anything approaching a perfect form; yet to my knowledge large sums have been expended by private gentlemen in procuring chamber organs the reverse of perfect from my point of view.

In treating of the chamber organ, it was absolutely necessary for me to adopt a certain size or type of instrument on which to hang my remarks and arguments; otherwise everything would have come out in confusion, and all point would have been lost. After careful consideration, I decided to fix on a type embracing between fifteen and twenty speaking stops. That this number is not excessive, has, I think, been satisfactorily proved by the specifications of "Chamber Organs" which have recently appeared in these columns. Be that as it may, the type was chosen in the belief that its treatment would prove the most instructive to the general reader, and most useful to the organ builder. Of course all the remarks passed on it are equally applicable to the construction of instruments of both a larger and a smaller size.

Now I come to "Uranium's" reference to my own Chamber Organ. He says:—"Mr. Audsley has several times referred to the organ he is the happy possessor of, and if it agrees with his description, which I would not doubt, it must indeed be nothing short of a marvel, and truly 'a pearl of great price.'" In the course of my "Notes on the Chamber Organ," I have been led to speak of certain details connected with it, chiefly by way of illustration, or with the view of showing that I had proof, satisfactory at least to my own mind, enough to warrant certain emphatic statements there made; but I had no wish to convey an idea that my instrument is a *perfect Chamber Organ*, or up to the standard I now advocate. All I need add is, if I had to build it now, it would be a somewhat different instrument to what it is at the present moment.

I shall indeed be gratified if "Uranium" will pay me a visit, with the view of inspecting and testing my organ, and giving me the pleasure of making his acquaintance. For a few months yet my organ will be in an unfinished state—it is in the process of re-erection—but if "Uranium" will place me in direct communication with himself, I shall not neglect to inform him when the organ is fit for his kind examination. Until then, I beg to thank him, through the medium of a letter, for his extremely kind and courteous allusion to what I have written in these columns. **G. A. Audsley.**

CHAMBER ORGANS.

[26363.]—As I am at present from home, and shall, in all probability, remain so for some weeks, it is out of my power to give much of the information Mr. George Landel asks for. I have frequently been asked to publish a full description of my chamber organ, by musicians who have played upon it; but I have always refrained from doing so, simply because it has so many shortcomings—the result of my ignorance twenty years ago—and fails, in some respects, to fulfil *the conditions* which, in the growth of my knowledge, I now consider imperative with reference to chamber organ building.

If Mr. Landel seriously intends to have all his manual stops of metal, the scales of the nineteen stops in my organ would, if given as he requests, be absolutely useless to him. I have six stops entirely of wood, and the basses of two stops in the same material. It is almost needless to remark that the scales of all the stops are affected by this important proportion of wood tone.

I have great pleasure in hastily answering the queries with which Mr. Landel concludes his courteous letter.

1st. It may be accepted as an axiom that a pipe cannot have too much room to speak in. Large pipes should have a space in front of their mouths about equal to their own diameter; but in Chamber Organ building they have often to be content with half that speaking room. The small pipes are seldom or ever too crowded.

2nd. Arrange the pedal pipes side by side, so that there will always be the interval of a full tone between those adjoining each other, and their quality will not be injuriously affected. It is not good to so plant the pipes that their mouths face each other. Pedal pipes may be laid horizontally with perfect safety if the above conditions are observed.

3rd. If proper wind-trunks are used, the reservoir may be twice the distance given from the wind-chest without any inconvenience. It is a desirable thing to have the reservoir as near the wind-chest as possible, while the feeder and receiver (supply bellows) may be many yards away. **G. A. Audsley.**

[26364.]—The following scales of pipes would suit for the chamber organ Mr. G. Landel intends building:

	Diamiter at CC	Tenor C.	Mid. C.	Treb. C.	C above.
	in.	in.	in.	in.	in.
Open Diap 8ft.	$5\frac{1}{2}$	3	$1\frac{3}{4}$	$1\frac{1}{8}$	$\frac{5}{8}$
Lieblich Gedact 8ft. ...	$3\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{1}{16}$	$\frac{11}{16}$	$\frac{7}{16}$
Dulciana 8ft.	$3\frac{3}{4}$	$2\frac{1}{8}$	$1\frac{5}{16}$	$\frac{3}{4}$	$\frac{7}{16}$
Harmonic Flute 4ft. ...	$2\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{1}{2}$	$\frac{7}{8}$	$\frac{9}{16}$
Piccolo 2ft.	$1\frac{3}{4}$	$1\frac{1}{8}$	$\frac{5}{8}$	$\frac{7}{16}$	$\frac{5}{16}$
Clarionet 8ft.	$1\frac{1}{2}$	$1\frac{1}{8}$			$\frac{13}{16}$
Geigen Principal 8ft. ...	$4\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{1}{2}$	$\frac{15}{16}$	$\frac{9}{16}$
Rohr Flute 8ft.	4	$2\frac{1}{4}$	$1\frac{7}{16}$	$\frac{7}{8}$	$\frac{9}{16}$
Gamba 8ft.	4	$2\frac{1}{4}$	$1\frac{3}{8}$	$\frac{7}{8}$	$\frac{1}{2}$
Voix Celeste 8ft.	$3\frac{1}{2}$	2	$1\frac{1}{4}$	$\frac{11}{16}$	$\frac{3}{8}$
Keraulophon 8ft.	same as Voix Celeste				
Gemshorn 4ft.	$2\frac{1}{2}$	$1\frac{1}{2}$	$\frac{15}{16}$	$\frac{9}{16}$	$\frac{3}{8}$
Flautina 2ft.	$1\frac{1}{2}$	$\frac{15}{16}$	$\frac{9}{16}$	$\frac{3}{8}$	$\frac{1}{4}$
Oboe (Bassoon Bass) 8ft.	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{16}$	$1\frac{9}{16}$	$1\frac{1}{4}$

If Mr. G. Landel will advertise his address in Address column, I will give him all information as to cost, &c. **G. S.**

[26365.]—I have read with more than usual interest the admirable and original "Notes on a Chamber Organ," by Mr. G. A. Audsley, which have lately appeared in your pages. The subject is one of immense importance to all organists, organ-builders, and, indeed, to musical amateurs generally.

What Mr. Audsley says concerning the present state of the chamber organ is so obviously true, that it is a marvel to me no one has before ventured to express publicly opinions on this subject, which must be shared by every true and thinking musician.

Who of us has not wondered at such a waste of power exhibited by the late Dr. Wesley's "Pieces for a Chamber Organ"? What kind of instrument could he have intended them for? Surely not that miserable abortion, that excruciating machine, the *ordinary* chamber organ? If so, were these lovely pieces only perpetrated as a *grim joke*—as the sarcastic protest of a great man against a musical abomination? Perhaps so. Dr. Wesley possibly never had the felicity of seeing, hearing, and playing upon Mr. Audsley's chamber organ. This has been my happy lot.

It may interest "Country Solicitor" and your

other readers to hear a musician's opinion of this remarkable and unrivalled chamber organ.

Mr. Audsley has very well and most eloquently described some of its many beauties, but his description is but a poor one when compared with my vivid recollection of a visit I paid to this instrument a short time ago. I can assure everyone that nothing ever gave me greater astonishment, or a keener sense of true artistic pleasure. Its expression is almost as boundless as the resources of a full orchestra, and its tone is pleasant to listen to in any part of the room. A blind man might easily imagine himself to be in a cathedral or large concert room. It is an organ which requires much "knowing" on the organist's part, and I must confess I was much confused at first; but before the evening was over I found myself managing the organ part of several concerted pieces with the greatest ease and facility. May I soon have the pleasure of playing upon it again!

Charles W. Pearce,

Mus. Doc. Cantab., Member of the Council and Fellow of the College of Organists, Organist of St. Clement's, Eastcheap, &c.

PIPE ORGANS AND FREE REED INSTRUMENTS.

[26366.]—I DO not think the most ardent admirer of the free-reed instrument, whether you call it a vocalion, an American organ, or a harmonium, can expect more from Mr. Audsley than he says in his letter on p. 108. The possessor of a pipe organ such as Mr. Audsley owns is not likely to envy "Country Solicitor" with his Mustel, for really there is no comparison. The only advantages possessed by the harmonium, to take the best known type of free-reed instruments, are expression and portability. The latter is an unknown advantage —depending altogether on private circumstances: a Mustel is more portable than a pipe organ of two manuals and a dozen stops; but then portability is scarcely in question. The one advantage possessed by "Country Solicitor's" Mustel is its adaptability to expression—adaptability because it is possible to produce on that what cannot be achieved on any pipe organ. The question then arises whether the expression which it is possible to put into a harmonium—it won't come out unless you put it in—is worth more than the grandeur and beauty of the tones from a pipe organ. In the one case coming to purely mechanical details you have an instrument which is to a certain extent like the concertina,—you can vary the pressure of the wind, and emphasise all or any of the notes, whereas in the pipe organ you are limited for your expression to the action of the swell; and, as I understand it, Mr. Audsley is endeavouring to show how the pipe organ may be made more expressive—knowing very well that no musician would hesitate for a second as to his choice when price is not to be considered. The pipe organ is not devoid of all expression when an artist is manipulating the claviers; but at present it is not the equal of the free reed instrument in that particular. Still, as most of your readers know, I have been an ardent supporter of the American organ, and I am fain to confess that if portability is out of the question, I should shelve the "expression" and vote for the pipes. But price steps in—and room. It is no use cramping up a pipe organ: it must have room; hence the majority of people will prefer a reed organ, and then, if they want it as a musical instrument, they had better dispense with the pedals, which are really too much for most rooms, and rob the performer of the greatest advantage possessed by the harmonium type of reed instruments. Pedals to an American organ, or a harmonium, serve a legitimate purpose when the instrument is used merely for practice; but the reed instrument, to compete successfully with the small chamber organ, must have two manuals and no "pedal department," as Mr. Audsley says, and then, while it remains an expressive instrument, it cannot compare with the pipe organ—it must always be "deficient in grandeur." There seems no possibility of rendering the pipe organ truly expressive. If I remember rightly, our old friend, the late "Harmonious Blacksmith," was more than "savage" at the thought that there was no way out of that difficulty, and I am curious to know how Mr. Audsley proposes to give us the capability of expression with the grand tones of the pipes. I know he is *facile princeps* in this matter—a genuine amateur, in the proper sense of the word—and I should be glad if he could suggest or devise any means of giving to the pipe organ the power of expression which is undoubtedly possessed by the harmonium in common with 'Arry's concertina. That accomplished, the king of instruments would become emperor, and Cæsar would reign triumphant. I think I have contrived to "second" the remarks of our friend "Uranium" (p. 130), though I cannot altogether agree with him that the reed organ exists "on suffrage." I think it supplies a want and fills a place; but those to whom money is not an object will, if they are musicians, always (as they have hitherto done) prefer a pipe organ. I am so catholic that I think a tin whistle properly played is better than nothing at all.

Organon.

TO PIANOFORTE TUNERS—KNOW THE PITCH OF YOUR TUNING HAMMER.

[26367.]—BEING at a loss for my tuning fork more than once, the idea struck me I should make use of the hammer. Put the hammer on a pin as lightly as is safe, and strike it on the end of the handle with your wedge, and it will produce a distinct note. My ordinary one, a 6in. Reynolds, is centre F natural when the instrument is to Phil. pitch. Make your F to this or any note your hammer sounds, and you have a handy fork.

London. **W. H. Nye.**

EGYPTOLOGY.

[26368.]—THE Samaritan version of the Old Testament gives the passage in Exodus "the sojourning of the children of Israel in Egypt was 430 years" as "in Egypt *and Canaan*," referring, it is generally supposed, to the wanderings of Abraham and his descendants in this land. This is in agreement with what St. Paul says, that the covenant made with Abraham "the law, which was 400 years after," could not annul, and, though a chance allusion like this is not to be taken as strict chronology, we may reasonably suppose that St. Paul quoted the generally received reckoning, and it is, I believe, now usually held that the period from Jacob's immigration to the Exodus was about half the 430 years. Assuming that Jacob's clan of 70 persons made 35 pairs, and giving 25 years to a generation (enough for an Eastern climate), and an increase of fourfold in each generation (again not extravagant when we know that their surroundings are favourable, and are told that they multiplied unusually quick), "Memnon" will find that in 200 years only they would number considerably over two millions, quite enough to furnish 600,000 men of "20 years old and upwards," which was the customary age for "bearing arms."

Dr. Colenso thought he had made a point when he wrote that the account of the Exodus could not be true because the Israelites were said to have come forth in the fourth generation, and from reduplications could not possibly multiply 70 into 600,000. He appears to have overlooked the obvious reply that Moses and Aaron, and probably other leaders, were of the fourth generation, and that the expression cannot reasonably be held to exclude later generations altogether; while if he insists on only four generations he is confronted by the increased length of a generation, as set forth by "Memnon." **P.**

[26369.]—IN reply to "Ramases" (26346), I beg leave to say that (1) If the Hebrews do not give all the links in their generations (as he says), then their generations are imperfect, and cannot be relied on, which is exactly what I said to Mr. Smith when I told him he could not rely on them to find out the number of years in question.

If "a generation of them *often* meant a century," but not *always*, my point is proved; but I doubt the fact. I imagine Gesenius would back up my views, as he ceased to be an ordinary rationalist when Strauss published his "Mythic Theory," and joined the philosophical and critical school.

It is curious that some writers should insist that irregularities, for which no grammatical or historical account can be given, are instances of a profound and well understood law, or national method. Why not simply admit that they are imperfections or errors?

Such assertions only satisfy the very simple, or those who are determined to see no error; but we know that in practice writers allow for errors which they will not admit in words. Statements of this kind, which, after more than 1,000 years of critical study cannot be proved, are valueless.

We know that generations are sometimes dropped for no natural or satisfactory reason (compare Matthew i. with 1 Chronicles iii.), and sometimes added apparently arbitrarily (compare Luke iii. 36 with 1 Chronicles i. 17), and when in important cases like these liberties appear to be freely taken, why should we suppose other genealogies are perfect? Indeed, some critics hold that certain names mean tribes, and others titles, such as Rhesa, Luke iii. 27.

This being so, it seems more probable to me that an error has been made in the statement, than to suppose that less than 80 people expanded into three millions in four generations.

So much for "Ramases'" answers to Nos. 1 and 3.

As to No. 4. Why are we to follow the Septuagint in preference to the Hebrew Bible? Is the latter wrong or unreliable? If, when the two versions differ, we are at liberty to take the uncanonical Septuagint and set aside the Canonical Hebrew Bible, then I think my assertion is borne out—namely, that we cannot rely on the latter for numbers or generations—I should not rely on either versions, though I admit their assertions should be carefully considered, though not necessarily adopted.

If "Ramases" does not necessarily rely on the Canonical book, I see no reason why I should admit the reliability of either.

"Ramases" apparently forgets that the midwives are distinctly called "the Hebrew midwives," and not Egyptians, as he says. It certainly seems to me that only two are supposed to be, but of course there must have been more. "Ramases" says 1 Kings vi. 1 has *about* 480. But the Revised Version says: "And it came to pass *in the* four hundred and eightieth year after the Children of Israel were come out of Egypt."

No. 6. If the Egyptians only wrote about their glories, we should know nothing of the Shepherd Kings, of the slave insurrection, the Assyrian invasion, or their other misfortunes. But they got a great deal out of the Israelites, according to Exodus, yet the Egyptians appear never to name them, and no unmistakable reference to them can be pointed out. I have read about Tahpanhes, &c., but do not know of any "reliable evidence which has come to hand from monuments and inscriptions" in Egypt which "dispose of the cavils of objectors," and will feel obliged if "Ramases" will point them out. Any new light obtained relates to late times, and though interesting is not important.

The people Diodorus refers to lived long after the time ascribed to Moses, and near that of Rameses III. The multitude of aliens who suffered from a "foul cutaneous disease" can hardly be the Israelites, who are stated to have left Egypt in remarkably good health, not one weakly person being amongst the 3,000,000, so these aliens do not anwer at all; besides, Diodorus was not an Egyptian, nor a reliable authority for ancient matters of the kind.

7. The Welsh retain their language while they live in Wales. I am not aware they keep it up in its purity when they emigrate in small parties, and stay in foreign lands for a lengthened time, say, 430 years. Has "Ramases" any such information?

Good authorities say that the early books ascribed to Moses are written in clear Hebrew, easily read, and not differing much from those known to be certainly late; yet, any one who compares Chaucer and Tennyson must know that language changes seriously in course of time. As the Pentateuch is full of late allusions, &c., "Ramases" is forced to admit it has been, at least, added to by later writers: he will find it hard to do more than assert that there may have been an early original not now extant, and in such an argument I am not much interested, as the evidence is too problematical.

"Ramases" is not happy in his reference to Deuteronomy xviii. 2, which says, "Or a charmer, or a consulter with familiar spirits, or a wizard, or a necromancer." I respectfully deny that the passage proves that the Israelites believed in the immortality of the soul. It proves that the later Jews (near the time of the Captivity) were superstitious, and believed in demons and supernatural beings; but, as no one doubts but that they did, that proves nothing in dispute. When the great doctrine of the immortality of the soul is markedly absent from the Law of Moses, it is absurd to attempt to prove it by such a passage as the above; indeed, in no other case but in that of the Israelites would such an attempt be made; but in their case it is well known that words are twisted any way to suit certain popular theories, and are used naturally or non-naturally as is convenient. **Memnon.**

[26370.]—REFERRING to the letter of "Ramases" (26346, p. 133), I must say that this gentleman's assertions are very unconvincing.

1. If the Hebrews did not give all the links, then their genealogies are worthless, for the object of genealogy is to show that an unbroken chain extends from the first to the last person mentioned. The Hebrews themselves evidently meant to imply that they were complete.

2. Both the authorised and the revised versions say, "*in* the four hundred and eightieth year," not "*about*," therefore the original Hebrew must support the former reading. The revisers have not even thought it necessary to notice the various readings, if there be one.

3. "Ramases" does not explain where Matthew got his names from. We can understand the omissions on the "broken link" theory; but the additions are inexplicable. Why did Matthew insert names which are not to be found in the Old Testament lists?

4. As the Septuagint version was made about B.C. 280, while our present Hebrew text was only settled by the Masorethes about the 10th century A.D., the former may represent an older version than we have, and therefore its variations are of great consequence. But these variations do not help our chronology—they only raise difficulties.

5. Exodus distinctly says that "the king of Egypt spake to the *Hebrew* midwives." Mr. "Ramases" has evidently not read the Bible, for he

asserts they were "Egyptians." Only two midwives are spoken of, and if the Israelites increased so rapidly they must have had plenty to do.

6. Diodorus's sources of information were no doubt the same as those mentioned by Josephus in his work against Apion. Josephus cites some statements of Manetho, and others, in order to refute them; and says that Manetho, although his work was compiled from Egyptian records, relates some fables about the expulsion of the Jews from Egypt, "not from the Egyptian records; but," as he confesses himself, "from some stories of an uncertain original." (Book I. Part 16, Whiston's Translation.)

7. I fail to see that "Memnon" has contradicted himself. The great Hebrew scholars, Reuss, Kuenen, and others, have come to the conclusion that the language of the Pentateuch is much more like that of the Prophets in most parts than anything else. No one doubts the Mosaic authorship of these five books, for they are a perfect "mosaic" of different pieces, written by different authors at different times. The verse mentioned does not prove the belief of the Israelites in the Immortality of the Soul, for it only speaks of a "consulter with familiar spirits." Mr. "Ramases" twists this into having dealings with the spirits of the dead. He should purchase a Bible, and read it. There is no proof that the Israelites had any other idea of a future life than that which was common to all other Semitic nations—viz., that the soul went to an underground place, called "Sheol" in Hebrew, and "Sualu" in Assyrian, and slept there for ever. They had no such ideas as are contained in the Egyptian "Book of the Dead," until after their contact with the Persians. "Ramases" concludes by informing us that all "reliable evidence" from Eastern monuments supports the truthfulness of the Bible narrative. Evidence that does not is, therefore, unreliable according to him; so that the inscriptions of Sargon, who says that he carried away 27,280 of the Israelites, and replaced them by other peoples, and that two years afterwards the subjugated Israelites rebelled against him, and were defeated with their allies at Karkar, are not "reliable," because the Second Book of Kings says that all Israel was carried away, and none left but the tribe of Judah (II. Kings xvii. 18).

Mr. "Ramases'" objections to "Memnon" are simply cavillings and hairsplittings. He says nothing about the main question, as to the reliability of the Hebrew figures and dates. No one who has given any attention to the subject can have any doubts of the utter impossibility of getting any reliable data from them. Mr. Gerard Smith takes a few which he makes agree pretty well with Bunsen's chronology. But there are half a dozen other chronologists besides Bunsen, all different. Mariette Bey seems most followed just now. However, the departure of the Israelites cannot be placed before the time of Rameses II., for that king overran the whole of Palestine, crossed the Lebanon, and defeated the Hittites at Kadesh on the Orontes. He should have come into contact with the Jews if they had been in Palestine at that time. His son, Meneptah, has left us a monument of one of his campaigns, and he may have been the Pharaoh of the Exodus; but this is merely conjecture, although Manetho mentions a king Amenophis at this juncture, and he is consequently identified as the man "who knew not Joseph." We must wait for more light before deciding positively on one side or the other.

Menes.

SPECULA FIGURING.

[26371.]—My esteemed friend "Orderic Vital" invites remarks upon the method described a week or two ago in these pages; but the fact is the details, which would be highly interesting, are conspicuous by their absence. The probability is that the author's paper has been too much curtailed to make its meaning clear; but the idea of parabolising the surface in 10 minutes is too, too—well, too good to be true.

People talk readily enough about forming a truly spherical curve, as if the task were as easy as drawing on an old glove, while those who work at it know it is extremely difficult.

The statement that a *truly* spherical curve was obtained by rubbing together an 18in. concave and an 18in. convex must be looked upon as a hyperbolic expression, unless we limit the meaning of the word "truly" to a mechanical sense; but this is not sufficiently accurate for astro. reflectors. The method of correction mentioned, if carried out strictly and designedly, may be a somewhat new departure; but the same thing is done every day, more or less, unintentionally. When a speculum is not far removed from the parabola, and is tested *à la* Foucault with an artificial star at centre of curvature, it is easy to get at one point along the reflected cone of rays just the appearance as suggested by this mode of correction—namely, the deepened centre and an expanded marginal zone; but this does not prove the figure to be a parabola; in fact, it may be considerably over-corrected, or much under-corrected in those cases where the total aberration required reaches a considerable amount.

Increase of aperture, and not the focus, is the chief factor in increasing the aberration, operating, in fact, in a geometrical ratio, while the focus influences it in a proportional one, so that the paragraph which states "the rate of decrease required in the amount of correction is very rapid with the increase of radius of curvature" is somewhat inaccurate. Although "by decreasing the focal length the rays cross at a less acute angle," which is quite true, I think few will agree "that small variations in the reflecting surface have not so detrimental an effect," but will believe just the opposite of what is sought to be conveyed here.

I will leave Mr. Wassell to express an opinion as to the result likely to be obtained with a polisher graduated as shown in the woodcut on page 59. Personally, I should not care to try it, although the idea is ingenious; but I think I can see my way to avoid rings without running so much risk.

I can only express my regret once more that the article was not printed verbatim in this journal.

Ramsgate. J. C. Linscott.

A SIMPLE WAY OF MAKING GLASS MIRRORS.

[26372.]—It may interest the amateur optical readers of the English Mechanic if I describe to them a cheap and simple way by which I have finished a 10½in. glass mirror which defines very well, easily dividing Omega Leonis, Zeta Cancri, and Mu² Boötis. I may mention that this is not my first attempt at specula-making, having ground several by various processes for some years. Whoever tries this way of grinding and figuring must make Mr. Wassell's testing apparatus, so as to be able to see what he is doing when figuring. The glass discs I obtained from Mr. W. S. Scott, a contributor to the "E. M." Its cost was 10s. 6d. It was cast concave on one face with a radius of 14ft., the edge was nice and smooth, and required nothing doing to, so I proceeded to grind by placing it on five or six thicknesses of house-flannel, which was laid on a disc of wood 14in. in diameter, which I placed on a 56 gallon cask. This cask was placed in the centre of a room so as to be able to walk round it. The grinding tool was a 6in. disc of glass 1in. thick, which had been used for grinding a 6in. mirror, so that it had a convex curve on one face. The stroke used was to start from one side of the mirror, and in four or five zigzag strokes to reach the other, then take a step round the cask and repeat the stroke so as to reach the side of mirror first started from. This was continued through the various grades of emery until a surface was obtained fit for the polisher.

The polisher was made by covering the tool with pitch divided into 1in. squares with a straightedge, the stroke used the same as in grinding towards the end of the polishing. The tool must start about 1in. within the edge of mirror. Of course, it will go over the edge of mirror at the end of each stroke, but if it goes over the side as well the edge in testing will be found turned back. If these directions are followed, the mirror will have a regular curve with no sign of rings, but most likely hyperbolic in a slight degree. This can be corrected by using different sized polishers on the zone between the centre and edge. My polishers were 3in., 1½in., and some smaller made by sticking a cork on a penny, a halfpenny, and a farthing, and putting pitch on the other grooved after the manner described by Mr. Brashear in his paper on making flats. If an uneven surface is obtained with the smaller polishers, the large one will correct it if used as at first. Ninip.

HAS ENGLAND GONE UP-HILL OR DOWN-HILL DURING THE LAST FIFTY YEARS?

[26373.]—A "Socialist's" (26337, Oct. 8, p. 131) remark that the poorer class pawn their Sunday clothes on Monday, and redeem them on the following Saturday, is, unfortunately for themselves, only too common a practice; but in many cases this is caused rather from bad management than extreme poverty.

Referring to the hours of labour of the tramcar employés, the Birmingham and Central and the Aston Tramways Companies have lately reduced the hours of working to 12 per diem. The men receive a fair remuneration—the conductors a small bonus on the amount of business done in addition to regular wages.

I gather from the last paragraph of "A Socialist's" letter that it is unfair to accept dividends, and, of course, this gentleman would only invest in concerns which would be unable to declare them. U., Birmingham.

[26374.] — "A Socialist," in replying to "B. R.," talks as Socialists and Communists usually do—wildly.

One example will show how worthless are his facts. He states that "B. R.," on the question of population has ignored Ireland, and that in the last few years the population of that portion of our empire has decreased *millions* (the italics are his). In point of fact, I find "B. R.'s" figures include Ireland, and instead of millions in a few years, the decrease in 10 years (from 1871-81) was from 5,402,759 to 5,159,339, or about 240,000. So much for socialistic facts. The paragraph respecting savings banks is so vague I can neither make head nor tail of it.

"A Socialist" talks of the "real worker," as if the man who puts on an apron or stands at a bench is the only being who does any work, while, in point of fact, it will probably be found that the merchant, manufacturer, or capitalist is by far the hardest worker.

"Socialist" takes two cases, each of them representing only a small portion of the community, and each of them generally acknowledged as scandals to the 19th century, and treats them as if they were a fair sample of the position of the working classes of to-day. The idea of thus treating the downtrodden slopworkers and tramway men is so absurd that it needs no reply. I contend that the bulk of the working classes to-day earn at least 25 per cent. more than they did 20 years ago, and that for the generality of requirements a sovereign has increased its purchasing capacity at least another 25 per cent. in the same period.

Our correspondent next falls foul of the tramway shareholders, because he (the shareholder) did not lay the tram lines, and does not drive or conduct the car, forgetting or ignoring the fact that if the said shareholder had not worked hard at some other trade, the navvy, driver, and conductor would have little or no work to do, for want of capital.

The long and short of the matter is that Socialist and Co. want to reverse things, so that they can occupy the places of employers and capitalists, and they are prepared to go any length to achieve the object, even to driving the capital out of the country. I have sufficient confidence in the majority of the working classes to believe that while there may be troublous times ahead, in which we shall have to pass through a furnace which will destroy the dross of the paid agitators, socialists, and the like, yet the result will be that master and man will come to a better understanding of each others' rights and wrongs, and each will strive in the common cause of improving the welfare of our nation and the well-being of the population at large. H. G. E.

[26375.]—"Socialist" seems to be very excited, and charges me with furnishing incorrect statistics with regard to the population of England, Ireland, Scotland, and Wales. As I copied the numbers from "Whitaker's Almanack," I must make the compiler of that work responsible. My object for giving the population was not to show the great increase, but rather to show that the advances made in commercial transactions have been in a much greater ratio.

"Socialist" next takes exception to my *implying* that "the poor are less poor" because the deposits in the savings banks have increased. He believes increased deposits indicate greater poverty. I can only say I beg to differ in opinion, but will not argue the point, nor will I question but there are large numbers of persons who work for very low wages. I only maintain that, upon the whole, wages are far in excess of what they were during the present generation.

In giving details of advances made in the commerce, education, and comfort of the nation I include other classes besides those who pawn their coats and petticoats every Monday.

B. R.

COMPOUND NON-CONDENSING ENGINES.

[26376.]—I have carefully read the letters of "Engineering, Manchester" and "Ingeniero" on this subject. With regard to the tandem engine, I agree with "E. M.," as it has several advantages over the simple engine irrespective of mere economy in coal. As pointed out by "E. M.," the strains on the crank-shaft and framing are greatly reduced by compounding, while the first cost is very favourable as compared with the ordinary compound engine with cylinders side by side. The latter, however, is more economical in fuel, and this I attribute to the more uniform turning of the crank-shaft. Still, very good results as regards economy of fuel and water have been obtained from the tandem engine, and it is by no means a class of engine to be despised, a large number being at work both on board ship and on land, giving every satisfaction. In reply to "E. M.'s" inquiry *re* compound locomotives, I think quite enough has been said on this subject now. It has been most conclusively proved that they are greatly inferior to the normal locomotive in every respect, and until some further develop-

ment takes place I see no good in continuing the discussion. Every credit is due to the engineers who have tried them, and we can only regret that the results obtained have not proved more encouraging. **G. D. Seaton.**

THE ADVANTAGE OF STEAM DOMES.

[26377.]—THE results, so far of my attempt to induce your readers to discuss the mechanical arrangements of engines, instead of giving mere lists of locomotives and times of runs, are not encouraging. "A., Liverpool" (p. 84), says I am mistaken when asserting that the use of a dome on a boiler is to increase the area for containing steam, and thinks it necessary to inform me that its use is to prevent priming. As I have not made the assertion it is of no moment; but I pointed out in the very letter that the locomotives which do the fastest work in this country are without domes, and they do not prime. If that is all the dome is for, it may be given up at once. "Kappa," p. 86, thinks he has answered my question by saying he "should think" that sixty miles in one hour is done every day on the G.N.R. He qualifies this "thinking" with a condition which puts it out of court. If there is a train which does sixty miles in one hour—in which a passenger can take his seat and find himself sixty miles distant in sixty minutes—I should like to know where it is to be found. **J. T. M.**

RAILWAY MYSTERY.

[26378.]—I QUITE agree with the opinions expressed by Mr. A. H. Allen (letter 26339, p. 132) with reference to the possibility of a pistol remaining upon a carriage step. Mr. T. Perkins, p. 134, and "Glatton," p. 136, appear to express opinions which are not in accordance with the results of the practical experiments. The moment a pistol or other article is dropped from a window of a carriage in motion its velocity decreases, whereas the train continues at the same speed—therefore, during the time the pistol was falling the train would move forward a certain distance. The wind would, of course, also tend to reduce the velocity of the pistol, and this fact was stated by me in giving evidence before the coroner's jury.

As the case is almost sure to form the subject of litigation, I do not here express any opinion as to whether or not the case was one of murder or suicide, and therefore I do not in this letter deal with the concluding portion of Mr. Perkins' letter.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
Railway Congress, Town Hall, Brighton, Oct. 8.

LOCOMOTIVES, &c.

[26379.]—YOUR correspondent "Loco.-Erector" (letter 26352) would apparently have us believe that Mr. Johnson does not understand his business In very offensive terms he contrasts Mr. Johnson's engines with those of his predecessor, Mr. Kirtley. But I should like to know whether it was Mr. Kirtley or Mr. Johnson who made the 800 class what they are—Mr. Kirtley, with his little boiler and 17in. cylinders, or Mr. Johnson, who has now completely rebuilt them, and turned them out a vastly superior engine to what Mr. Kirtley designed?

Has not Mr. Johnson now rebuilt and enlarged nearly all the engines that Mr. Kirtley constructed? and who will venture to say, much less to prove, that he has not improved them? And who can say that Mr. Johnson's own engines are not fully equal to the 800 class?

Out of several hundreds of engines designed by Mr. Johnson, the 1667 class are the only ones against which there has ever been a complaint raised. And these engines are not such egregious failures as some would have us believe. Until the 1740's came out, they worked the Leeds expresses south of Nottingham regularly, with splendid punctuality, on 29lb. of coal per mile. All they wanted was to be worked expansively. With more heating surface and 20lb. more steam they would be as fine engines as there are in the country. They have now gone to Derby to be altered, and when they come out I have no doubt they will answer the expectations formed of them when they were first built.

I should think that a gentleman who has turned out some of the very finest engines in the kingdom deserves the title of a *thorough engineer*, and I think the Midland Company has enough sense to fully appreciate his services.

If your correspondent thinks otherwise, I would ask him to compare the locomotive stock of the Midland Company now, with what it was when Mr. Johnson first went to Derby, and I think his doubts will very soon be set at rest.

"Engineer" (letter 26317) asks why no engines can be built now to equal the 800 class. I should like to know in what points any of Mr. Johnson's engines are inferior to them.

Do not the 1560 class pull the same trains between Skipton and Carlisle on a far harder road, as the 800 class pull between London and Skipton?

If "Engineer" will first prove that the 800 class are the best engines on the line, it may be worth while to discuss why; but till then any discussion on the subject would be out of place.

Rugby Oct. 8th. **E. A. Speed.**

[This must end the discussion, which, as unfortunately has been the case so many times lately with correspondents about railway engines, &c., has become absurdly personal.—ED.]

PLATELAYERS.

[26380.]—INTERMINABLE discussions continue on the subject of locomotives, their various types, capacities for work, and a vast amount of technical detail is brought forward, which is almost Greek to one not an expert. When you are borne along in an express train, perhaps by night, at the rate of 60 miles an hour, it must occur, of course, that your safety is primarily in the hands of the engine-driver who has charge of the train; and, secondly, of the various signalmen along the line. Doubtless the responsibility of engine-driver and signalman is most serious and weighty.

But it must not be lost sight of that the safety of the train equally depends upon the rails—a deficiency in the gauge here, or a bolt loose there, might be the cause of a train plunging off the rails to immediate destruction. Over all the many miles one may travel by railway, every inch almost of the permanent way must be in thorough order, and we therefore think the work of the platelayer is equal in responsibility to that of the engine-driver or signalman.

It would be interesting to have some details from some of those correspondents acquainted with the subject, about the work of platelayers. What is the average distance of the line one would have under his supervision; how often inspections are made, and the *modus operandi* of replacing a rail, which is rather a rare operation for an ordinary passenger to witness? Is this latter, on crowded lines, generally done in the night, when the traffic has virtually ceased for a few hours?

Oct. 10th. **E. E. M.**

LAUNCH ENGINES.

[26381.]—IN reply to Mr. W. H. Taylor (letter 26348, page 133), my opinion is that in adding a large cylinder to the two 6in. cylinders no beneficial results will be obtained; in fact, I firmly believe that the additional cylinder would be a drag. I have only had to do with two engines of this class, viz., in which the two h.p. cylinders exhausted into one l.p., both of which were a failure. It is the usual custom in a compound engine of this type to place one h.p. between the two l.p. cylinders. The reason this class of engine is made is, that when very high pressures are used it would necessitate a very large l.p. cylinder; consequently, by using two the areas may be reduced, the initial loads on the pistons are reduced, and the engine will run much smoother at slow speeds, on account of the power being distributed over the three cranks. But it has this against it: The friction of the three cylinders is greater, also the extra cost in making, and more space is occupied than the double crank compound. Another class of 3-cylinder engine is coming to the front—the triple expansion—this has a low pressure, medium pressure, and high pressure cylinders. To work this engine with success, it is necessary to expand the steam down to 8lb. to 12lb.; it has been found that this is the type of engine for very high pressures, such as 120lb. and over.

In your case, I would suggest your placing two 3in. cylinders on top of the 6in.; that is, if it is your intention of compounding. Then, again, assuming that you compound them in the 3-cylinder style, the engine would be too small to obtain good results.

In opening this discussion on the compound non-condensing engine for launches, I never anticipated that compound surface condensing engines would be brought against it; but of every 100 launch engines I have no doubt that 99 will be found high pressure, and in preference to these I advocated the compound non-condensing engine. There is not the least doubt but that the compound surface condensing engine is far superior as regards economy, and would do away with the evil of exhaust; but, as I mentioned in a previous letter, the extra cost and weight would be against it for small boats. The compound engine with outside condenser has been advocated. I know nothing of their efficiency; but I believe that a few of the steam pinnaces in the navy had them, and have given up using them for some reason or other; for myself, I like to see everything connected with a marine engine above board, and easy to get at.

Engineering, Manchester.

VIBRATION.

[26382.]—I NOTICE that it is thought much of that a flame will reply to the fundamental and harmonics of the voice and musical sounds. Perhaps it will interest our fellow-readers to know that the filaments of a pigeon's feather will *vibrate* the same. I do not say they will cause a sound for me to hear, as I have not a delicate microphone or telephone to test. A suitable feather will also vibrate any fundamental sound. If a certain supply of inked sand is made to rest on the point, the inked sand will be scattered according to the pitch of the note, and as it falls on a damp unrolling slip of paper, registers the sound. This small instrument was shown at the Inventions Exhibition (Stand 3707) by me, 1885.

T. Wood.

THE NEW APOCHROMATICS.

[26383.]—IN my paper on the new apochromatics, which you do me the honour to publish in your last issue, I observe one or two errors, and would esteem it a favour if you correct these in your next issue.

1st. On page 127, centre column, 40 lines from foot, read *num. aper.* instead of "mm. aper."

2nd. On page 127, end column, in table of apochromatic objectives read *focal lengths* instead of "screen distances."

3rd. The heading of the second table should be thus:

Screen distance of the objective 250 mm.	Search oculars.		Working oculars.				
Focal lengths	1	2	4	8	12	18	27

Kindly make these corrections.

Paul Schulze.

LATHE MATTERS, &c.

[26384.]—THE melancholy fate of useful appliances when made up after discussion or review in our columns, of the which "O. J. L." makes us aware, appears to me to be largely due to the depression in trade. Those who would purchase cannot, and are necessitated to get along with such appliances as they already possess. Some are in advance of and some unfitted to the times, and amateurs generally, I think, have a preference for their own schemes and a belief in their capacity to improve on any extant appliance—thus they become hesitating buyers.

Novelties have also to contend with vested interests in the form of other appliances and apparatus to produce them, as well as with prejudice, conservatism, or indifference.

The phrase "Survival of the Fittest" is an abbreviation responsible for a pretty complete and general misunderstanding of the natural law of selection. "Survival of the fittest *to the conditions*" is the proper expression, whereas the abbreviation implies, and is generally understood as meaning, the "survival of the fittest *to survive*"—a result or action of which the natural law is almost entirely innocent. That pills, toothpicks, penholders, and other "inventions," and trashy novels, &c., are more profitable and approved than things of sterling merit, simply shows that such are better adapted to existing conditions; the "remnant" is not the million. It is Zadkiel's and not the "Nautical Almanac" that sells. Which would the Hottentots prefer—beads, bangles, and rude weapons, or a Cremona?—fetishes and charms, or the appliances of science?

I have never been able to see the supreme difference in merit that the Patent Law decrees between two inventors, both of whom have brought the same invention to practical perfection—the loser having perhaps spent the more time, labour, and money, and being the more elaborate and careful, and the only difference between whom is an hour or so in the time of filing their specifications. The "telephone case," for instance. And how much might have been done, compared to what has been done, if right, justice, and "survival of the fittest to survive" had always ruled?

I like "F. A. M.'s" headstock, and should like also to see the rest of the drawings. A few suggestions might be made as regards the headstock. The inner portion of the front traversing bush is exposed. It would be better covered, the cone being moved back, if required. To allow the bushes to turn is desirable, and if headstock was properly made in a full workshop, could be done; but I doubt if tools or abilities of most amateurs would be equal to the task. The splits would require a piece of paper or wood between them after cutting, to keep grit from oil grooves, &c. The unusually large face and centring would be difficult and expensive, according to present ways; but if adopted and attempted, might be managed more easily than expected. If mandrel were cut after spring-tempering throughout, the face and centring would be easier to get true than if hardened after shaping closely, but the internal thread would be difficult to cut nicely. The large internal centring would be apt to come in contact

with the heads of screws; but if cut a little nearer centre than slot holes, the defect would be avoided. There appears to be room, in case spring-temper mandrels were used, for a hardened ring to be inserted and form the centring, attached with sunk screws, half and half into ring and plate, the ring being a pretty tight fit, and ground to truth and size after fixing.

I do not quite understand the traversing gear. In the explanation of the mechanism the "traversing handle" is called the "reversing handle," I think, and is spoken of as proceeding from *the strap* of the eccentric. This would result in a capacity to rotate the star-guide only. To throw it in and out of gear, it would be necessary to fix the handle, the traversing handle, with the tooth on it, on to the eccentric itself. Adjusting collars might be put behind the mandrel pinion to take back-thrust, and render cones more easily fitted by the less skilled, as the shoulders might be omitted.

Vulcan.

LATHE MATTERS.

[26385.]—"F. A. M." is to be congratulated on the good solid ground he has given us to work upon after our rather long pause. The general features of the design he gives us appear able to take care of themselves; but some of the details seem open to discussion and capable of improvement. To ease reference, I will number my remarks.

1. The reverse carriages on slide-rest are common in clock and small lathes, and are suitable for light cuts; the increased leverage, or overhang, on the V's renders the arrangement unsuited to heavy work. For working up to face-plate they are handy; but for general work, especially near centres or loose-head, they are less convenient than the more usual style, as the slide requires a clearance equal to its length plus its movement, instead of its length alone; in fact, they are awkward, and apt to foul the loose-head and such work as cranks, &c.

2. The vice-screw would be apt to catch clothes and sleeves, and there is not room to reverse tool to tail side of box, as is sometimes desirable; the rest seems designed for a "mandrel" rather than a lathe for working to fast-head only.

3. The slip or gib seems out of place under the tool: it is less solid than if on other side; the box could not be "set," or nipped up after setting tool, as two of the screws are covered by it; it would be unhandy when near face-plate, and if horizontal set-screws were used they would be left-handed to screwdriver.

4. A ball-turning arrangement might be fitted to saddle, but there would be little difficulty in doing so.

5. The collar on lead screw is a good device where screws are stiff and short; but in long screws when thrusting, nuts at the tail end lend a valuable tensional resistance to bending. A plain collar, about one diam. long, with set-pin in a groove —to prevent it turning—and a fit on shank, should precede nuts where a good result is needed.

6. The clasp-nut is on a neat mechanical plan; but a defect in connection with it is that it is fitted to one end of saddle only; the screw would get worn locally, and about a foot at tail end would not be used at all. The remedy is either two nuts, or to make the one movable from end to end, as then a little manœuvring with top-rests would wear the screw pretty evenly.

7. The gib at bottom of saddle is about in its best place; wear could be taken up, or, in case of local wear, bottom V of bed could be scraped up, without affecting general alignment. The bulk of the wear would come on this V, as it takes the weight and down thrust, but the saddle tending to come outwards, would be checked by top V, so I should suggest a more acute angle on top, and less acute one on bottom V—a rather obtuse angle on the latter.

8. From the height of centres, the V's look a trifle close together, and for metal work they would be none the worse for the support of a temporary V, or a counterweight, at far side of bed, and on horizontal saddle, or temporarily-fixed arm.

Vulcan.

STATIC ELECTRICITY—CHROMIC ACID.

[26386.]—IN reply to "A., Liverpool" (26344, p. 132), there is no difference in principle between the two editions of my "Electricity." The second is an extension of the first, taking up additional branches and describing the various advances of the science; but the whole of the first edition is wholly reproduced. I do not think more than 20 pages were cut out in the process of reconstruction, though the matter was differently arranged; therefore all I said on p. 107 applies, though my quotations were taken from the second edition. However, the greater part of them will be found on pp. 40 and 41 of the first edition, in the very description of the muslin bag experiment to which "A." refers. At the end of § 47 it is distinctly stated "If an interior body is provided, through which the circuit is completed, then electricity is to be found in the inner surface." The matter is also fully explained on the next page.

As to the other matter of the glass and rubber, "A." will never get a clear comprehension as long as he holds to the absurd notions of an electrical fluid or fluids, and talks about their trying to join each other. It is all clear enough when we study the action of the whole circuit instead of one part of it only. The resistance to discharge is in the air and the glass. The tendency to discharge is not at the point of contact of glass and rubber. The stress in the opposite direction is set up there, as it is in the valves of a pump; but there is no more tendency to discharge them than there is for the water in the pump to run back.

The other experimental observations of "A." in like manner are explainable by the simple laws of the induction circuit, in which static stresses correspond to the motions of the conduction circuit in which current occurs.

In regard to the remark of "Mag. est Ver.," p. 135, I will look up the question and see what I have to say. I may say now that some time ago I spent a week over some very full experiments on chromic acid; but pressure of other occupation has prevented me from working them into the form of an exhaustive article or two, as I intended. I suppose I shall manage to complete the work before long.

Sigma.

PHYSICAL BASIS OF LIFE.

[26387.]—WHETHER the following details will in any way supply the information inquired for by "No Sig., Paris," No. 26345, page 133, I am unable to say; but having long pondered on the fact of coal being permeated by sulphuret of iron, and in many cases blended with it, at the close of 1859, when reading M. Pouillet's "Eléments de Physique Expérimentale et de Météorologie," I stumbled on the Solar System, and when I came to "l'ellipse brillante" of Saturn's ring I paused, and frequently repeating the word "brilliant," it flashed to my mind that that ring must contain the gas of a metal, and, if so, it may be the source of our iron-beds, which in their construction correspond to those of coal and of salt, none of which are accounted for by geology, which branch of science is remote respecting the formation of our ocean and atmosphere.

We are told by Prof. Huxley, in "Physiography" (1882), both by word and sketch, that the roots of the plants of the coalbed period are invariably in the underclay, and as the seams of coal are very numerous, whilst the intervening rocks are, as we are told, of ocean formation, it does not exactly appear how the protoplasm for the production of the vegetation of the several seams or beds found its way into the mud or clay.

If, however, as it occurred to me in 1852, we contemplate the Solar System as being simply the means devised by the Creator by which to prepare an abode suitable for the reception of man, on the evidence of facts we find that geologically every orbit has assigned to it its share in the production of that abode, and the rungs of the ladder, after all, are not so very much opposed to those of Jacob. The sun, then, being a highly incandescent body, is surrounded by an atmosphere electrical in proportion to the incandescence, but decreasing with distance, and the approach of all the "planets" to that luminary at the rate of the diameter of their respective orbits will account for the changes they are respectively undergoing; hence the change in our climate—afterglows, earthquakes, &c., but more especially the chop seas instead of the round waves of 60 years ago.

The number of orbits, so far as we are aware, is nine, four on this side of the asteroids—those troublesome bodies to the astronomer and period of creation—and four on the other side: and allowing the positive or *cold* condition of the sun's atmosphere to cease with the orbit of man, that on the other side must necessarily be hot or negative in proportion to distance; and granite, it is said, has been subjected to heat, although "of deep-sea formation." I need scarcely state that the matter of the rock, &c., is in the respective orbits, and that the rocks themselves, so beautifully disposed in layers, are of nebulous formation —the orbits of Neptune, Uranus, and Saturn being of the primaries, terminating in the coalbeds; Jupiter the secondaries, Bath and Portland stone, saltbeds, reptiles, and cretaceous. The water of the North Atlantic and all other waters are as gas in Saturn, whose atmosphere extends to his outer ring, and as vapour in Jupiter's atmosphere, the crust of the north being formed as a belt round the Equator by centrifugal. The orbit of the Asteroids is divided into rings, the Wealden being the first evidence of fresh water, there being a geological break after the Cretaceous; so that it would appear that during this unaccounted-for period there prevailed an enormous vegetation to the production of the beds of lignite and our atmosphere, followed by the antediluvians of the Eocene and Miocene periods, when the belt was broken up by change of inclination to the Sun, and the antediluvian mud was sent to the North, forming Siberia and New Siberia, which collection of bones, &c., terminates at the Gulf of Obi. The Pliocene I conceive to have followed the disturbance above referred to, and to have been the period of the creation of the present race of animals, the post of honour being that of man; after which our planet passed from the Asteroids into the orbit of Mars, when the earth covered the whole surface of the planet, the orbit of Mars being the Compressing period (when were formed the gigantic convolutions that have so much engaged the attention of scientific men) preparatory to the formation of the bold headlands that were to resist the influence of the present disturbed ocean. I need scarcely state that all th protoplasm or germ matter came from above, and this closes the Forming period.

Chertsey, Oct. 11th. **F. T.**

LEGAL REPLIES.

[26388.]—SHARE CERTIFICATES (60593.)—A shareholder is (1) a subscriber to the memorandum of association, or (2) a person who has agreed to become a member, which is done by an application for shares followed by allotment. Every shareholder is entitled to a certificate of his shares upon payment of the nominal fee. In this question both classes named have become shareholders, and, therefore, they should have certificates; but these certificates will show what is paid upon each share, and will leave the holders liable for the rest of the share should they be called upon, or should anything happen to the company.

LEGAL MARRIAGE (60616).—The English Courts will recognise as valid a divorce of an English marriage granted by the courts of the foreign country in which the parties are then domiciled. But the English Courts would not admit the validity of a divorce granted in America at the instance of one party while the other was domiciled in England, and the fact of such an application by a wife would not legalise the husband's second marriage in England.

LIFE POLICY (60635.)—If money is lent upon a life policy it should be done by way of mortgage, and a proper deed of assignment drawn up, giving the borrower a power of redemption on repayment of loan, and providing for the application of the policy moneys; the payment of interest, the production of receipts, &c., and notice given to the insurance office. Compound interest cannot be claimed unless expressly agreed upon. If no proper mortgage is made the lender may have some trouble afterwards in enforcing his security.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, E.C.

A RECENT number of the *Japan Weekly Mail* contains a short account of a night ascent of the active volcano Asamayama. The party left Karnisawa in the afternoon, and commenced the ascent from the eastern side about sunset. The sky was perfectly clear, and the summit was reached an hour before midnight. The wind, blowing from the south, carried the sulphurous vapour away to the northwards, and thus the ascent was made less uncomfortable. The party saw quite to the bottom of the crater, which presented the appearance of a furnace filled with glowing coals. The sound of the roaring, hissing, and bubbling is described as loud and awful. The walls of the crater are of a light-brown colour, and are composed of successive layers marked out with striking regularity, like the seats of an amphitheatre. Allowing ten of these layers to each interval of 20ft., the depth from the surface to the incandescent matter would appear to be 200ft. The periphery of the crater is about half a mile, although the Japanese calculate it at two miles and a half.

Tobacco Growing—A correspondent writing to *Notes and Queries* with reference to the cultivation of tobacco in Yorkshire a hundred years ago, says:—Now that there seems a prospect of English-grown tobacco becoming a marketable commodity, it is interesting to call to mind the fate of a previous attempt. In and about 1782 many acres were sown with tobacco in the vales of Pickering and York, the greater quantity in the latter. In the Pickering district the growers were not molested, and in the richer parts a considerable quantity was grown and properly cured and manufactured for the pipe and pouch by a man who had been employed in an American plantation. But in the Vale of York the tobacco was publicly burnt, and the growers were severely fined and imprisoned, penalties being laid, it is said, to the amount of £30,000. This not only put a stop to the illegal cultivation of tobacco, but also stopped the cultivation of the limited quantity (half a rod) allowed by the law for purposes of "physic and chirurgy." It was applied in farming to the cutaneous disorders of cattle and sheep.

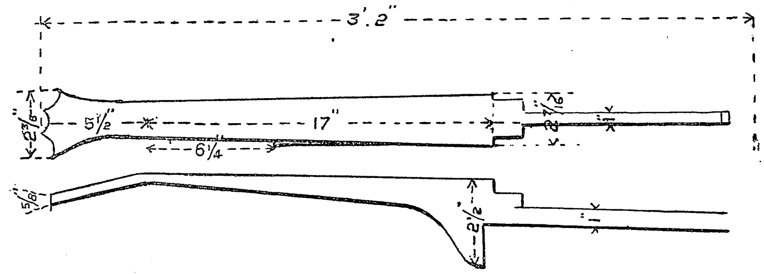
REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60049.]—**Silica.**—To "SOUTH AMERICA."—If "South America" will send me a small sample of his silicious earth, I may perhaps be able to give him the information he requires. For my address please consult the Address Column.—P. HOLMES.

[60186.]—**Mathematical.**—To "E. L. G."—I took the size off the drawing-board as 9·4in., but here is the working:—The side x of the cube $= \frac{6 + 6\sqrt{3}}{\sqrt{3}}$, or $2\ (3 + \sqrt{3}) = 9{\cdot}464$in.—T. C., Bristol.

[60275.]—**New Banjo.**—Taking up your query, the vellum would be drawn down between if you screwed far enough; but it is little more than drawn over the inner hoop. I hope Fig. 1 will explain. The inner hoop must be very strong, and certainly ought to be thicker than the outer hoop or pan, as it is called. A 12in. hoop will be best. I



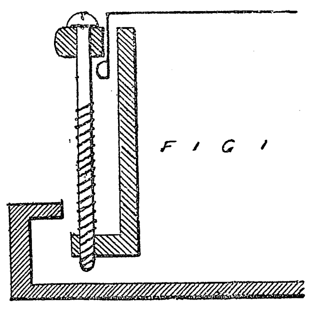
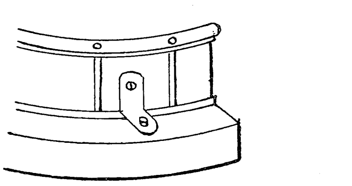


FIG 1

FIG 2.



send sketch of a staff for 12in. hoop; but you don't say how many strings, so I have left out the width of nut. You must allow ¼in. for each string; thus a 7-string banjo will be 1¾in. across the nut. Note that the inner hoop is to be made complete, the staff fitted to it; then the pan is put on, and held in its place by brackets, shown in Fig. 2. It is known as the Dobson banjo, and I advise you not to start on brass until you have overcome the difficulty of tightening the vellum without having to remove the pan. If you get into difficulties with your brass one, and would like to make a silver one of the latest pattern, I shall be glad to help you.—SAM KOE.

[60296.]—**Black Stain for Wickerwork.**—It is doubtful if anything cheaper than logwood and copperas can be found; but surely this is a matter for experiment by the querist.—NUN. DOR.

[60306.] — **Photographic Engraving.** — To discover the reasons for this querist's failure it would be necessary to have the book referred to and personal experience of the manner in which he carried out the instructions. Further, it is not easy to understand what is meant by "etching it wholly by mechanical means," for etching, which I believe comes directly from the German ätzen, implies the eating out of parts by means of acid.—SAML. RAY.

[60312.]—**Lubricating Oil.**—I do not think "J. B. G." will find any test of the kind he requires; but he should read the article on p. 496 of the last volume, and look through the indices. Something may, of course, be done with the spectroscope; but I know of no published experiments in that direction.—F. I. C.

[60316.]—**Electric Time Ball.**—I thank Mr. Glatton for his suggestion in answer to my query; but it would not be applicable to my case. I want the ball to rise suddenly about six minutes to each hour. I should be pleased to hear from E. Conry, or any practical man.—WATCHMAKER.

[60317.]—**Specimen Fish.**—The art of stuffing fish is one of the most difficult branches of taxidermy, and it would be useless to attempt its explanation in any detail. The fish is usually turned with its worst side uppermost, and a cut made along the sub-dorsal or lateral line, having previously covered the other side with thin paper, which will readily adhere to the scales, and keep them in position while the flesh is removed from the back. There are several manuals of taxidermy to which the querist may be referred.—ESOX.

[60323.]—**G.W.R. Outside Eccentric Engines.**—"G. N. R." asks for what purpose the eccentrics are placed outside on the engine which has since been illustrated on p. 90. I presume he knows that it is a common practice on the Continent, and that it is done to get more room for the cranks in the axle and the slide-valves, and also because the motion can then be more easily examined and oiled.—J. T. M.

[60324.]—**Terrestrial Telescope.**—A pancratic eyepiece is an ordinary four-lens eyepiece which permits the distance between the two pairs of lenses to be increased. Without examination it would be impossible to say if your glass was worth the alteration. My glasses were made by Dallmeyer.—EDWARD M. NELSON.

[60334.]—**Falling Bodies.**—If the track of a body falling through the earth is an ellipse, as "E. L. G." states, then its angular slope from the plumb-line will be at a maximum directly it is let fall, for at that point the tangent to the curve is at right angles to the major axis (i.e., to the plumb-line), and the angle will continually diminish until the extremity of the minor axis is reached, where it will be nothing, the tangent being parallel to the major axis. However, "Dubliniensis" says that the body starts along the vertical, and if this is the case the curve cannot be an ellipse. I do not see the utility of prolonging this discussion, for several assumptions as to the density of the earth have to be made, some of which we know to be incorrect, while we have no means of verifying others. Moreover, no two correspondents agree in their figures, the time required to fall to the centre of the earth being given as 20 minutes by one, and half an hour by another, and the velocity of passing the centre as 5 miles and 3½ miles per second, while another asserts that the body is retarded by the portion of the earth's crust behind it!—R. E. F.

[60334.]—**Falling Bodies.**—Suppose a stone capable of falling freely through the body of the earth were dropped from the surface at the Equator, it would have, at starting, an eastward velocity of about 1,525ft. per second, and since we are supposing the earth homogeneous, and are neglecting the slight disturbance of the problem caused by the fact that the earth is an oblate spheroid, the stone would be attracted towards the centre of the earth with a force proportional to its distance therefrom, and it would describe an ellipse, with its centre at the earth's centre. The axis major of the ellipse would be the diameter of the earth, and the axis minor would be twice the above 1,525ft. $\div \sqrt{\mu}$; μ being the attractive force at unit distance from earth's centre, or g the gravitation at earth's surface; $\div$ R, the earth's radius. Calculating from the numerical values of these, we shall find that said axis minor would be about 520 miles—that is to say, the stone would miss the centre of the earth by the half of this, or about 260 miles. When abreast of the centre, if we may so speak, the stone would be very nearly that distance away from the well bored through the centre of the earth to the opposite side. It is easy to see, by drawing the ellipse, which would be stationary, and considering the rotating well in connection with it, that the stone would be still increasing its distance from the well until it had reached the opposite side of the earth. The above 260 miles may be depended upon; it is easy to see, without calculation, that the distance must be pretty nearly that.—DUBLINIENSIS.

[60352.]—**Fire-Engine.**—Sorry to say I can't oblige "J. K." without more particulars, as S. and M. make many different sizes. Was it a vertical, single, double, or triple? If at a fire-station, where?—SAM KOE.

[60410.]—**Electro-Motor.**—To MR. THOMSON.—Length 36in., 9in. beam, 6in. deep, and 4in. deep in water. As I have not got the boat with me just now, I cannot tell you what weight it would take to sink it, because I have never tried. It is made of wood. I have got bichromate cells, chloride of zinc, and Bunsen cells, all pints.—ROCHDALE.

[60421.]—**Carriages — Railway Mystery.**—It is amusing what a controversy has sprung up on this apparently simple point. Without presuming to instruct "Glatton" or the others, may I remark that the wind would have remarkably little practical effect on such a body as a pistol, which would offer no resistance. The action of gravity, of course, would not have the least effect on the position of its fall, merely tending to pull it straight down, while *vis inertiæ* would tend to carry it on, being set in motion by the train, and, therefore, it would fall nearly under the window, as Mr. Perkins points out. There is no reason why it should move while on the foot-board, when once it got there, more than it would inside the carriage on the floor, barring the wind, which would have little or no effect.—R. A. R. BENNETT.

[60430.]—**Gravity Daniell Battery.**—To "WEALD."—Read my reply again. In using plain water to charge the zinc, where do you suppose the acid comes from which acts upon the zinc, if not from the copper sulphate? Free acid is formed in the cell as follows: Zinc and sulphuric acid form sulphate of zinc and hydrogen. The hydrogen so formed passes on towards the negative plate; but on reaching the sulphate solution is exchanged for copper, which, in turn, is deposited on the surface of the negative in the form of metal. This action transforms the sulphate of copper $CuSO_4$ into sulphuric acid H_2SO_4, and unless a reserve of crystals is kept to reinforce the solution, nothing but free acid will remain. You say that the solution contains free acid, per test paper. Then what need had you to ask from whence it came? Perhaps the above will make all plain to you; if not, you had better consult "Thompson," "Guthrie," "Sprague," or some authority, in preference to an "A.S.T.E.," as although the letters look imposing, the privilege of using them does not depend upon the amount of knowledge the individual may possess, but entirely rests upon the payment of one guinea per annum.—C. D. R.

[60432.] — **Architecture, &c.**—Among the books to be recommended, I would mention Fergusson's "History of Architecture," Stuart and Revett's "Antiquities of Athens," Tarn's "Geometry for Architects," Haskell's "Architect's Guide." With regard to the contemporary history of architecture, I should think that the most useful thing for "Upsilon" would be to consult the criticisms, expressed in torrents of execration, on Mr. Street's designs for the New Law Courts, which appeared in the public press. Let him see the *Builder*, Dec. 2nd, 1871, and March 30, 1872, the *Times*, August 19th, and Dec. 6th, 1871, the *Illustrated London News*, Sept. 23rd, 1871, and March 30th, 1872; also the attacks of Mr. Fergusson in Macmillan's *Magazine*, Jan., 1872, and in *Builder*, July 1st, 1871. As for special articles in periodical literature, I would refer "Upsilon" in particular to "Classic and Gothic Architecture," dispassionately considered by G. Wightwick, in *Builder*, March 1st and 15th, 1862; "A Fight against Gothic," by Alex. Thomson, in *Builder*, May 19th, 1866; a Lecture against Gothic, by the Hon. Cavendish Bentinck, in *Builder*, Feb. 24th, and March 3rd, 1877; also, "Have We a National Style of Architecture?" in *Builder*, Sept. 10, 1859. Architecture at the present day is labouring under a terrible incubus in the shape of the so-called Gothic Revival, which is causing our new buildings to be erected with hideous deformity, a galling air of monkish austerity, and the utmost inconvenience of plan. This is chiefly due to the action of some superstitious old women who have such a superstitious veneration for the remains of the Middle Ages that they insist on having our new buildings made in exact reproductions of those ancient edifices, and presented in one hotch-potch of such reproductions. The present mania in England for this Gothic patchwork has made our architecture the laughing-stock of the whole world, but it is only a passing fashion. Gothic—which is the monkish architecture of pre-Reformation times—is quite

inadequate for secular buildings; it cannot present unity of effect; it cannot afford convenience of plan. There is nothing to approach the majestic simplicity, the proud bearing, the dignified solidity and symmetry of Classic. But leaving aside architectural appearance, there never was such an atrocious failure in point of practical requirements —since the Tower of Babel—as was the new Law Courts, a building which does not even admit the light of day. We see also that the stonework of the Houses of Parliament is already falling fast into decay, so that they cannot remain as a lasting monument for future ages, and yet any common stone-mason ought to be able to test the durability of stone by simply trying its resistance to the action of fire. Such miserable and deplorable mistakes as these are due to the fact that the designs and plans for Government buildings are selected by one or two members of the Government who generally have no natural faculty for architectural discernment, nor any knowledge of the practical work of building.—DELTA.

[60453.]—**North British Engines.**—Dimensions of 592 class are: Cylinders, 18in. by 26in. Wheels—bogie, 3ft. 6in.; driving and trailing, 7ft. Boiler—length of barrel, 10ft. 3in.; diameter, 4ft. 5in. Heating surface—tubes, 980 sq. ft.; firebox, 110 sq. ft.; total, 1,090 sq. ft. Wheel base of bogie, 6ft. 6in.; of driving and trailing wheels, 9ft. 3in. Weight in working order, 45tons 9cwt. For working drawing and illustrations see the *Engineer* Sept. 17th and Oct. 8th.—E. A. SPEED.

[60454.]—**Wind Motor for Electric Lighting.**—I am afraid that I shall not be able to comply with "C. D. R.'s" suggestion at present; but I think I may promise that a full description of the motor shall appear in the "E. M." before very long.—J. G. GWYNT.

[60462.]—**Testing Lightning Conductors.**—The testing of the upper part of lightning conductors is simply humbug. For example, suppose that 11 strands out of 12 strands of No. 16 B.W.G. lightning conductor are broken, continuity would be maintained by the single strand; its resistance would be so low that no instrument would be capable of detecting it. The only way of testing the upper part of a lightning conductor is to periodically examine it. The "earth" may be tested in the following manner:—Connect one pole of a battery to the water supply and the other pole of the battery to a shunted galvanometer, the other pole of the galvanometer to a resistance box, thence to the lightning conductor. Open no resistance in the box, and adjust shunt until you get a deflection of, say, 30°; now open resistance until that deflection is halved: the resistance inserted will then equal the resistance of the battery, shunted galvanometer, line, and earth.—EDWARD M. NELSON.

[60484.]—**Twilight.**—My data last week seem to have got considerably mixed up. The distance apart of the two circles = circular measure of 18° × earth's radius = ·31416 × 3,956 = 1,242 miles. The actual distance is about 1,172 miles. In speaking of the "two *great* circles," I did not use the word in a technical sense, for it is evident that two great circles cannot be parallel to each other.—R. E. F.

[60484.]—**Twilight.**—The statement of "F.R.A.S." on p. 130, that "there is no doubt that twilight not only should, but does, last 72 minutes at the Equator," comes opportunely as authority for what "R. E. F." objects to. I had said only "nearly 70 minutes," because, if it ends (as generally allowed) when the sun's zenith distance is 108°, day does not end till his true zenith distance is 90° 50′—namely, 90° + his semidiameter + the horizontal refraction. It is not twilight, but day, as long as any of the sun's disc is visible above a sea horizon. He has only to descend 17° 10′ between that and the depression 18°, so that I cannot make the shortest possible twilight exceed 69 minutes, nor the width of the zone thereof exceed 1,200 statute miles. I must leave "R. E. F." to his own diagram to find that his line $a\,x$ necessarily cuts off double of this if inclined 18° to the horizon at a. If he means that to be a place where the sun is depressed 18°, and this line to point to the sun, x will be a place where he is elevated 18°. If the twilight zone were of the width he says, we could have no hours dark in London in the months of April, May, June, July, August, and half September! The shortest Equatorial twilight, too, he would make 141 minutes, while telling us there are places where it is but 15. Where, and according to whom? It does not end, moreover, at the "first sixth-magnitude star" appearing, but the faintest ones, and not at the zenith, but near the N. or S. horizon. Those in the east or west may be dimmed by zodiacal light when proper twilight is quite absent. "R. E. F." will find me as bad as "Libra" for persisting in "errors" that happen, like his probability calculus, to be more correct than peculiar.—E. L. G.

[60491.]—**Time.**—There are several ways by which "Chronos" might find time to rate his regulators. Star transits are, of course, the best and most accurate method; but for their observation they require a transit instrument with a telescope of at least 2in. in aperture on a very firm pillar, and in an apartment isolated from housemaids and their dusters. This puts star transits out of the category of "simple methods" which "Chronos" requires. Another very excellent method is an observation of the sun with a sextant and artificial horizon: a mean of five good sights of the sun when not less than three hours from the meridian should give you the time to one second. This method is simple enough. The objections to it are the time and trouble it takes, and it requires an assistant to note the times. Another method is by a dipleidoscope. It is an instrument for taking a meridian observation of the sun. It is very simple, but requires to be thoroughly well fixed. The best plan would be to bolt it to a stone pillar in the garden with a suitable cover to protect it from the weather. The simplest and best of all is a meridian sundial, of which Fig. 1 is a side view.

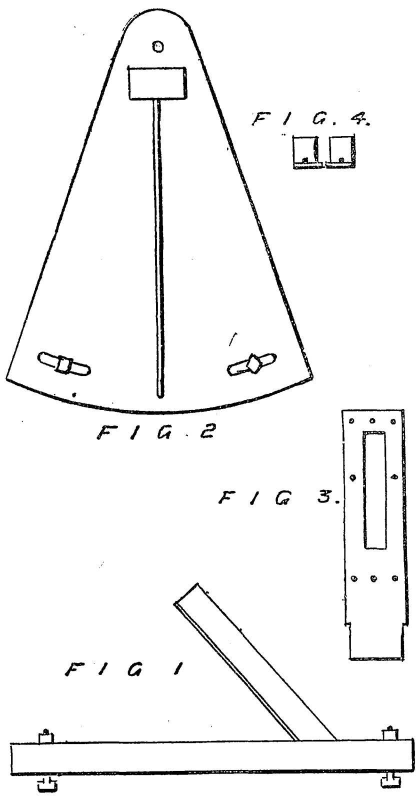


FIG. 4. FIG. 2. FIG. 3. FIG. 1.

It should be made of gunmetal, and should be bolted to a massive stone pillar which is set on a good foundation. Too much importance cannot be placed on the quality of the foundation. I have noticed that a great many sundials are inaccurate from want of attention to this point. The gnomon should be inclined to the base plate at an angle equal to the latitude of the place. Fig. 2 shows a plan without the gnomon. Slots are cut at the wider end for the bolts to pass through and allow for final adjustment. On the lower side of the gnomon a thin plate is screwed, having a vertical slit $\frac{1}{25}$in. wide. Fig. 3 shows the gnomon with the plate removed, and Fig. 4 shows a section of the gnomon with the plate fixed. The base plate might be 11in. long, and the gnomon 6in. The metal should be $\frac{1}{4}$in. thick, or, in any case, not less than $\frac{3}{16}$in. The meridian lines on the base plate should be very clearly ruled and be $\frac{1}{20}$in. apart. Time should be found with this dial to five seconds. Although not so accurate as some mentioned above, it will, I have no doubt, suit "Chronos'" purpose; at any rate, it fulfils his condition—viz., that of simplicity.—EDWARD M. NELSON.

[60503.]—**Photography.**—Mr. T. Perkins, replying to this query, is very inaccurate. He says: "Mr. S. Bottone, replying to this query, is very inaccurate." Now, as a matter of fact, Mr. Bottone did not send the reply quoted by Mr. T. Perkins. It was sent by a much better man than I—namely, Mr. R. A. R. Bennett. Surely, Mr. Perkins, if it pleases you to throw stones, you should be careful about your own glass house, and be quite sure you are *quite correct.*—S. BOTTONE.

[60503.]—**Photography.**—In case Mr. Bottone may be inclined to regard himself as a hardly-used mortal, after Mr. Perkins's remark, I hasten to take my sins upon my own shoulders, and to remark that it was not he, but I, that wrote the answer referred to. It is certainly gratifying to a humble individual like myself to be taken for such an authority as the gentleman above mentioned. As to the plates, I can answer Mr. Perkins that I know as much about them as he does, at any rate; the full explanation being that the "Ilford" plates now, and the "Britannia" plates a few months back, are one and the same. In consequence of a lawsuit between Harman and Marion, the name of the plates has lately been changed to "Ilford," and they are now manufactured by the "Britannia Works Company"; while Marion's present name of "Britannia" is a different make. If Mr. P. can get "German" and "Ilford" plates for 1s. per dozen, he may congratulate himself—I can't. Marion's old "Britannia" ("Ilford") plates were advertised at 1s. 6d.—R. A. R. BENNETT.

[60510.]—**Mathematical.**—If the origin be at the centre, then r cos. θ is the ordinate of any point in the periphery of the circle whose radius is r. Let all the cosines be drawn in a quadrant, so that any two adjacent ones have a perpendicular distance a between them, and let a be extremely small; then the area bounded by any two adjacent cosines, the periphery and the radius, is expressed by $r \times \cos.\,\theta \times a$, and the sum of all these small areas between 90° and 0° is the area of the quadrant, or $\frac{\pi r^2}{4}$; hence, $\sum_{0^\circ}^{90^\circ} r \cos.\,\theta \times a = \frac{\pi r^2}{4}$; and if n is the number of spaces or elementary areas, then $n\,a = r$, or $a = \frac{r}{n}$; wherefore, $\frac{r^2}{n} \sum_{0^\circ}^{90^\circ} \cos.\,\theta = \frac{\pi r^2}{4}$; but $\sum_{0^\circ}^{90^\circ} \cos.\,\theta$ is the average value of the cosines in the quadrant, and each side of last equation being divisible by r^2, we get average value cos. $= \frac{\pi}{4}$.—G. H. H.

[60511.]—**Boys' Marbles.**—It does not quite appear, from the account "J. K. P." quotes, how they become so accurately spherical. There is doubtless a trade mystery in the process. We used to buy some about a third the diameter of his, I think, in white marble for ½d., and in agate (or perhaps pale flint) for 2d. apiece, these last with a polish equal to glass. Now, it strikes me that, whatever way those were made, smaller ones of glass, clear quartz, or even garnet or zircon, ought to be producible, and being afterwards split, each piece could have a plain side wrought, and then serve for a lens, either for microscope or telescopic eyepiece. The boxes of "J. K. P." fully illustrate the waste of room I said must be involved if the border balls of a layer be in contact, as he seems in every case to put them. The number in his first; the cube of 8in., I suppose a misprint for 512, each internal ball touching only 6 others. If each layer were a honeycomb layer, it would be 68, and the box would hold 544, each touching but 8 others. But by making these layers alternately of 68 and 67, he will find depth for 9 of them, or 608 balls; each interior one touching 10 others. Of course, that still wastes room compared with natural piling, where each touches 12; but it is probably the most that his arbitrarily chosen size of cube will hold. Indeed it only needs $8 \times 7{\cdot}93 \times 7{\cdot}93 = 502{\cdot}9$ cubic inches. What he means by his No. 4 being "closer packing" than the others, I cannot tell. Its 11 equal layers, of 64 each, require $8{\cdot}5 \times 8{\cdot}5 \times 8{\cdot}0711 = 583{\cdot}2$ cubic inches, whereas No. 2 is but $8 \times 8 \times 8{\cdot}0711 = 516{\cdot}6$ cubic inches, and putting 629 balls into this, I make rather closer than putting 704 in the larger box. But now compare either with the cube of $1 + 5\sqrt{2}$, which holds half of $(11^3 + 1)$. The cubic inches are $151 + 265\sqrt{2}$ = not quite 525·8; holding 666 balls. It adds but 9·2 cubic inches to "J. K. P.s" No. 2, to admit 37 more balls. Again, his No. 4 has to augment it no less than 57·4 cubic inches for only 38 more balls.—E. L. G.

[60512.]—**Mathematical.**—I think "R. E. F." has rather missed the point of this query. We are required to solve the simultaneous equations $a = x^2 + y$, $b = x + y^2$, which means that we have to find x in terms of a and b, and y in terms of the same symbols, such values to satisfy both equations. From the first we get $y = a - x^2$, and from the second $y = \pm\sqrt{b - x}$. Equating these two values of y and squaring, we get an equation of the fourth degree between x and a and b, which if solved would give four values of x, and a similar equation in y would give four values for y; but as it is a troublesome business to solve a bi-quadratic the following will be found easier, especially if numerical values be given to a and b. We have $a - x^2 = \pm\sqrt{b - x}$, the term on the right may written $\pm\sqrt{b}\sqrt{1 - \frac{x}{b}}$. Now, take the square root of $1 - \frac{x}{b}$ and we get

$$a - x^2 = \pm\left(1 - \frac{x}{2b} - \frac{x^2}{8b} - \frac{x^3}{16b} - \text{\&c.}\right)\sqrt{b}$$

Now, if a and b are each not less than unity, we

must have a or b greater than y or x, consequently $\frac{x}{b}$ must be a proper fraction, and as the squares, cubes, &c., of fractions diminish rapidly, especially when divided by increasing denominators, the term involving x^3 and those following may be omitted for the present at least, and thus we get a quadratic equation in x, or rather two equations. Owing to the double sign each of these will give two values of x, so we get four values, and from these the corresponding values of y may be found. If further accuracy is required substitute the values thus found in the term involving x^3 and solve the quadratics again, and thus any degree of accuracy may be obtained.—M.I.C.E., Bath.

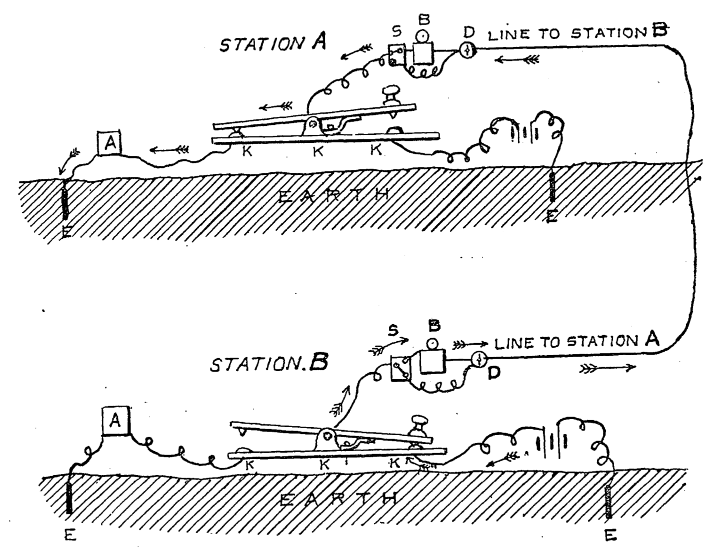
[60513.] — **Pianoforte Repairs.** — TO MR. DAVIES.—The keys cannot be taken out of a grand piano without first removing the hammer-frame; this may be done by taking out the screws or nuts at the ends and middle, when the frame may be lifted clear of the hoppers. In loop actions the process is more complicated, as each loop must first be unhooked from the spring and pulled through the hopper; in replacing the frame, the hammers should be kept clear of the hoppers by a straightedge, which may rest on each end of the frame. It will be rather tedious to rethread the loops, but a little patience is of as much value as experience in matters of this kind. Take your time, and do not get flurried or use force: if any part does not drop easily into its place, see what is stopping it before you exercise pressure. A little undue haste may break some of the delicate mechanism which would probably be out of your power to repair. If, as is most likely, the keys are bushed, the key-pins will be of an oval or cricket-bat shape, in which case the sticking may be eased by turning the oval of the pin more parallel to the key. If this is done with pliers the surface of the pin should be protected with paper, as a roughened key-pin would make an unpleasant grating noise and soon wear through the cloth.—W. H. DAVIES.

[60518.]—**The Starry Heavens.**—To "FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY."—"Cœli besse tenus liceat convexum tueri." Thanks for your reply to the above query in the "E.M." of October 9th, p. 130, and also as to the Latin, which is not mine—certainly not the "infinitive" of the verb. I did not write tuera, which is purely an error of the printer. It is now nearly fifty years ago since I had anything to do with Latin.—ONE NOT AN ASTRONOMER.

[60525.] — **Bewitched Barometers.** — E. B. Fennessy seems to be one of the numerous class of people who look upon barometers as rain indicators, whereas a barometer simply tells the weight of the column of air above it; and this, I do not doubt, his barometer has continued to do faithfully and truly. As a rain indicator a barometer is only useful when read in conjunction with other things, such as the direction of the wind, the appearance of the sky, the amount of moisture in the air, the temperature, and the readings of other barometers at a distance. A great deal of the misunderstanding with regard to barometers is due to the practice of the makers in putting on the scale such words as very dry, dry, change, rain, much rain, which really have little or no meaning. It is quite possible by carrying a barometer up a mountain to change its reading from very dry to much rain, though the weather may be all the time perfectly fine, and likely to continue so. Let E. B. Fennessy observe other atmospheric phenomena, in addition to that one which the barometer indicates, and he will then find that, although he may not be such a dogmatic weather prophet, he will, on the whole, be a truer one.—BUNTING.

[60540.] — **Tricycling Matters.** — "Gamma Sigma" inquires why small geared-up wheels on tricycles give better results than large level-geared wheels? He has raised a question which has been discussed a great deal in cycling papers, and the great majority attribute it to decreased weight and windage; but, in my opinion, though they do make a difference, they do not make all the difference. I think the secret lies in their revolving at a greater rate, and on that account overcoming resistance more easily, especially up hill and against the wind. Then, again, the wheels being smaller, they throw less strain on the framework on account of their decreased leverage. With respect to the automatic steering, that is giving way to the "stuffing-box" system, which causes the steering-wheel to turn stiffly; the automatic steering was found very trying when not riding in a direct line.—G. TOWNSEND.

[60549.]—**Telegraph Connections.**—TO E. CONRY.—A, single needle telegraph; K, key, for sending: the axis of lever must, of course, be insulated from the two contacts on the stand. B, bell, S, two-way switch for putting bell in circuit or cutting it out; D, a simple low-resistance detector, or galvanometer, for indicating that the current is passing and the circuit therefore complete. This last is not absolutely indispensable



(as two bells will ring in series, though not well) but it is a better arrangement to have it in. A small compass with a few turns of wire round it will do. There is a battery at each end. When the telegraph is not in use, the bells are left switched on. When you ring to station B, you cut your own bell out for the instant, and directly you stop ringing switch it in again, so as to receive the answering ring of station B, who similarly cuts his own bell out, leaving it out until the completion of the message. These switches can be made by contacts above and below the lever, if you like it to be a better arrangement. You then cut your own bell out and send through A, by means of the key, the "Are you there?" (three raps), if there is any possibility of anybody but your regular correspondent being at the other end, to which he replies by two raps, and you then proceed to send your message. If there is a regular attendant at the station B, and no one else is allowed to touch the instrument, the "Are you there?" may be dispensed with. A similar signal, four raps answered by three, or any other you may arrange, marks the end of the message, when you and station B both switch your bells in, and leave the apparatus till next wanted. There are two batteries you will observe. With a line of the length you mentioned, I should use four cells at each end—they need not be large, the smallest Leclanchés made would do. If you experience any difficulty in getting your bells to ring with the four-cell battery, owing to not having specially wound telegraph bells, you can arrange another switch so as to leave A cut out, until wanted, like the telephone connection. The P. O. has special keys which do all the switching work automatically, so to speak. The lever is metal, with metal points—these and the contacts preferably of platinum.—E. CONRY.

[60554.]—**Charging Accumulators.**—It is very difficult to tell, merely from the quantity and gauge of the wire, what current a dynamo will give, as so much depends on the make; but even with the best make, I should think it would take you a long time with such a dynamo as you describe, to charge any cells, on account of the very little current. Cannot you get an actual measurement by ammeter or tan. galvanometer of what your machine gives.—E. CONRY.

[60557.]—**Honours Exam. in Electricity.**—TO S. BOTTONE. — Procure J. T. Sprague's "Electricity;" also S. P. Thompson's "Electricity and Magnetism." Join the City and Guilds or the Birkbeck classes, and try to repeat every experiment given in the two books mentioned above. Take written notes of every experiment, and do not be satisfied till you have thoroughly understood the why and wherefore of every one. By next May you will be ready for the exam. You must keep yourself in the swim with all electrical novelties, and must know mathematics.—S. BOTTONE.

[60560.]—**Water Wheel.**—There would be no theoretical difference in the velocity of the water, and the inclined trough is the best arrangement as things are; but the wheel should have been larger to utilise the fall. It is the weight of water and fall utilised, not the impact, which represents so much loss.—T. C., Bristol.

[60560.]—**Water Wheel.**—Yes; the position C B would be better, because you would thus add the force of gravity of a falling body to the impetus of the water. The A B position, however, might be advisable where you had a strong head of water on, and depended on this head or jet power for your force. Where there is no more head than will about make the water run freely, C B would be best, making the distance C D as great as possible. —E. CONRY.

[60561.]—**Polish.**—If "Colombo" has access to Vol. XLIII., July 9th, he will find several good recipes for polishes by "Nun. Dor." that will suit his purpose.—T. H. G.

[60561.]—**Polish.**—What does this querist mean by a good and cheap polish, as he does not wish to varnish? A polish is a varnish, and properly applied costs a great deal more than varnishing. French polish is made by dissolving shellac and gum benzoin in wood naphtha (say 3oz. shellac, ½oz. benzoin to the pint of spirit), and a good brush polish, which I suspect is what the querist requires, may be made by mixing two parts of French polish with three parts of the ordinary brown hard varnish of the shops. If either of the above is used on black work it will be as well to crush up a bit of Prussian blue, and put in it, so as to bring up the black of the stain.—SAML. RAY.

[60562.]—**Current Quantity.**—The intended process is impossible, and any answer in this direction wholly misleading.—SIGMA.

[60562.]—**Current Quantity.**—The size of the zinc has absolutely nothing to do with the number of ampères. This depends on the resistance of the fluid and the size of the negative element, together with the resistance of the interpolar.—S. BOTTONE.

[60562.]—**Current Quantity.**—Cannot be done by the method you propose; there are other considerations beside the surface of the zinc, viz., strength of liquid, surface of negative, distance of zinc from carbon, &c. You must calibrate by means of a standard instrument.—C. D. R.

[60562.] — **Current Quantity.**—You cannot calibrate any ammeter that way with any serviceable degree of accuracy, as different batteries vary in the size of plate producing a certain current, and the same battery will, for a certain number of sq. in. immersed, give different amounts of current at different times, according to the state of the solution and plates. The only way that I know of by which you can get any good results in calibrating by current of primary batteries is to get a large Daniell cell, or, better still, a Latimer Clark's standard cell, which, you know from the size of the C. plate, gives more than some particular quantity, say one ampère, but ½ or ¼amp. will do. If I remember rightly, a well-made Daniell cell takes about 22 sq. in. of Cu immersed to produce one ampère. Then get from some instrument-maker a couple of standard resistances as 1 ohm and 2 ohms; but it does not matter what they are so long as they are known and accurate. For convenience, one should be about double of the other. By means of these you can construct a Wheatstone's bridge, and with this apparatus measure off any resistance you want, and since the Daniell gives practically just 1 volt E.M.F., and you know from the size you have more than, say, 1 amp. current, you can obtain from it any proportions of current you want; by Ohm's law $C = \frac{E}{R}$, and, as you know, E = 1 volt and R = what you have measured it to be by the bridge, you can get C, as, for example, with R of 1 ohm 1 volt will put exactly 1 ampère through. The Wheatstone's bridge is not at all difficult to make, and having once made it, roughly, but accurately, by its means and the Daniell you can calibrate a tangent galvanometer, by which in turn you will always be able to calibrate ammeters so long as you use the tangent galvanometer in the same town or part of the country.—E. CONRY.

[60563.]—**Lathe Speed Pulleys.**—You do not give distance between centres of crankshaft and mandrel, which affects size of grooves; but if you require to use a single gut, 12in., 13in., and 14in. on the wheel will be near about. The tighter you make your gut beyond a certain point, the harder the lathe drives, and with ordinary tension and depth of grooves, no difficulty should be experienced in changing from one speed to another when lathe is moving slowly.—T. C., Bristol.

[60566.]—**Relief in Photo. Negatives.**—There is no method of "drying the plate and preserving the relief." The only thing to do is to take photographs in such a way that there will be the quantity of relief wanted by "Sepia" on them when dried. Use plates with thick films, under-expose, develop with a double quantity of pyro, and you will get relief, or contrast, which is the same thing.—B.Sc., Plymouth.

[60569.]—**G.E.R. Locos.**—No. 538 is an 8-wheeled goods engine of the Mogul type. Principal dimensions are: Diam. of leading, driving, and trailing wheels (coupled), 4ft. 10in.; wheels of pony truck, 2ft. 10in.; cylinders (outside), 19in. by 26in.; total wheel-base, 23ft. 2in. Heating-surface: tubes, 1,291 sq. ft.; firebox, 102 sq. ft.; total, 1,393 sq. ft.; grate area, 17·8 sq. ft.; weight in working order on pony truck, 8tons 10cwt.; leading wheels, 12tons 11cwt.; driving, 13tons; trailing, 12tons 11cwt.; total, 46tons 12cwt. The engines of this class were built by Neilson and Co., and are Nos. 527—531, 1878; and Nos. 532—541, 1879.—EAST ANGLIAN.

[60570.]—**Burning Oil.**—If you try to use your pipes for paraffin oil I am afraid you will regret it, as you are sure to have a mess from the oil working through the joints, however tight they may be, to gas, and a very little of that goes a very long way. If I used any pipe at all I would use compo, with as few joints as possible; and, after all, nothing would beat a small cistern with a tap to fill lamps from as required.—T. C., Bristol.

[60571.]—**L. and N. W. Locos.**—No. 2082 is not a compound, unless City of Liverpool now bears that number. There are 30 Dreadnoughts on the line now.—E. A. SPEED.

[60573.]—**Lighting Schoolroom.**—There are cheaper lamps made on the same principle as the "Bower" and "Wenham,"—the "Furness," for instance, is, I think, less than half the price. It is difficult generally to get a bell-mouth ventilator fixed above each burner and still have the neat appearance that everything in a schoolroom ought to have. Would not a large fret-work covered ventilator in the ceiling do better?—I. LOW.

[60574.]—**Astronomical Photographs.**—I am not aware that the photographs of the Orion Nebula and the Pleiades by Messrs. Common and Henry respectively can be purchased at all. I have only seen them myself at Burlington House, in the R.A.S. library. But probably Mr. Sadler would be able to give "S. R. C." some definite information respecting these marvellous examples of the photographic art. As to photographs of the moon, those by Rutherford (about 11in. diameter) can be obtained from Mr. Brothers, of Manchester. The price *was* 7s. 6d. each; but possibly they may now be sold at a cheaper rate.—W. S. FRANKS.

[60575.]—**Bichromate Battery.**—To MR. BOTTONE.—Yes, retort carbon will do. Saw it in slabs with an old saw, sand and water. See No. 1,117, p. 561, of the "E. M.," for illustration and description of kind of battery required, under the heading "Wonderful Lamp." One cell is enough.—S. BOTTONE.

[60575.]—**Bichromate Battery.**—Any pot or jar, with a zinc and a carbon plate in it (retort carbon will do, with clamp binding screws, screwed hard on to it, or the end copper-plated and the binding screws soldered to the copper, and the latter painted with Brunswick black or paraffin wax) within the jar a solution of 3 parts bichromate, 1 part sulphuric acid, and 6·6 parts water. A very small battery, with only a few square inches of acting carbon, will do for a medical coil.—E. CONRY.

[60575.]—**Cheap Bichromate Battery.**—To make a cheap bichromate battery procure a marmalade jar 5in. deep by 2½in. diameter at the top, also two plates of carbon (without terminals) each 5in. by about 2in., and a zinc plate of the same size. Amalgamate the zinc thoroughly, and solder a binding-screw at the top. Cut two pieces from a cigar box, 3in. long and ½in. broad. Place the two pieces of wood to the right and left of the top of the zinc; place the two carbons to right and left of the pieces of wood, and fix this arrangement by means of a clamp binding-screw, which becomes the carbon terminal. When the cell is in action the plates are in the usual bichromate solution in the jar, supported by the projecting ends of the pieces of wood. When not in use lift the plates out. Retort-carbon would do, if one had the patience to cut it. Should the querist try it, however, and succeed, the binding-screw is attached by being soldered to copper, which is deposited at the part where the connection is made.—BOBADIL.

[60576.]—**Faulty Bell.**—The fault is in the bell itself; it requires to be adjusted. Examine the tip of contact screw, and see that it is clean; also ascertain if the spring is corroded at the point of contact. Both the screw and spring should be tipped with platinum, and if they are not, corrosion is sure to take place. See also that the spring is sufficiently strong to bring the armature away from the magnet after contact is broken.—C. D. R.

[60576.]—**Faulty Bell.**—No. 2 is corroded, probably from the air of the surgery being infused with drugs, as that of a surgery generally is. In No. 3 the cores of the magnets have not been properly softened, and should be taken out and heated, and re-softened in lime thoroughly. Put the armature closer to the ends of the cores by means of back screw, the spring of the bell seems weak, or else the battery is, which you can judge of by the way it rings the other bells. I suppose you have either a three-terminal bell or else some switch in the line O, as in the drawing the battery would be short-circuited through No. 3 if it is an ordinary bell.—E. CONRY.

[60578]—**Lathe.**—The pulley would be keyed to shaft, or made to revolve with it in some way, and would be used for obtaining a low speed of mandrel without back gear. An ordinary tap will cut the thread in wood for chucks.—T. C., Bristol.

[60578.]—**Lathe.**—The loose wheel does not appear to be of any use as it is: tighten it upon the shaft and you can use it for slow speeds; you can cut a thread in a wooden chuck with a tap. It can be obtained at most tool shops where tools for metal are sold. If your mandrel-thread is of Whitworth gauge, all you need do is to measure the diameter with a pair of calipers, and get a tap of the same dimensions.—C. D. R.

[60579.]—**Lathe.**—Scarcely a job for a beginner; but if the bed is very bad—so very bad—you can see what you can do with a file towards making it true.—C. D. R.

[60579.]—**Safe.**—Of course. Get a straight-edge and file and work away. If bed is only "fairly" true make it quite true, or you will soon be disgusted with it.—T. C., Bristol.

[60580.]—**Paquelin's Thermo-Cautere.**—"Vet. Surgeon" is under a mistake in thinking that "the price charged is out of all bounds." I have Collin et Cie's list before me, and the price for the apparatus complete is only 125 francs (£5). I have often thought while using it that it was one of the cheapest instruments used in surgery. The price of the cautère cylindro-conique, which is the platinum part oftenest used, is 35 francs (28s.), and "Vet. Surgeon" couldn't possibly make it for this. The maker's address is 6, Rue de l'Ecole de Médecine, Paris.—B.Sc., Plymouth.

[60584.]—**Blueing Steel without Heat.**—The only way to blue steel without heat is to coat it with a blue-coloured lacquer or varnish. The question has often been asked, and is an essentially stupid one, as it is cheaper to blue steel by means of heat than by lacquer which needs a skilled hand to put it on properly.—NUN. DOR.

[60585.]—**Laying Pipes.**—Only ordinary stiff clay, used as dry as it will work. A little oil is sometimes used with the lead to prevent spattering; some pour the oil in the joint.—T. C., Bristol.

[60585.]—**Laying in Cold-Water Pipes.**—A clay that will make good red bricks is the sort used for lead jointing. It is made smooth, pliable, and tough by constant kneading: no oil is used.—B.Sc., Plymouth.

[60586.]—**Wimshurst Influence Machine.**—To "INDUCTION."—So long as the ebonite keeps its insulating quality it will answer in place of glass. It is not easy to say where you are wrong; but from what you state it is possible you may not have the plates turning in the proper directions. Remember, the front plate should turn in the same way as the hands of a watch. The back plate must turn in the opposite direction. Another cause may be that the supports to your collecting combs are of imperfect material, and the electricity may escape away by them. Test them for insulation. It is better to have all four brushes in metallic contact with one another; but omission in this respect will not prevent the machine from working.—J. W.

[60587.]—**French Button Lens.**—Is a single achromatic lens, consisting of a double convex crown and plano-concave flint. Three of these are generally mounted together in three little brass discs, and screwed together. They cost in Paris about 6s. the set, and the lower powers are really excellent. I have one by me now, which cost me 10s. mounted. It is a good ¼in. o.g., and the photo-micrographs which were published last year in the *Photographic News* were done by it. I would not sell it for ten times its cost, so good is it.—S. BOTTONE.

[60589.]—**Laminated Armature.**—Provided you buy the patent punchings from the patentee or his agents, you may use the laminated armature without risk. I shall be happy to procure some for you, if you will write to me. (See advertisement in Sale Column). They should be mounted on a steel spindle, and extend the whole length of the F.M.'s. The armature can be supplied without the other parts. You are right in supposing that the magneto-machine would require a commutator to rectify the currents. This is also required if it is to be used for incandescent lighting. The armature also would need to be wound with coarser wire than when used for "shocking."—S. BOTTONE.

[60591.]—**Hardening Spring Steel.**—Heat your springs to a bright red, plunge into water. Then rub on some oil, and again carefully heat. The moment the oil flares drop your spring into water again, and it will be correctly tempered. Of course, the great point is to heat your steel uniformly in both heatings; otherwise it will be hard in one place and soft in another.—HENDON.

[60591.]—**Hardening Spring Steel.**—Some rub a little tallow on the spring after hardening, and then draw it backwards and forwards over a clear fire until the grease catches light, and it is allowed to burn a longer or shorter time (and quenched), according to nature of steel, which is found by testing a piece off each bar.—T. C., Bristol.

[60593.]—**Share Certificates.**—They can only be issued to those who have paid the sums due on the shares. People in the conditions stated are liable to proceedings to make them pay up.—SIGMA.

[60593.]—**Share Certificates.**—In neither case given by "Secretary" can a certificate be issued. In the first case (A), an allotment letter should be sent, or rather a letter in that form, with the additional intimation that the application money is still unpaid. In the second case (B), the usual allotment letter is all that can be issued. Forms are to be found in Pulbrook's "Handy Book of Joint-Stock Companies," 2s. 6d.—B.Sc., Plymouth.

[60594.]—**Model Yacht.**—If "Amateur Yachtsman" would care to write to Norie and Wilson, 156, Minories, London, E.C., and inclose 4s. 6d., he could procure a very good book on model yacht building by T. E. Biddle. I have made a successful model myself from his instructions.—H. K. F.

[60595.]—**Geometrical.**—If I understand the query rightly, there are four straight lines given, and the positions of the first two lines are fixed. On each of the given straight lines construct a rectangle having for its second side the line which is to be perpendicular to the first. Then, where the sides of the rectangles opposite the given lines intersect, will be the point required. If the positions of the first two lines are fixed, there can only be one such point, and very often no point at all; but if not, then there are any number of points.—R. E. F.

[60596.]—**Pump.**—I have seen some made of vulcanite throughout, and should think this would answer.—T. C., Bristol.

[60597.]—**One Side of Room Dark.**—If room has a dark-coloured paper, replace this by one having plenty of white ground. Or you might try a large screen covered with white paper placed (at an angle) opposite the window. If this does not reflect sufficient light, cover the screen with tinfoil, and if that will not do, place a mirror in the corner.—HENDON.

[60597.]—**One Side of Room Dark.**—Put up a mirror, or an article of furniture having plenty of mirrors, opposite the window, but slightly angled, so as to reflect over to the middle of the left-hand wall; from there, by mirrors or silvered plate door bookcase, reflect the light to the right-hand dark corner.—B.Sc., Plymouth.

[60597.]—**One Side of Room Dark.**—An ordinary mirror the height of the window, and about 18in. wide or more, will, if placed at the side of the window, deflect the rays of light and spread them like a fan all over the room, except just the part adjacent to the opposite side of the window. If mirror is unavailable, bright sheet-tin will make a good substitute, and even a board covered with white paper would be a help.—E. CONRY.

[60600.]—**Musical Intervals.**—The ratios in the major scale are—

Do	Re	Mi	Fa	Sol	La	Si	Do_2
1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$	2

and a little investigation will show that there are in this scale three kinds of intervals:

(1) $\frac{9}{8}$ between Do-Re; Fa-Sol; La-Si.
(2) $\frac{10}{9}$ between Re-Mi; Sol-La.
(3) $\frac{16}{15}$ between Mi-Fa; Si-Do_2

According to Ganot, the two first intervals are called tones; but Blaserna calls $\frac{9}{8}$ a major tone, and $\frac{10}{9}$ a minor tone, which seems better than using the same word for two distinct ratios. Similarly Ganot terms the interval $\frac{16}{15}$ a semitone, and thus makes no distinction in name between it and the interval $\frac{25}{24}$, which he also calls a semitone. Blaserna uses the terms "major semitone" and "minor semitone." The magnitudes of the intervals are best represented by the logs of the ratios, thus—

Major tone	·0511526
Minor tone	·0457574
Major semitone	.0280287
Minor semitone	·0177288

The term "limma" to denote the ratio $\frac{16}{15}$ seems peculiar to Deschanel. It may occur in Stone; but I cannot refer at present.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60600.]—**Musical Intervals.**—Deschanel has given the only three diatonic ratios there are, and it is equivalent to saying that eight-ninths of the string which sounds Do (all other conditions being equalised) will sound Re, nine-tenths of the string which sounds Re will sound Me, and fifteen-sixteenths of the string which sounds Me will sound Fa, and so on, the first interval being a major tone, the second a minor tone, and the third a limma or diatonic semitone. Why are there two kinds of tones? Because the major third which contains them shall have the simple proportion of four to five with the keynote, and $\frac{8}{9}$ of $\frac{9}{10} = \frac{4}{5}$. In the same manner a minor third of five to six contains a major tone and a diatonic semitone for $\frac{8}{9}$ of $\frac{15}{16} = \frac{5}{6}$. The minor tone is the quantity required to complete a major third, and the diatonic semitone that required to complete a minor third when a major tone has already been taken. Now, two diatonic semitones are somewhat larger than a major tone, and considerably larger than a minor tone; hence the term semitone is a misnomer. Thus fifteen-sixteenths of the string sounding Do will sound Re flat, and fifteen-sixteenths of this will sound Me double flat; so that $\frac{15^2}{16}$—that is, $\frac{15}{16}$ of $\frac{15}{16}$, or $\frac{225}{256}$ of Do sounds Me double flat, which is two diatonic semitones from Do. But the $\frac{8}{9}$ Re takes $\frac{227\frac{5}{9}}{256}$ of Do, and a $\frac{9}{10}$ Re grave would take $\frac{230\frac{2}{5}}{256}$ of Do, and the intervals left by the minor tone and major tone are smaller than that left by the two diatonic semitones. I do not see where your difficulty lies if you can deal with vulgar fractions, unless you are trying to reconcile the true musical intervals with those of the equal temperament keyboard of the piano, organ, harmonium, &c., where two equal temperament semitones make an equal temperament tone, and 12 make a just octave. If so, you must entirely dissociate these totally distinct matters. It has been justly remarked that these tempered intervals are but a rough approximation to the true intervals, none being correct with the exception of the octave, the errors in slow movements being very palpable.—S. E. HUNT.

[60601.]—**Battery.**—Cannot be done economically by battery power; you want a dynamo.—C. D. R.

[60601.]—**Battery.**—Five or six Smee's, gallon size; about a fortnight. But why not use a small plating dynamo?—S. BOTTONE.

[60602.]—**Aquarium.**—Did you take particular care in your experiments to remove everything of a decaying nature as soon as you discovered it? I think many animalcules would naturally die at the expiration of a month or two. I have kept some alive for a long time with plenty of growing weeds in the water, planted in well-washed gravel, and the glass put in a strong light. If the green algæ grew all over the sides of glass, they ought to do well. The best weed is *Anacharis alsinastrum*, the "American water-weed," which thrives apace.—R. A. R. BENNETT.

[60607.]—**Polishing Photo. Frame.**—Polish with rottenstone and oil, and lacquer. Many recipes for brass lacquering are to be found in previous numbers.—B.SC., Plymouth.

[60607.]—**Polishing Photo. Frame.**— You can clear it with sawdust and weak nitric acid; when clean and polished, paint it with brass-o-line—a new fluid manufactured by Mr. Birtwhistle, of Burnley, Lancs. This prevents all brass coated with it from getting tarnished again. It does not show in the slightest degree.—R. A. R. BENNETT.

[60610.]—**Fluorine.**—TO "L."—Where did you see the statement that this element had been isolated?—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[60610.]—**Fluorine.**—The following is a reply to this query; but as to a description of the element, all that can be said is that it is a gas. What sort of description does "L." require? The element known as fluorine is chiefly remarkable from the fact that it is the only known element which forms no compounds with oxygen. It has an intense affinity for hydrogen, and is extremely difficult to obtain in a separate condition. M. Moissau having prepared anhydrous hydrofluoric acid (HF) by a method due to M. Fremy, submitted it to electrolysis in a platinum U-tube under the action of 50 Bunsen elements. Hydrogen was given off at the negative pole, and at the positive pole a gas was obtained which had the following characteristics: In the presence of mercury it was rapidly absorbed with the formation of proto-fluoride of mercury of a clear yellow colour. In contact with water the latter was decomposed with the formation of ozone. Phosphorus was inflamed with the formation of two fluorides of phosphorus, sulphur was melted with rapidity, carbon seemed to be unaffected, melted potassic chloride cools with disengagement of chlorine; and lastly, crystallised silicon takes fire and burns with great brilliancy upon contact with the gas, forming silicic fluoride. The platinum-iridium electrode forming the positive pole was much corroded, the negative electrode was not attacked. M. Moissau prefers for the present to reserve his opinion as to the exact nature of the gas he has obtained, pointing out that although the most obvious supposition would be that it consists of pure fluorine, yet at present the evidence is not conclusive. It may, for instance, turn out to be a perfluoride of hydrogen, or some mixture of ozone and hydrofluoric acid. It will be noted that the gas differs from that previously taken for fluorine in its action upon silicon.—F. I. C.

[60614.]—**Electro-motor.**—TO MR. BOTTONE.—Yes, you could use your dynamo as a motor, but you would probably find it "reversed" if wanted afterwards to use it as a dynamo. Six quart bichromates would work it to the full.—S. BOTTONE.

[60616.]—**Marriage.**— An American divorce would not affect an English marriage unless both parties became American citizens. Such a divorce and consequent marriage would render the wife liable to a prosecution for bigamy if she came to England, and would be good ground for the husband obtaining an English divorce; but it would in no way unmarry him here.—SIGMA.

[60616.]—**Legal Marriage.**—A divorce obtained in the circumstances detailed by "Subscriber" can never be recognised in this country, and I question very much if it would be legal in America where granted, seeing that the husband is English, the marriage English, and the husband remains in England. If this husband marries again while his wife is still alive (unless he first obtains a divorce in England), he may at any time be prosecuted for bigamy.—B.SC., Plymouth.

[60617.]—**Electric Light.**—I do not recollect the battery you refer to, my last volume of the "E. M." being at the binder's. When it is returned I will look my reply up; but I do not think you will get a battery to last four months with one charge, and work it for six hours every evening; at least, I am sure I never described such a cell—I only wish I could. We should hear very little about Upward's, Schanschieff's, and the Regent battery then.—W. HOLDER (EVELINE), Newport, Mon.

[60618.]—**Tainted Lard.**—Wash it well in hot water several times, and sell it for lubricating purposes.—NUN. DOR.

[60620.]—**Bells.**—Best wire would be No. 26. Sketches of continuous ringing bells have frequently appeared in these columns. You will find one on p. 523, Vol. XLII. (No. 1,091 for Feb. 19th, 1886) which ought to suit your wants.—W. HOLDER, Newport, Mon.

[60621.]—**Leclanche Batteries.**—Agglomerate blocks are manufactured under a patent. You must therefore purchase what you require; not only so, but you would require hydraulic pressure. The arrangement of a terminal connected to the agglomerate has been tried, and condemned.—C. D. R.

[60623.]—**Dynamo.**—TO I. LOW.—I am very busy just now; perhaps someone else will reply to your questions. If not, I will endeavour to do so in a week or two.—I. LOW.

[60624.]—**Cement or Varnish.**—Why not use tinman's solder?—NUN. DOR.

[60624.]—**Cement.**—The following will probably suit:—Dissolve best glue in boiling water to the consistence of a thin syrup; then stir in wood ashes to thicken it; then add a little bichromate of potash, in the proportion of 1oz. to the half-pint.—W. HOLDER, Newport, Mon.

[60624.]—**Cement or Varnish.**—"Metal" asks for a cement that will stand a heat of 80° C. Try the following:—Five parts of clay are to be thoroughly dried and reduced to fine powder; to this add two parts of fine iron-filings free from oxide, one part of peroxide of manganese, half-part of sea-salt, and half-part of borax. These are to be mixed together thoroughly, and made as fine as possible, then sufficient water added to make them into a thick paste. It must be used immediately after making. After application, expose to heat, which is to be gradually increased. The cement will become very hard, and resist heat up to the temperature of boiling-water.—BOBADIL.

[60626.] — **Forming Accumulators.** — TO "SIGMA."—The only way to ascertain the periods inquired about is to watch the lengthening intervals during which charge can be taken in, and to note the results of either reversing or simply charging and discharging. It is a matter varying with the thickness of plates and other conditions, and to be settled principally by judgment and experience.—SIGMA.

[60627.]—**Turning Cotton and Paper.**—I presume these are the compressed rolls used for calendering. If so, an ordinary tool, as used for steel, and rolls driven slowly, say 8ft. per minute. The job takes longer than turning a metal roll same size.—T. C., Bristol.

[60628.] — **Battery Resistance.**—TO MR. BOTTONE.—Because the section of the fluid increases in like proportion, and since the conductivity of a body is directly proportional to the section, it follows that by increasing the section, you increase the conductivity, or lessen the resistance.—S. BOTTONE.

[60634.]—**Safety Lamps in Mines.**—Having taken considerable interest in the question of safe and unsafe lamps for miners' use, I have made some hundred of tests with all the leading lamps in use (over 30 in number) including the Davey, Clanny, Protector, Marsant, Muesler, Bonneted Clanny, Evan Thomas, Gray's, Morgan's (three patents), and other well-known lamps, and I do not hesitate to say, that there is only one really practical safety lamp in existence, that of Mr. Morgan's last invention, which, it is to be regretted, was not patented in time to place before the Royal Commissioners so that the merits and value of this new lamp were duly recorded, as well as the merits of his patent No. 2, upon which the Royal Commissioners in their report say: "We believe this to be one of the safest lamps submitted to our inspection." Mr. Morgan's 1st patent was selected as one of the best for the Lever prize. His 2nd patent won the Gold Medal at the Inventions Exhibition, and is the one now under discussion in many scientific papers. His third patent will win the favour and blessing of every miner who uses it, when its value is known to him. The Morgan testing apparatus is far more severe than that used by the Government, before which there is no lamp but what I can explode in less than ten seconds, except the Morgan lamp, whereas his third patent is better still, and, although I have placed it in almost every conceivable position, I have never yet succeeded in exploding it, although tested to a pressure of over $1\frac{1}{2}$lb. to the square inch with explosive mixture. I have not yet tested the McKinless lamp, so cannot say if it is safe or not; but if Mr. Palmer will send me one, or write me where it can be purchased, I will thoroughly test it and report through the columns of the "E. M." if it can be exploded or not. I should not care to trust my life under ground with some of the so-called safety lamps, which are nothing better than death traps. But with a Morgan lamp I should not hesitate entering the most explosive pit in the kingdom. I trust others who have any knowledge of the Morgan lamp will clearly express their opinions for or against this invention, as the subject is an important one to the community at large.—ARTHUR SHIPPEY.

[60634.]—**Safety Lamps in Mines.**—I was present at the meeting at Leigh, mentioned by Mr. Henry Palmer, and was deeply interested in the experiments there made. The apparatus used by Mr. Morgan, with which he exploded so many of the "safety" lamps in common use, including those most approved by the Royal Commissioners out of the lamps submitted to them, is of a very simple character. It consists merely of a small arrangement of foot bellows, the nozzle of which is inserted in a tube, the further end of the tube being connected with a double jet, so constructed that the air surrounds the inner one entirely, and through which latter ordinary lighting gas is admitted. When pressure is applied to the bellows, air and gas unite at one point in a proportion calculated as nearly as possible at one portion of gas to eight or nine of atmospheric air. Mr. W. Pickard, J.P., miners' delegate for the district, who saw the experiments of the Royal Commissioners, declared at the meeting that Mr. Morgan's experiments were more satisfactory. Certainly, Mr. Morgan's tests were not absolute. He only intended them to be comparative. At velocities much below those liable to be encountered in mines he exploded the Marsant, the Gray, the Mueseler, and Evan Thomas lamps, his own lamp standing the test, and remaining unaffected. The "Morgan" lamp must, in my opinion, supersede all others at present in use, as it yields a better light, and cannot be made to pass the flame. If Mr. Henry Palmer has used the McKinless lamp, he will surely have found that it is not a practicable lamp

in the pit. The Royal Commissioners said of it—"The supply of air to this lamp is very defective; and it is difficult to handle. Mr. Palmer speaks of Mr. Morgan's demonstrations as "a rude awakening." Well, the Commissioners' report was a rude awakening, and thousands of Davy and Clanny lamps have since been discarded. John Woolley's evidence at Leigh also was an awakening. Mr. Palmer thinks Mr. Morgan's success in exploding the four lamps mentioned above in from one to ten seconds a rough comment upon the labours of the Commissioners; but he should have remembered that the Royal Commissioners simply selected the lamps which they considered, on the whole, the best of those submitted to them. As Mr. Morgan stated at the meeting, his lamp was submitted too late, and they could not experiment with it. It, however, won the highest award—the Gold Medal—at the International Inventions Exhibition.—Nemo.

[60636.]—**Painting Magic-Lantern Slides.**—If the dyes are required for colouring photographs, the brighter colours will be required—Oxford blue, Cambridge blue, orange, canary, green, crimson, and scarlet. There is a colour called "cerese." (Why cannot Judson call it "cherry," which is quite as pretty?) This is good for flesh tints when mixed with orange and very much diluted; but as a rule the colours should not be mixed before using them, the most unexpected results being found—for instance, green and one of the reds make blue. All the reds are very powerful, and require much water, and a little spirits of wine to make them flow better. Blues are apt to be weak. If not required for photos, you will require a neutral tint for the shades, or "slate" in the Judsonian vernacular. To begin with, try coating a pane of glass with gelatine, and colour some figure of the church-window order.—M.I.C.E., Bath.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

USEFUL AND SCIENTIFIC NOTES.

The Court of the Shipwrights' Company has just arranged for the delivery of six free lectures to workmen and others connected with the craft of shipbuilding, at the Mansion House, during the Mayoralty of Sir R. Hanson, the incoming Lord Mayor, who is a member of the Company. The following is the list of dates and lecturers:—November 25, Sir E. J. Reed, K.C.B., M.P.; December 9, Sir N. Barnaby, late Chief Instructor to the Navy; December 16, Mr. W. B. Martell, of Lloyd's; January 13 (1887), the Master of the Company, Mr. A. D. Lewis; January 27, Mr. W. H. White, Assistant Controller to the Navy; and February 10, Mr. Elgar, Professor of Marine Architecture at Glasgow.

Cremation.—The cost of cremation at Gotha, according to a report recently read before the Berlin Cremation Society, amounts to £21 10s., exclusive of church fees, singing, bell-ringing, mourning coaches, and urn. An urn may be deposited, free of expense, in the columbarium for 20 years, at the expiration of which term the safe keeping is to be paid for, or the urn will be properly interred, unless otherwise disposed of by the relatives. If the incinerated remains are to be interred in a Gotha cemetery immediately after being cremated, such interment must be paid for like any other; they may, however, be taken away in a tin case by the family if so desired. The quantity of coal required for an incineration, as included in the fore-mentioned specification, is two and a half tons at £1 each. If several incinerations take place on the same day, only one and a quarter tons are charged after the first.

Dr. Lucien C. Rose, of Ohio, has sailed for Gothenburg, Sweden, where arrangements have been made for a public test of his telephone, and his trip abroad is to enable him to be present at the test. Dr. Rose claims to be able to speak and hear with ease and satisfaction with his instrument over a distance of 2,500 miles.

QUERIES.

[60639.]—**Balloons.**—I beg to ask for information as to easiest method of filling (1) paper balloons with coal gas, (2) indiarubber balloons with coal gas. My difficulty with the rubber balloon is that the gas pressure from the jet is not equal to overcoming the elastic compressive force of the balloon.—R. W. C.

[60640.]—**Heating Apparatus.**—I should be glad if any of your correspondents could inform me how, in warming factories by steam pipes, they get over the difficulties of making the pipes rise and fall to pass doors, &c., without the condensed water lodging in the lowest parts. The pipes I presume should be at the bottom of rooms in order to be efficient; but this seems to increase the difficulty with regard to the doors?—A. M. E.

[60641.]—**Horse-Power.**—Will anyone oblige me, if possible, with a rule so that I can determine, by the aid of arithmetic only, the H.P. of engine, the dimensions of which are: pair of direct-acting marine condensing engines, bore, 2ft. $1\frac{1}{2}$in.; stroke, 3ft. 6in., working at 40lb. steam, condensers showing 25in.?—Sam Koe.

[60642.]—**Dynamo Building.**—To S. Bottone, and Others.—I have made a dynamo from instructions and particulars given by "Xero," and have been very particular with every part; no contact anywhere. I have run it all speeds, and tried all ways of connecting up; but have not succeeded in getting a single spark. It will not light either one, a dozen, or twenty lamps. I wound armature with 20lb. No. 12 B.W.G., and field magnets with a total of 60lb. No. 18 B.W.G., double c.c., insulated each layer. Will some brother electrician help me out of my difficulty?—Kent.

[60643.]—**Electrical.** — Would any reader kindly inform me as to the comparative resistance between the armature and field magnets of shunt and compound and series-wound dynamos, or a simple rule to work out the same?—One Anxious to Learn.

[60644.]—**Heating Surface.**—Will any of our kind friends show me how to calculate the number of square inches in a firebox 10in. high by 8in. diam. round firebox?—C. W.

[60645.]—**Faulty Watch.**—I have Geneva watch. It is thoroughly clean, and in beat it goes well in all positions, but will occasionally stop in taking it sharply from the pocket. The only fault I can see is the escapement being too deep. When it is stopped the balance requires moving a considerable distance on either side before there is any drop of escape-wheel teeth on or in cylinder. I shall feel greatly obliged if any reader will kindly inform me how to correct this failing.—F. W.

[60646.]—**Cracked Gongs.**—I have a gong having a crack in it; also two hand bells similarly affected. Can the tone be restored to them, or are they useless? If it is possible to make them ring again, I should feel obliged by someone telling me how.—W. W.

[60647.]—**Music Stand.**—I am about to make a music stand with four shelves resting on turned pillars. If I put the pillars immediately above one another, of course each would only have a hold of half the thickness of the shelves, and I am afraid this would not be strong enough. I shall be obliged if anyone will let me know what is generally done in such cases. If I did not place the pillars immediately above each other, should I put every alternate set inwards at the front and back, or at the sides?—Spes.

[60648.]—**Transparency.**—Could S. Bottone, or any other of the many scientific readers of the "E. M.," kindly tell me a method of making good transparencies from the ordinary gelatino-bromide dry plates? Have a quantity of quarter-plates, which are cut too large to fit my dark slides, so wish to make use of them as above. Have tried contact printing with ordinary pyro-alkaline and ferrous-oxalate treatment, but always get creamy results.—W. W. Railey.

[60649.] — **Low-Resistance Lamp.** — To Mr. Bottone.—I have a small series-wound dynamo, which lights four 5c.p. 8-volt lamps well in parallel. Is it possible to obtain a lamp of 20c.p. which will give a light equal to the four with the above dynamo?—Spencer.

[60650.]—**Geometry.**—If two exterior angles of a triangle be bisected, and from the point of intersection of the bisecting lines a straight line be drawn to the opposite angle, it will bisect that angle. How is this?—X. Y. Z.

[60651.]—**Electrical Signals in a Mine.**—Would any reader of "Ours" give me instructions how to fit up some good electric signals in a mine and to top of shaft, shaft about 200 fathoms; length underground, about one mile, with levels about every 500 yards? What would be the best wire for shaft, as we have had two different sorts of insulated wire, and they have not lasted more than a few months, and frequently repaired in that period, for the copper wire eats away in the guttapercha, sometimes going all to a green powder for a couple of inches, though cannot find the flaw until it is stripped. Suppose we want to communicate with every level, shall we want a separate wire? Are "trembling bells" or distinct bell the best for this purpose, and the difference in the price? Can get what materials I require. Also, will a "push button" for an electric wire have any influence on a barometer and thermometer if placed in the casing merely for safety?—A. O. H.

[60652.]—**Small Dynamo.**—Will Mr. Bottone or Mr. Eaves kindly assist me a little? Having made a small dynamo with success, I wish to make a larger one, about 60-candle-power. I am making it of all rough iron; fields, 5in. high, $1\frac{1}{2}$in. thick; two plates bolted to fields for poles, $2\frac{1}{2}$in. by $\frac{1}{2}$in. Could you tell me the distance to put fields apart, and what size laminated armature, and what thickness for poles? Must the poles be welded or bolted to the plates that span from field to field? Please say how many segments in armature, and size and weight of wire. I have 8lb. of 14 d.c.c. Could I use that for fields, the machine to have two upright fields? If my sizes will not be right, will you kindly give me same, and wire for same?—A Four Years' Subscriber.

[60653.]—**Rust Joints for Socket Pipes.**—Can any reader give me instructions as to making the above to stand 100lb. pressure?—W. P.

[60654.]—**Mid., S.E., and G.N. Locomotives.**—(1) Mid. Ry.—To what classes do the following engines belong: 1292, 109, 1299, 1286, 1301, 1550 (tank), 1490, 1377 (goods tank), 169 (renewed)? (2) What engines belong to the class described in *Engineering* for Oct. 20, 1876, Vol. XXII. p. 343 (heavy passenger tank)? (3) S.E. Ry.—Could anyone give dimensions of 159, 183, and 259 classes? (4) G.N. Ry.—What are the dimensions of 208, 229, 235 classes? Also, what are the engines in each class?—V. J. B.

[60655.]—**Strength of Type Metal.**—Will anyone acquainted with this subject let me know its strength by comparison with another metal?—Pica.

[60656.]—**German Ph.D.**—Will anyone please inform me what course of study it is necessary to attend at the Universities in Germany in order to qualify for obtaining the Degree of Doctor of Philosophy (Ph.D.)?—Chemical Student.

[60657.]—**Battery for Lathe Motor.**—I should like to know what would be the best battery and motor to use to work a small lathe or grindstone, and, also, if I could fit up the motor myself? I know very little about motors, and a very little about the batteries used for driving the same. Would a Leclanché or bichromate do?—J. Cameron.

[60658.]—**Indiarubber Solution.**—Will any reader kindly give me any useful hints about using indiarubber solution? I have been repairing some wading stockings for fishing, but it does not seem to last long. Ought it to be applied warm, or cold, ironed afterwards, or merely spread like butter on the material? Mine seems to be getting stiffer (in the tin) than it was at first. Does it want to be made more fluid by addition of naphtha, or would it become so by being warmed at the fire or in a jar of hot water? Any "tips" will greatly oblige—C. H. C.

[60659.]—**Getting-up Fire Brasses, &c.**—Would some practical hand kindly assist me with above? I find after dipping the work discolours before I can get it burnished and lacquered. I should also be glad to know the description of brushes used in lathe for getting up smooth surfaces, large round knobs, and scroll work; also cost of same and where procured. Also, in burnishing with oval burnisher in vice, what lubricant to prevent scratching?—Brum.

[60660.]—**Electric Light.**—To Mr. Bottone and Others.—I have a large machine stitching room that I required. Would one $2\frac{1}{2}$c.p. lamp give sufficient light for wish to light up with electric light in preference to gas. 40 lights would be each machinist if placed near the needle? Would a dynamo that will light eight 20c.p. lamps light 40 $2\frac{1}{2}$c.p. equally as well? What power would be required to drive the dynamo? I have at present an 8H.P. using about 4H.P. What would the lamps cost per doz., and what will be the cost of the dynamo? What sort of dynamo would suit us best?—W. H.

[60661.]—**Electro Motors.**—I am desirous of making an electro-motor for small launch of 2 or 3H.P. Will any of your numerous correspondents kindly give instructions how to make the same, the quantity of wire it would require, and whether two or four coils would be best to drive the same? What size wire would you advise us to use? Would cotton-covered do? I am intending to drive the motor with batteries.—Amateur.

[60662.]—**Solution of High Specific Gravity.**—Some time ago I saw in the "E. M." the account of a reader having recovered a diamond which he had lost amongst some glass, &c., and recovered it by means of a solution of high sp. gr. Will any reader kindly acquaint me with the ingredient or ingredients composing this solution, and the sp. gr. of it?—Alkali.

[60663.]—**G.E.R. Locos.** — I want the following information concerning these locos. to complete my engine list. If anyone can give it I shall be much obliged. Class, maker, date, and cylinders of 23 to 26, 125 to 162, 200 to 208, 421 to 424. Maker, date, and cylinders of 1 to 6, 7 to 22, 81 to 86, 30 to 36, 44 to 51, 105 to 116, 308 to 417, 418 to 561, 572 to 591. Date and cylinders of 40 to 43, 60 to 62, 73 to 76, 87 to 90, 137 to 139, 140 to 145, 210 to 227, 562 to 571, 610 to 639, 640 to 649, 690 to 699. Cylinders of 37 to 40, 52 to 59, 64 to 72, 77 to 80, 91 to 102, 117 to 140, 163 to 169, 170 to 199, 209 and 210, 223 to 244, 592 to 599, 686 to 689, 696. The designer of above will oblige. In reply to F. Thomas, 538 is a 4ft. 10in. 8-wheeled 6-coupled outside cylinder goods engine of the Mogul class, with outside cylinders 19in. by 26in., and pony truck at leading end. Weight, 46 tons. Designed by Adams.—G. Head.

[60664.] — **Pendulum.** — Will some correspondent favour us with a description of the best zinc and steel pendulum, say 80 beats to minute?—Daddy.

[60665.]—**Scent.**—Can a good scent be made from the lemon plant (scented verbena)? If so, how?—Daddy.

[60666.]—**Card and Wood Cutting.**—I want a method of cutting out zigzag puzzle patterns out of cardboard and wood. The fret-saw is too slow, and some of the angles are very acute. The design is on paper, and is then pasted on the cardboard or wood. Some of the designs are intricate. Is it possible to do the work by special knives, and, if so, where could I get them? A large quantity of each sort is required.—M. A.

[60667.] — **Magneto-Electric Call Bell.** — Will some kind reader, through the medium of these columns, favour me with an explanation of the mechanism of one of these bells?—Chemist.

[60668.]—**Etching Brass with an Acid.**—Would it be suitable for ornamental purposes and filled in with a dark substance? Kindly say how best to go about it, and what to use.—Rob.

[60669.]—**Gut Driving Bands.**—Which is the best way of securely affixing hooks and eyes? Should gut be prepared previously by any treatment? How can gut be kept from unravelling?—B. C.

[60670.]—**Electric Tram.**—Would Mr Bottone kindly tell me what size cores I should want for an electric tram 6 by $3\frac{1}{2}$? Also, how much wire and what size should I require? Could he please say what should be the size of armature, and of what form should it be?—A Beginner.

[60671.] — **Boiler Incrustation.** — I saw a Mr. Smither some years ago, and another correspondent of the "E. M." lately, recommending soda as a cleanser of steam

boilers. I have tried soda in the boiler I work several times, and she always leaks about the tubes. Once I applied 3lb. of soda to an 8H.P. traction boiler, newly done up, and she would not keep it in. She got dry when soda wore off. Would anyone explain the reason why?—J. G. L.

[60672.]—**Battery.**—Could someone tell me what is the most suitable and cheapest battery for lighting three 5c.p. lamps for about four hours every night? I have tried the Bunsens and bichromate, but they are too expensive and troublesome.—F. C. S.

[60673.]—**Mechanics.**—A room is 12ft. square, and the floor is loaded with 1cwt. per sq. ft. equally distributed over it. The joists, which are made of Memel fir, are 12in. from centre to centre and 10in. deep. What should be their breadth, taking the working load at $\frac{1}{8}$ of the breaking load? Note.—A bar of Memel fir, 4ft. 2in. long, 2in. square, when supported at both ends and loaded in the centre, breaks with a weight of 1,000lb.—DARENTH.

[60674.]—**Strawberries.**—I feel most grateful to those who have troubled to give me information as to strawberry growing. I have endeavoured, in my autumn treatment, to carry out the suggestions I have received, except as to removing the plants to new ground, which is impossible, as I have none for the purpose. Will Mr. S. Ray add to the obligation to him which I am under, by telling me the cheapest way of procuring the chemicals he names? I don't know where dissolved bones are to be had; but have bought bone dust from a seedsman. What quantity of green vitriol to the square yard ought to be used? I have no means of procuring what is ordinarily called liquid manure, but always use the contents of the slop pail to water the plants in the spring. The soil in my garden is very far from light, and it is very sunny, having a south aspect. I have another garden for flowers, and grow carnations. This year not more than one in five of my plants has flowered, and those but poorly. My geraniums also have been a failure, the plants growing large and very strong looking, but with few flowers. Will anyone tell me the probable reason for this?—LADY GARDENER.

[60675.]—**Fire.**—Will anyone suggest the best way of keeping in a fire throughout the night?—E. G.

[60676.]—**Mother o' Pearl.**—Can any reader give few particulars and information sufficient to enable undersigned to cut, polish, &c., mother o' pearl? Any book on the subject?—J. T. B., Calcutta.

[60677.]—**Vergara's Slides and Woodbury Tissue.**—Will some member who has used these kindly explain former and give opinion regarding both cardboard and wooden slides?—PHOTO.

[60678.]—**Varnish to Harden Paper.**—What varnish, or other preparation, can I use to make cardboard hard and strong, to use, say, for shutters of a dark slide? Has no manufacturer yet produced dark slides in papier mâché? This seems to me to be an excellent material for the purpose, and should produce light, strong, and cheap slides.—PHOTO.

[60679.]—**Ink for Window Tickets.**—How can I make a good glossy and opaque ink, various colours, bright, for writing window tickets? I have consulted last two indexes in vain.—SHOW CARD.

[60680.]—**Field Magnets.**—Will "Sigma," Mr. Eaves, Mr. Bottone, or anyone else, give me their opinions on the following? Why is it that dynamos are never made with the armature revolving in the magnetic field of greatest density? All machines, except Siemens and Gramme, have the armature near the feet of what is practically a horseshoe magnet. Sure the field is more intense when the F.M.'s and armature are in line—i.e., at the extreme end of the poles. Again, in the Elwell-Parker at the Exhibition, each of the two pole pieces on either side are wound in pairs, one loop embracing both poles. Would not the field be intensified if each pole was inclosed in its own coil? Lastly, having read everything in "E. M." for many years past on the subject of winding drum armatures, I am not at all sure that I could make one with many segments in the commutators, the diagrams in illustration of this operation being not easily understood. Of course, it is simple enough in Mr. Bottone's book, where there are only two segments in the commutator.—AMPERE-METER.

[60681.]—**Water Clock.**—In the water-clock described some time ago in the "E. M.," why have a conical drum for the wheel, and about how long will the clock go, as described?—A YOUNG MECHANIC.

[60682.]—**Leclanche Batteries.**—I have been charging some of these batteries (one with agglomerate plates and the zinc held in rubber bands a short distance from the plates, the others with porous cells containing the carbon plates and crushed carbon and peroxide of manganese and loose zinc rod), and from some cause, of which I am not aware, the zinc rods are eaten away rapidly when the battery is lowered into the fluid. I should feel very much obliged if any fellow reader could explain where the error is. I could have understood it if the cells had been connected up in a bad circuit; but the above takes place when the batteries are not in use. Is it possible to put too much salammoniac and cause the trouble? I may mention one cell is quite new, but the zinc deposits a thick, black sediment just the same as the others.—H. E.

[60683.]—**Electric Bell Indicator.**—I have an electric bell with ten pushes in various rooms, and a ten-hole indicator. It was put up by a firm not now in existence. The wires are inclosed in zinc pipes under the plaster of the walls. The bell rings well enough when any of the pushes are used; but the indicator does not act at all. How does the current get through the indicator without moving any of the discs? I have tried by moving them forward with my finger, and find that the replacing push at the bottom also refuses to act. Can any correspondent assist me by explaining the construction of the indicator, or tell me of some book on the subject?—A NEW SUBSCRIBER.

[60684.]—**Shaft.**—Will Mr. A. Gray (who answered query No. 57301, August 28th, 1885) kindly show me the method of working out the diam. of the pinion shaft from the data given?—A MILLWRIGHT APPRENTICE.

[60685.]—**Electrical.**—In what respect do the carbons of the Pollak battery differ from the ordinary carbon? Will the ordinary do as well? If not, how is the other made?—PEREGRINUS.

[60686.]—**Staining Iron Black.**—Can any reader tell us how to stain iron a good black—that will stand knocking about? The Japan blacks we use all chip off.—FIRE IRONS.

[60687.]—**Screw Cutting.**—Will one of your readers inform me how to find the wheels to cut 18 threads in $22\frac{1}{4}$in., and what wheels to use?—F. FOOT.

[60688.]—**Nickel Silver.**—Will some person please inform me if nickel silver is to be had in the form of sheets and wire, soft enough to work in every way like brass, and to be used as a substitute for it: or if there is any other metal capable of a high polish that would come cheaper than nickel?—DAVID.

[60689.]—**Silvering Glass.**—Can any one of your correspondents give the process by which mirrors are silvered—the one termed patent process?—G. H. H.

[60690.]—**Wood Carving.**—Will some practical hand kindly give the names of the tools necessary for carving common ornaments, and a few hints as to their use?—G. H. H.

[60691.]—**Wood Naphtha.**—How can I free this from water, so that it will mix with turpentine?—PETRO.

[60692.]—**Relative Positions of Flat and Eyepiece.**—Though my query is put in connection with Newtonians, it applies (mutatis mutandis) equally to Gregorians and Cassegrains. Suppose we have a mirror 10ft. focus in a 12in. diam. tube, on what principle should we fix position of flat with reference to position of eyepiece? If we put the flat 6in. within the focus of the mirror, the apex of the cone of rays would just reach the outside of the tube. If we put it 12in. within the focus, the apex of the cone will fall 6in. outside the tube; if 18in. within the focus, the apex will fall 12in. outside, and so on. For a further detail, let the field lens of the eyepiece be assumed to coincide with the outside of tube, and let it be of 3in. focus and with an eye lens of 1in. focus. Then apparently the cone of rays should be so placed that after refraction by the field lens they should form the image in the focus of the eye lens; but, if so, there must be some method of approximately fixing where the flat must be placed in order to secure this result. Now the smaller the flat the less the loss of light by obstruction, while on the other hand it must be necessary to throw the apex of the cone to a sufficient distance outside the tube in order to suit the eyepiece. What method, then, have opticians been in the habit of using to fix this said "sufficient" distance? I give a specific example because I should like whoever deals with my letter to work the whole thing out in figures, so as to render it clear. I used somehow to picture to myself this part of the world as having no winter worth mentioning, whereas now (corresponding to the end of your February) we are getting torrents of rain, hail, cold winds, and even snow—in fact, as wretched weather as even an English November can show. As far as climate is concerned, I think this of N.S.W. is simply detestable: a stew-pan in summer, an ice-house in winter, and a rapid alternation of both at other times. I hope shortly to send what may prove a useful account of the mechanical trades and kindred matters; but one caution I would at once give our English mechanics—viz., "Don't come here at present."—A. S. L.

[60693.]—**Trigonometry.**—If $\tan 2\phi = 0{\cdot}1723$, what is the value of $\tan \phi$, and how is it obtained? Can the expression $\dfrac{2 \tan A}{1 + \tan^2 A}$ be adapted to logarithmic computation?—X. Q. Z.

[60694.]—**Phosphorescence.**—There was in our orchard a rotten stump of some fruit-tree, which has now been chopped up for burning, and strange to say, it shows a strong phosphorescence in the dark, looking as if it had been rubbed well over with phosphorus, or painted with luminous paint, the light emitted therefrom being visible even in the moonlight. Would someone versed in these matters kindly state whether it is probably caused by the presence of innumerable phosphorescent animalcules, or what other cause? I should be happy to send a few chippings for inspection or microscopic examination to anyone who will forward me a stamped and addressed envelope.—A. JACOBY, Onibury, Craven Arms, Salop.

[60695.]—**Model Marine Boiler.**—Would anyone kindly assist me by explaining the way to fix in the tubes, and what size they must be, the copper No. 20 B.W.G., also give sketches of one?—MARINE.

[60696.]—**Dynamo.**—I am about to construct a small dynamo after the style of one advertised by Blakey Emmott and Co., Aug. 20th, with Gramme armature and two upright field magnets. I should like it to give a current of twenty-five volts, and twelve ampères. What I require is, what length and thickness to make field-magnet cores, what diam. of armature, and what number and quantity of wire to put on both.—BURNLEY.

[60697.]—**Electric Lighting.**—I am running six Crompton arc lamps in parallel off a compound-wound Elwell-Parker dynamo, and find that in the case of two or three lamps the current occasionally reverses, or at least burns away the lower carbons the faster. Would some electrical friend kindly explain the difficulty, and suggest a remedy?—AMATEUR.

[60698.]—**Lathe Speed Pulley.**—I have a 5in. centre back-geared headstock for treadle lathe; speeds of cone are $2\frac{3}{4}$in., $4\frac{1}{4}$in., and $5\frac{3}{4}$in. respectively. Would some kind reader inform me the diameters of speed pulleys? The belt, without alteration, should fit two of the speeds with movable piece taken out to fit small speed.—J. HUMPHRIES.

[60699.]—**Photo. Enlarging.**—How can I enlarge one figure in a group to C.D.V. size?—AMATEUR PHOTOGRAPHER.

[60700.]—**To Draughtsmen, &c.**—Is there any royal road to the division of circles or straight lines into any number of equal parts—any instrument by means of which, in the workshop or drawing office, it can be done in less time than by calculation, geometrical construction, or trial? In the best equipped shops or offices, what methods would be adopted to divide a circle of 17in. dia. into 19 equal parts, and a straight line 12in. long into 11 parts?—WORKMAN.

[60701.]—**Japanning.**—I make small brass stampings which I wish to get up to a good finish, coloured black equal to buttons. Are buttons japanned? If so, how should I proceed to japan my stampings quickly and in large quantities? Is a turning barrel the best method for taking away sharp edges, and can machinery be used for the japanning?—BUTE.

[60702.]—**Liquid Gold.**—Can any friend furnish me, through your columns, with the recipe for making liquid gold, as used in the gilding of earthenware? It burns bright in the kilns, and so saves the expense of burnishing. There is a process of bright gold gilding with a mixture of sulphide of gold and various essences. Can any one give me the proportions? I think it is called Duterte's process.—J. M. T.

[60703.]—**Galvanism.**—TO MR. BOTTONE.—I am suffering much pain from what I think is muscular rheumatism, finding no relief from hot baths, embrocations, or medicine. I should like to try the electric current. I know all about the various instruments, but nothing about the application. Will you kindly tell me if the continuous current or the Faradic is best—if the direction of the current is important. It is principally under the ribs, left side, and back to shoulders that I am now suffering.—R. J. T.

Sugar as an Anti-Incrustator in Steam Boilers.—The last number of the *Rivista di Artigliera e Genio* contains a brief, but important, article by Colonel Agostino Polto, of the Italian Engineers, giving the result of certain experiments carried out by him with common sugar as a remedy for preventing incrustation in boilers. The boiler made use of by Colonel Polto was a 20 horse-power Field tubular boiler, containing 126 tubes. This boiler was ordinarily scraped and cleaned out every forty-five days (i.e., after 380 working hours), when the average weight of scale removed, after making use of the best methods known for preventing incrustation, amounted to 12 kilogrammes. Before beginning the experiments with sugar, one-third of the tubes were purposely left uncleaned; the boiler was then filled with water and two kilogrammes of sugar added to it; a further supply of one or two kilogrammes, alternately, being added every seven days. After working the boiler for the usual forty-five days, it was found that it could be cleaned easily without the necessity for scraping it, and that the tubes which had been left uncleaned were considerably more free from scale than before, whilst the other tubes remained clean and bright; about eight kilogrammes of old incrustations were found lying at the bottom of the boiler, having become detached by the beneficial action of the saccharine solution. A similar result was obtained after repeating the experiment for a further period of forty-five days; the tubes originally left uncleaned being in still better condition, and only three kilogrammes of old incrustation being found at the bottom of the boiler. The success of these experiments proved conclusively that the boiler could be used with advantage continuously for a longer period than forty-five days, and that it could then be easily cleaned by simply injecting water. The advantages claimed by Colonel Polto for this method, if borne out by prolonged experience under varied conditions, are self-evident, and we shall be glad to hear and record the results of further trials. The sugar employed was a kind of raw sugar known in Italy by the name of Muscovade, which possesses a large amount of saccharine matter. With water of medium hardness the best results were obtained by using 10 grammes of sugar per horse-power when working the boiler ten or twelve hours a day; but the exact proportion would, of course, vary under different conditions. This saccharine solution was found to have no corrosive effect on the boiler; but Colonel Polto admits that too large a proportion of saccharine, or the use of impure water, might possibly lead to corrosive action, which, however, would probably be easily obviated by adding a small quantity of soda in the proportion of one-tenth to sugar.—*Engineering.*

A DISCOVERY which is of vast importance to New Zealand is announced. Oil has been struck near Gisborne, and the well is now producing fifty barrels a day. It is believed that there is an unlimited supply, requiring only further appliances to increase the quantity obtained very largely.

IT is claimed that by a new process white wood can be made remarkably homogeneous and tough. The result is said to be obtained by steaming the timber and submitting it to end pressure, thus compressing the cells and fibres into a compact and inextricably interwoven or interknotted mass.

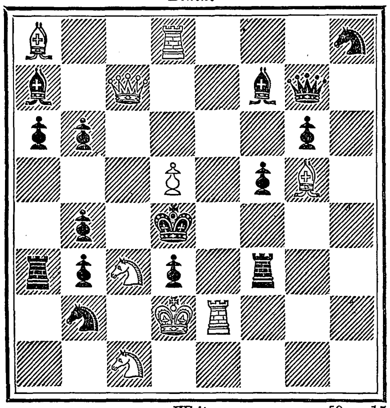
IN a recent number of the *Organ für die Fortschritte des Eisenbahnwesens* is a paper by M. Krüger, on "Conical Tires of Railway Rolling Stock," in which the author shows these to be a cause of resistance to traction and of the travelling of the rails.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXIII.—BY BLACK PAWN.

Black.



White. [9 + 15

White to play and mate in two moves.

This is the last problem in Tourney C. The award will be announced in a fortnight.

SOLUTION TO 1,011.

White.	*Black.*
1. B-Q Kt 4.	1. Anything.
2. Q or R mates, or P disc. mate.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,011, by A. Dean (but main variation 1. $\frac{\quad}{\text{P takes Q}}$ omitted), E. W. Edmunds, I. M. Brown, Link, J. Mackenzie, J. A. M. (a pretty problem), "——," and Isca; to 1,010, by J. Thompson, "——," G. A. A. Walker, Link; to 1,009, by Link (second solution).

G. A. A. W.—We are obliged to you for the trouble you have taken. The problems are very acceptable. We will endeavour to comply with your wish shortly.

LINK.— Your second attempt at 1,009 will not do, as if 1. $\frac{\quad}{\text{B-K B 6}}$, 2. $\frac{\text{Kt-K Kt 3}}{\text{B takes Q (ch)}}$. The same objection holds if 1. $\frac{\quad}{\text{B-Q R 5}}$, 2. $\frac{\text{Kt takes Kt}}{\text{B-Q 2 (ch)}}$.

W. DUFF.—Problems should be sent on a diagram; all variations should be given in solutions. Your attempt at 1,011 is all wrong, as 2. P takes Q, even if Black could not prevent White's second move by advancing any of his three P's.

BLACK PAWN.—Many thanks; but the idea in the last two-mover sent is too hackneyed. The problem might be made into a good three-mover.

PROBLEM-LOVERS will be glad to obtain the neat little volume of "Chess Souvenirs" by the well-known composer, Mr. Winter-Wood. Most of these problems are in two moves, and they have all been published before in various Chess Columns, including the ENGLISH MECHANIC. They are characterised by excellent finish and subtlety of conception. The volume winds up with a long and amusing tale in verse, entitled "The Unexpected Guest," written in t' e style of the "Ingoldsby Legends." In our next number we shall quote one of the compositions. Mr. W. Morgan, jun., 17, Medina-road, Holloway, is the publisher. The printing and get-up are admirable.

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Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 13, and unacknowledged elsewhere:—

REV. G. WALL.—J. T.—K. Wessberg.—A. Wheeler.—W. F. Stanley.—A. G. G.—A. Clegg.—P. London.—A Reader.—Zero.— Anxious.—M.I.C.E., Bath.—Original Querist.—Fireman. — Amateur. — Lime-Weary. — Accrington.—Veuton Veor.—Postulata.—Glatton.—W. C. —Ernest B. Martin.—J. C. D., Liverpool.—Joseph Marples.—Perplexed.—D. W. W.—Cooper's Hill.—W. Clifford.—Thomas Buckney.

WIDG. (There is a recipe for marine glue on p. 231, last volume. There are two or three formulæ, but the simplest is—Dissolve one ounce of finely-shred indiarubber in twelve ounces of coal-tar naphtha, using heat carefully. When the solution is complete, add twenty ounces of powdered shellac, and when all is thoroughly melted and mixed pour out on slabs of polished stone or metal. In some cases chloroform is used as the solvent and mastic instead of shellac; or the rubber is dissolved in refined petroleum, and twice its weight of asphaltum added. The hotter it is made the more fluid it becomes, up to 300° Fahr.)—NATURE. (They are soaked in rainwater until the soft parts are sufficiently decayed to be brushed away. The bleaching is accomplished by immersing for a few seconds in a weak solution of chloride of lime.)—C. MATHER, Altrincham. (We do not remember the subject; but if you were so told you will find references in the indices. You speak of bronzing and blueing. If it is the latter, a query appeared last week.) —W. P. (The "catch-'em-alive" fly-papers are made by coating pieces of paper with a preparation of linseed oil and a little resin boiled until sticky.)—WEE LADDIE. (The chisels are made hard by heating to a red and quenching in water, and are then brought to the required temper by heating on a hot plate until the "colour" appears, when they are finally cooled off in water. An expert smith does it at once; but it is better to repeat, as the edge can then be polished up and the right colour seen directly it appears. 2. The numbers are 1048 and 1052. The publisher will send them on receipt of ten halfpenny stamps.)—RENFREW. (It can be: whether it is so or not we do not know; but we recently mentioned that fish has been preserved in steel barrels, into which a solution consisting of water, 3 per cent. of boracic acid, a little tartaric acid, and some salt is forced. 2. Most things are poisons used in "excess." 3. No book. See indices.)—HARMONICUS. (Harmonium reeds are tuned by filing or scraping the reeds—at the free end to sharpen, at the rivet end to flatten. The scheme for getting them all to equal temperament has been given many times. See p. 322, No. 1082, for full directions for tuning a harmonium. 2. Procure the lists of the music sellers.)—ENQUIRER. (If you cannot hammer them out with the mallet, solder a wire hook to the surface, and pull them up.)—POOR OPTIC. (What do you mean by lines? A line is the 12th part of an inch. 2. Sometimes with nitrate of silver, sometimes with nitrate of copper, or tetrachloride of platinum, and occasionally with a black lacquer. See p. 401, No. 1086; and p. 168, No. 944.)—DAVID. (You want stoving japan, a preparation containing asphaltum, and you must have a japanner's oven. See an article on japanning and japans in No. 860, and the indices generally. 2. You do not say which metal you wish to deposit, but there is full information in back numbers.)—AMATEUR TURNER. (Almost all the textbooks on the steam-engine contain diagrams; but see the indices of back volumes. Nos. 995, 999, contain illustrations which will fully explain the motion and action of the slide-valve.)—H. WIDDOWS. (Dissolve shellac in wood-naphtha, about two pounds to the gallon, and add vermilion or Venetian red.)—J. BYGRAVES. (You must test with a delicate sine or tangent galvanometer and a large resistance, or on Wheatstone's plan. See the indices of back volumes or any textbook.)—F. W. G. (See p. 561, No. 1117, and many other back numbers.)—APPRENTICE. (The displacement must be calculated according to the rules, and the weight of the body is then equal to the weight of the liquid displaced. You should procure such books as Molesworth's Pocket-book (Spon) and Templeton's "Workshop Companion," published by Crosby Lockwood and Co.)—A VICTIM. (Your question is incomprehensible. Having served the time agreed upon in the indentures, you are free to do as you please.)—OLD MECHANIC. (The only way is to article him for, say, three years, which will cost from £100 to £300, according to the status of the professional and the amount of the work he has to do. As to education, the lad will require as much as he can get, and should attend art classes and those on building construction.)—GLASS. (The only way is to regrind and repolish; but if the scratches are deep that will involve too much labour.)—A. Z. (The best course is to consult a surgeon.)—YOUNG. (Very! Yes, if it is only water; but as soon as it becomes warm the air is driven out and any lime it contained is deposited, so that it becomes just a trifle less in quantity. Is that the "straw" you want?)—COLONIAL. (We could not afford space for such a discussion. A specific question might perhaps be answered, but as a rule it is very difficult to advise about emigration.)—DOT. (To prevent collapse in case of the water becoming short. The plug is inserted in the furnace crown, and should melt when uncovered with water, thus allowing steam to escape.)—PORTHOS. (No one could value the instrument without seeing it, and the other question is so purely of personal interest that we cannot find space for such a query. Surely in your town there is one dealer who could answer your questions. We think the name is more likely to be Forster.)—Z. Y. X. (Yes, certainly; intensification is necessary at times. Why not procure one of the cheap manuals which give instruction in the art?)—LITTLE JIM. (It is generally linseed oil well rubbed in, but sometimes it is varnish or French polish. Directions will be found in many back volumes. 2. By measuring the distance between the points when furthest apart; that is, just within the distance that the spark ceases to pass. See even recent back numbers.)—E. B. WALKER. (The other Nos. are 616, 627, 636, but only 627 is in stock.) YOUNG ENGINEER. (See Reed's "Engineer's Handbook," published by T. Reed and Co., Sunderland. You must have served an apprenticeship to an engineer of three years at least, and have also served one year at sea in the engine-room. Then you must be able to give a description of boilers and their construction with all their accessories, and understand how to correct defects. Ditto of steam engines. Must write a legible hand, have a good knowledge of arithmetic, including mensuration, and so on. You must deposit a fee of £1 as a preliminary.)—PADDY. (Instructions have been given many times. See indices.)—INQUIRER. (No, there are none made for the purpose. Fine Turkey sponge should be used, as described in No. 1054, p. 295.)—AMATEUR ASTRONOMER. (You must get the focus with some degree of accuracy, because that is the length of main tube required. Of such a lens it is more likely to be 40in. than 30in.)—R. S. S. (Balkwill's "Mechanical Dentistry," or Cole's "Manual of Dental Mechanics" may give the information required, for we know of no work that answers exactly to your requirements. They are both published by J. and A. Churchill, New Burlington-street. Hunter's "Mechanical Dentistry," published by Crosby Lockwood and Co., Stationers' Hall-court, E.C., describes the various kinds of artificial dentures. Its price is 7s. 6d.)—C. B. (By placing in fine sand heated to about 140° Fahr., and rubbing well with a piece of rather coarse flannel or dogfish skin. See No. 999, p. 240.)—YANKEE. (See a recent discussion and consult works on the subject. 2. About the thorough bass look on p. 465, No. 1113; and offer the stones to a manufacturing jeweller, or advertise them in the Sale Column.)—A. JACOBY. (Nothing remarkable in such matter being phosphorescent, but what is the actual cause can only be stated after examination.)—GEO. FISKE. (See Nos. 946, p. 226; 1083, p. 348; and 1085, p. 390. Look through the indices of back volumes for a number of articles on lantern slides, and procure the required colours from any dealer in artists' materials.)—YOUNG AMATEUR. (Answered over and over again. The best way is to take indicator diagrams; but an approximate estimate can be formed by taking the area of the piston in inches, multiply that by 2, by the length of the stroke in ft., by the number of revolutions per minute, and by the pressure in pounds. Divide the total by 33,000, and the quotient is the horse-power.)—SAMUEL TAYLOR. (We do not know. Some observers believe they have seen the so-called planet Vulcan, which is supposed to be roaming about between the sun and Mercury; but although its existence is possible, some say probable, there is at present practically no evidence which can be deemed satisfactory.)—CONSTANT READER. (See p. 477, No. 1036, and the indices generally; but procure also the Calendar of the London University.)—A. R. B. (Answered many times. See p. 353, No. 1056, or any textbook of optics. The length of the main tube may be taken as approximately correct.)—F. B. (Why not ask the maker himself? Those we have seen had a revolving shutter, and, as we said when first brought out, are well worth the price.)—J. E. (How can any one say without personal examination? Seek the best medical advice within your reach.)—HENDON. (Registration of a design protects for five years only; a patent for fourteen years. Registration of a design is not the same as patenting an invention.)

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The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday, to insure insertion in the following Friday's number.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 22, 1886.

MICROSCOPICAL ADVANCES.—XIII.

Minute Coloured Imagery.

By DR. ROYSTON-PIGOTT, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians, Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

First Order of Interstitial Colouring.

THE intensity of the lustre displayed by many objects, such as diatoms and moth scales, is worth particular attention. Whether we can arrive at satisfactory conclusions on this rather mysterious subject or not, the attempt to solve the question is full of interest and thoroughly worth making.

These are two remarkable points: whilst in scales the most brilliant blue colouring is entirely extinguished by viewing them by transmitted light; the colour is instantly resuscitated by using reflected light.

Of the moths, *Morpho Cypris* and *Morpho Menelaus*, the latter is gorgeously exhibited at South Kensington. On the other hand splendid colours are omitted both by reflected and transmitted light in the case of selected diatoms.

To begin: with an intensely blue diatom, examined by a low power against the light, in the centre there is a reddish glow fading gradually into an intense Oxford blue*. Investigate the structure with the best glasses extant; the whole is resolved into minute beading very symmetrically arranged, crowded in all blue parts; more sparse as the red centre is reached. These beads or spherules are chiefly of two orders, radiate or arched. You see long radii of well separated beads, then arcs of a concentric form, packed by threes or fours between the radii. The whole are displayed upon a circular disc.† The beads all display intensely black *Test Rings* with brilliant focal discs suspended aërially above each. The illumination preferred was, for this resolution, attained by an exquisite two-thirds objective used as a condenser, a plane mirror, and an ordinary moderator lamp. In one sense, we had certainly radiating lines closely packed, and we know Sir David Brewster discovered closely-packed lines in mother-of-pearl, and ascribed its pretty colours to this lined structure. The strange fact, however, crops up that as the interstitial spaces widen the colour changes from blue to crimson; yet the beading remains the same size, both radiate and central. Are we to ascribe the deep blue colour to the gauge of these spaces? It seems as though the red rays could not find admittance through these minute vacuities, but the blue can.

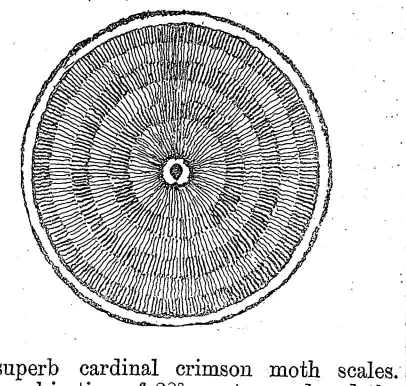
Another observation. An objective of 70° aperture destroys the blue colour, turning it into a pale French grey. As you focus upwards a blue dim disc reappears.

An exceedingly fine 1-10th imparts a slightly ruddy glow when the brilliant focal discs sparkling above the *Test Rings* assume their greatest brightness. With a glass of 1·43‡ aperture, of surpassing excellence, a pale sapphire tint can be easily seen without the black test rings, especially in the central part of the Eupodiscus, where the red colouring appears with a low power. This effect can hardly account for the intensely deep azure blue already described. In a focal plane about 1-6,000th above the focal discs, red eidolic dots like red currants are seen, but this cannot account for the rich cerulean blue in hand. I am obliged to fall back on the hypothesis that the interstitial spaces admit here only the blue rays, but admit red when they are large enough.

In rather a large Eupodiscus the diameter of the brilliant disc within the test ring of a spherule was 1-45,000th of an inch, and of the red eidolic dot suspended above the 1-55,000th nearly.

Several tints are developed in different specimens apparently, according to the closeness of the spherular arrangement:—pale sea-green, deep violet, crimson, lemon-yellow, brown, deep umber, salmon colour. In Mr. Watson's guinea slide there are many more colours, and an exquisitely-arranged circle

FIG. 1

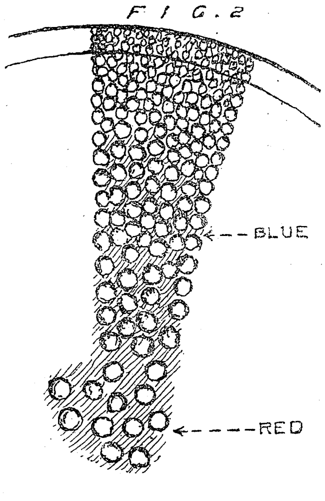


of superb cardinal crimson moth scales. A ½in. objective of 22° aperture reduced the deepest blues to a much paler colour—steel blue. Power 200.

On one of these discs a piece had been chipped out, exposing a second set of beading belonging to the under surface, and placed about 1-6,000th of an inch deeper. Having so often seen the lower beading in diatoms, I cannot but regard this observation as valuable evidence on the point.

My swinging substage of 1862 carrying a 1½in. fine objective tilted at an angle of 20° exhibits on a black field a group of astonishing brilliance under sunlight illu-

FIG. 2



mination (⅔rd objective and D eyepiece). An entirely new order of superb colouring supervenes. Black lined reticulations, radial bars glowing with all prismatic hues, demonstrate the variety of rays decomposed by the refracting molecules, and emanating in every possible direction.

Eupodiscus Argus.

Fig. 1.—Represents the radial bars. These glitter with golden and every other prismatic hue × 200.

Fig. 2.—The same frustule exhibiting sparse beading giving red, and closer beading emitting blue rays × 2,500.

By oblique illumination, many diatoms display a beautiful iridescence with transmitted light; the colours change also by rotating the object, as well as by altering the angular apertures. Parallel rays answer the best; obliquity then develops intensely black shadows—often crescentic in refracting spherules and semi-lunar blackness startles the eye of the observer under the highest powers. The scene constantly changes with the obliquity. The swinging substage (made in 1862) was of the greatest service.

Second Order: Transmitted Colours.

Interstitial transmission of light through the minute crevices in these diatoms is not the only cause of the colours. With the best powers, we have to deal with infinitely small and infinitely numerous sprays of light decomposed into prismatic colouring by the refractive nature of the silicoid structure of minute spherules capable of forming various focal points, spurious discs, eidolic forms, and mixed phenomena. Nor is this all. The immersion oils import their own peculiarities. The residuary errors of the objective also enter into the game. Objects in higher or lower focal planes, with the very best glasses, assume different tints. The position of the internal lenses again manipulates colour.

My best glass, Powell's 1-12 (1·43), at its best estate, displays two colours at *different focal planes*—salmon pink and pale sapphire blue. Immersion oils of great variety change these colours. Powell had informed me for many years that an immersion fluid of low dispersion and high refraction was a desideratum. I tried a great many in 1870. Sir David Brewster worked out these qualities in an exhaustive manner, and from his tables most valuable data may be obtained.

Indeed, for every fresh immersion oil the best objective requires new adjustments. Observe the following table.

The first column is the index of refraction for mean rays (μ). The second dispersion or distance between the red and blue rays of the spectrum ($\triangle\mu$).

	μ Index of Refraction.	$\triangle\mu$ Dispersion.
Oil of Rhodium	1·503	·022
„ Lavender	1·457	·021
„ Rape seed	1·475	·019
„ Olive	1·47	·018
„ Rosemary	1·47	·020
„ Sweet Fennel Seed	1·506	·028
„ Almonds	1·47	
„ Brick	1·47	·021
„ CASSIA	1·64	·089
„ Mace	1·481	
„ Nutmeg	1·497	·021
„ Peppermint	1·47	·019
„ Dill Seed	1·477	·023
„ Pimento	1·51	·026

Castor oil has some excellent properties; also 1 grain of chloride of gold dissolved in glycerine has answered extremely well in my hands. The white, pallid oil of olives (in which I intend to dissolve proportions of camphor) strongly recommends itself in the table*. Camphor has a refraction 1·50.

The scintillations of diatomic beads, when all is done that can be for attaining perfection of definition, well reward the attentive observer. As a mass of highly refracting spherules, or *quasi*-lenses, their play of colours is most remarkable. Rich bundles of iridescent rays emanate from all these wonderful little gems;—small though they be, they are huge compared with the wavelets of light that play around and within them. Old-fashioned glasses reveal none of these beauties. The corrections were too coarse. The colouring of many objects is more exquisite

* Eupodiscus fulvus is a good example.

† In Watson's German slides (£1 1s. each), many tints are selected, and the diatoms form patterns resembling engine-turning.

‡ 1·43. This exceeds the numerical aperture of any of Carl Zeiss's objectives, which only reach 1·40.

* Burgoyne et Cie, 16, Coleman-st.

and fascinating as the perfection of the instrument advances.

My friend Mr. Fletcher, with a fine 1-15th by Ross, sees 10 colours on the arched surface of the Formosum, using a fine ½in. objective as condenser.

These effects are totally different from the first order of colouring caused by the interstitial penetration of blue or red wavelets already discussed. It is a new order of beauty dependent upon many complex combinations.

To illustrate these points it is necessary, first of all, to allude to the earliest experiment with a small lens placed in a beam of solar light.

Sir John Herschel's experiment with this small solar beam presents phenomena of the highest order of interest, though these were only viewed with a small lens. But imagination fails to conceive beforehand the splendid beauties of the solar marvels exhibited by examining a miniature sun with a power of 1,000 diameters, instead of about 10. (Sir John, unfortunately, does not give the focus of the hand lens he employed.)

The experiment was this: A solar beam admitted through a small aperture in a shutter was received on a distant lens which converged to a solar focus,* thus forming a miniature of the hole in the shutter by a totally uncorrected lens.

This was now viewed with a small lens: coloured rings were displayed of great beauty, though of minute diameter. The following is Sir John's list of colours, the rings following nearly in the order of the colours of thin plates. It should be stated that as the distances are varied, these rings expand or contract in vivid contrasts of prismatic colouring:—

1st Order.—White, pale yellow, yellow, orange dull red.

2nd Order.—Violet, blue, *broad and pure*, whitish greenish yellow, fine yellow, orange red, very full and brilliant.

3rd Order.—Purple, indigo blue, greenish blue, pure brilliant green, yellow green, red.

4th Order.—Good green, but rather sombre and bluish; bluish white, faint red.

5th Order.—Dull green, faint bluish white, faint red.

Sir John also says:—When the eye lens and hole are brought nearer together, the central white spot contracts into a point and vanishes, and the rings gradually close in upon it in succession, so that the centre assumes in succession the most surprisingly vivid and intense hues; he used an examining lens of short focus. At page 484 of his article on "Light," he gives a much longer table of these coloured rings at measured distances of the hole from the eye lens, which it is unnecessary to detail.

When the writer employed the leisure of some years of research on "Circular Solar Spectra," by means of a magnifying power of 1,000 with exquisite definition, he was not aware of this early experiment.

It seems never, however, to have occurred to Sir John that the image-forming lens itself was afflicted with both spherical and chromatic aberration. If we substitute for this lens a very perfectly corrected lens, such as a modern objective, these rings nearly all disappear, and we are left with a most brilliant central white spot surrounded with an intensely black and very true circular ring, the slightest deviation from truth in this *Test Ring* denoting either eccentricity of the component lenses, bad setting, or inaccurate curvatures; of course, also errors of achromatism are at once vividly developed.

It should be especially noted that in the Herschelian experiment the angular aperture of the condensing lens is exceedingly small, as also that of the observing lens. In the experiments to be described, enormous apertures were generally used, as in immersion glasses.

The inconvenience, too, of an ever-changing solar beam of light strongly militates against continuous observations and written records.

For this reason I have endeavoured to devise totally different kinds of apparatus. A heliostat is an expensive instrument when driven by clockwork. In the new arrangements the solar beam remains stationary for many hours. Instead of Herschel's minute shutter aperture, a fine one-fifth object-glass of 140° aperture is placed 200in. from a horizontal microscope. The axis of this objective is directed to the horizon, and to the azimuth of the sun, rays from which can enter at all angles up to half apertures.

Any small adjustable simple plano-convex lens is placed beneath the stage, and its spectrum is now viewed with a powerful microscope (× 1,000 diameters).

So soon as the spectrum is caught in the field of the microscope, all your manipulative skill will be required to subdue, on a bright day, the magnificent—the almost blinding—splendour of the scene. You are viewing a focal image of the sun formed by a simple lens. The excessive effulgence of the accompanying phenomena often elicits a shout of delight from the beholder.

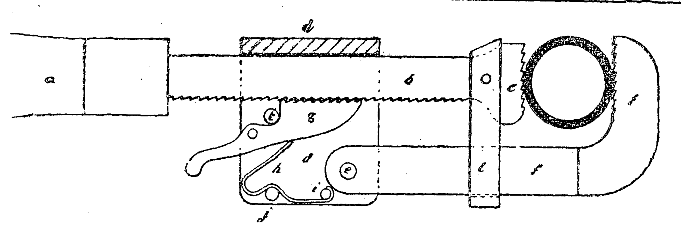
It is necessary that one optical axis only should pass through the instrumentation; slight deviations or obliquities develop the most exquisite figures, composed either of ellipses, parabolas, or hyperbolas.

In the midst appears Herschel's brilliant white spot, surrounded, first, by an intensely black ring, strangely distinct amid such wonderful brightness. The colours, vivid beyond experience, form concentric rings expanding and contracting with every change of focus. When the stage lens is more achromatic and true, the rings gradually diminish in number, so that a very perfect stage objective reduces the immense circular spectra to two, or even one, black central ring as a margin to the brilliant white sun spot, or spurious solar image. It is necessary to choose sunshine on a clear day, free from haze. May is generally the best month.

(To be continued.)

* Diameter of solar beam passing through the hole of the shutter was 1-30th of an inch; its distance from the luminous point about 78in., and its distance from the eye lens 24in.

A NEW WRENCH.



ANOTHER improved wrench has been recently patented in this country, this time by Messrs. Potter and Gulick, of Orange, Essex Co., New Jersey, and its principal features are shown in the annexed illustration, which is a sectional side view. The invention consists of a wrench of simple construction which is easily manipulated. *a* represents the handle of the wrench; *b* is the shank of the fixed jaw *c*, which is provided with teeth along one edge to constitute a rack. This rack *b* is embraced by a U-shaped frame *d*, free to slide thereon. Between the two parallel pieces of frame *d* there is pivoted at *e* the shank of the movable jaw *f*. *g* is a dog likewise pivoted between the cheeks of frame *d*, and having a serrated biting edge to engage rack *b*. A suitable spring *h* within frame *d* bears with its free end against the dog *g* and tends to hold it against rack *b*. The patentees prefer to make the spring *h* of the form shown in the drawing, that is to say, it is partly bent around two pins *i*, *j*, located at opposite sides of the spring. Below the biting edge of dog *g* there is a strong pin *k* fitting into a concavity of the dog. This pin is of importance, inasmuch as it bears against the dog when the wrench is used, and takes a large portion of the strain from the pivot of the dog. *l* is a yoke pivoted to shank *b* and embracing the shank of the movable jaw to properly guide the same. The operation of the wrench is as follows: To open the same, a handle on dog *g* is pressed towards the rack *b*, and thus the dog is released from the rack. The frame *d* and movable jaw *f* may now be slid up the desired extent. After the work is inserted, the dog is released, and caused to engage rack *b* by spring *h*. The movable jaw is now pulled down until the work is tightly clamped between the jaws.

MINERS' SAFETY-LAMPS.

THE question of safety-lamps for use in mines has recently come to the fore, and it is to be hoped that something more definite than the report of the Royal Commission may soon be arrived at; though that report was definite enough in one particular—viz., that none of the lamps tested were safe in all conditions of the atmosphere of a mine. There is some reason to think that an electric lamp can be made perfectly safe, and at the same time cheap enough for general use, but sufficient experience has not at present been obtained in practical work to justify a confident expectation that a difficult and vital problem has been finally solved. Probably before long Mr. Lever's prize will be won, however, for there are two, if not three, electric safety-lamps which appear to answer the conditions, and at least two improved forms of the oil lamp which can compete with a fair chance of success. According to Mr. Arnold Lupton, lecturing recently at the Yorkshire College, all the safety-lamps at present in use are modifications of the Davy, and, in his opinion, the Mueseler, the use of which is enforced in Belgium, and the Stephenson lamp, if well constructed, are the best lamps for use. Where fire-damp is known to exist, the greatest essential is protection from the current of foul air and gas. The only means of protection is to put the lamp behind a cover, and if the Davy lamp is put in a tin case, from being a most unsafe lamp it becomes one of the safest. The Royal Commissioners considered it might be safely used in a current of 2,000ft. velocity per minute. In a safety-lamp there should be nothing between the glass and the oil pot, so as to secure the best possible light. It is still more important, however, for colliers and deputies, before a lamp is used, to see that all parts are in their proper places, a departure from this rule involving far greater risks than the use of less safe lamps. After describing the Swan, Morgan, and other inventions, Mr. Lupton said that the lamp of the future would be one of the following: An electric, with secondary battery like Swan's, or with a primary battery like Walker's, a bonneted three-gauze lamp, a bonneted Mueseler lamp, a Morgan three-gauze lamp, or a Clifford lamp, if it stood the tests as well as its inventor said it would. Some experiments made by Mr. Lupton on the 8th inst., in which the Clifford lamps were extinguished without firing the gas, suggest the question whether, after all, it would not be better to use oil-lamps which are extinguished in the presence of fire-damp, in preference to those which are supposed to be incapable of exploding a mixture of gas and air. It goes without saying that the miner would rather have a lamp that continued alight while showing the presence of an explosive mixture; but unless a lamp can be made which is proof against all conditions of the air of the mine, it would no doubt be safer to employ lamps which are extinguished before they can fire the gaseous mixture.

Many experts indeed consider that the chief use of a safety-lamp is as an indicator for detecting the presence of gas, and that working should not go on in the presence of an explosive mixture; but unless the lamps are so arranged that the explosive mixture will put out the flame, it is certain the miners would go on working long after the appearance of the flame of the lamp indicated the nature of the surrounding atmosphere. It is stated that the new Morgan lamp is absolutely proof against the most severe tests, while at the same time it gives a high illuminating power, and is not readily extinguished, as some are, by the ordinary movements necessitated by the work of the miner. Some of the safety-lamps are too easily extinguished by a trifling accident, and miners naturally object to tramping back to the lighting station—it may be a mile from the place of working—in order to have the lamp relit. The Morgan lamp, which was awarded the Gold Medal at the Inventions Exhibition, has a double shield made of two plates of sheet metal perforated in such a manner that the holes in one shield are never opposite those in the other. Any blast of air directed against the outer shield has its force greatly reduced before it gets through the inner shield, and then it is met by the gauze cone and chimney protecting the flames. The lamp is, besides, perfect in minor details, and well deserved the gold medal; but if the newest pattern is better still, it would seem that at last we have a real safety-lamp. Still, it must be acknowledged that experimental tests carried out with a blast of explosive gases do not produce exactly the same conditions as may occur in a mine, where the lamp may be altogether surrounded and consequently filled by an explosive atmosphere. What is wanted is a lamp that is safe in all conditions of its environment, and probably it is only in connection with electrical devices that such will be found.

THE GREAT BRUSH DYNAMO AND THE COWLES PROCESS.

THE great "10-ton" 42in. dynamo manufactured for working the Cowles Electrical Furnace by the Brush Company has been tested, and is evidently a remarkable machine, if we may judge from the reports which have been published. The metallurgical world—for that matter the scientific world—is now awaiting with interest the result of the practical operations in extracting aluminium by means of the electric current, although there is no doubt of the practicability of the method. That has been demonstrated: the question to be settled is the price at which aluminium alloys can be sold, for if as low as promised we shall undoubtedly see a revolution, and it is possible that steel may find itself supplanted by one of the new alloys. The great Brush dynamo weighs altogether 21,671½lb., or, according to some, 21,900lb., and is thus near enough to be called "10-ton" in British measure. Calculated to give a current of 3,200 ampères, with an E.M.F. of 80 volts, and a normal maximum current in the fields of 80 ampères, at a speed not greater than 600 revolutions, it has accomplished that standard at 405 revolutions, yielding 249,000 watts, the E.M.F. being 83 volts. The largest current measured was 3,400 ampères, with an E.M.F. of 68 volts, and if a more powerful engine had been driving, there is no doubt 300,000 watts might have been reached in safety. A few dimensions, with weights of this, perhaps, memorable machine, may be of interest. The armature, 42in. in diameter, contains 1,600lb. of iron, and carries 825lb. of copper wire, the total weight being 4,300lb. It consists of 16 bobbins, each carrying 21 turns of best copper wire, two strands lying side by side, the wire being 0·35in. in diameter. These 16 bobbins are operated in multiple arc, thus giving 32 strands of copper wire of the diameter above stated, and about 65ft. long. Sixteen copper bars carry the current from the bobbins to the commutator, each bar being 1in. by ½in. in section. The two commutators are coupled in multiple arc. The driving shaft carrying the armature is 13ft. long by 5½in. in diameter at the main bearing, and is made of open-hearth steel. A 40in. pulley on this shaft is driven by a double leather belt 44in. wide. The field magnets, eight in number, consist of cylindrical cast-iron cores 11in. in diameter by 16in. in length, and wound with 30 layers of 102 turns each of copper wire, 0·134in. in diameter,—all the eight wires being coupled in multiple arc, as in a shunt-field. Thus combined they have a resistance of about one ohm, total, cold. The pole pieces are of peculiar form, and are fitted carefully to the field. They weigh 67½lb., while the pole-piece stands weigh 18lb. The eight magnets with their copper-wire weigh 9,295lb. That the whole machine is well proportioned, mechanically and electrically, was demonstrated on the trial, when, after a run of two hours, the armature was cool enough to handle in all parts, as were the other portions of the dynamo, the bearings being free from heating and cutting. The maximum horse-power of the engine which produced the above results with this dynamo is 355; but it is now connected, we believe, to a Victor turbine of 550 horse-power, and we may shortly expect to hear of the work effected in producing aluminium and its alloys.

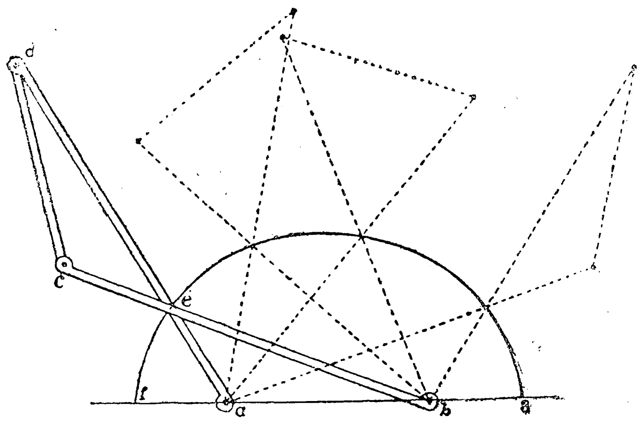
Meanwhile, we learn from a paper by Prof. C. F. Mabery, who is associated with the Messrs. Cowles, that the results of working with a 30 horse-power engine are sufficient to encourage the belief that the energy represented by 300 horse-power and more will enable the company to produce aluminium at a very low price. In contradiction of the assertion made by Dr. Werner Siemens that aluminium could not be reduced without copper, Prof. Mabery says that mixtures of metallic aluminium and carbon have been frequently taken from the electrical furnace in large quantities. A product which has attracted considerable attention during the past year is obtained by reducing alumina in presence of iron. A cast iron is formed containing sometimes as much as 10 per cent. of aluminium, and this product is used to facilitate the working of crude iron and to introduce into the various grades a small percentage of aluminium. The slags resulting from this reduction are composed chiefly of calcic aluminate and cast iron. In the reduction of aluminium in the presence of copper, a yellow product is frequently taken from the furnace, which is composed of metallic aluminium to the extent of one-half or three-fourths, the balance being silicon and copper. With a small percentage of calcium it is also formed in the absence of copper and then contains a higher percentage of aluminium and often contains nitrogen. It has a resinous lustre and decomposes water at 100° C. The aluminous slags are composed of reduced metal, calcic aluminate, and fused oxide, and since they have always proved to contain about 1 per cent. of carbon, which is liberated in the gaseous form of hydrochloric acid even in the absence of iron, a carbide of aluminium may also be present. A remarkable effect was observed in a bar of 10 per cent. bronze which had been heated for the purpose of forging. It was allowed to become too hot, and when struck the entire bar assumed a crystalline condition. Some of the individual crystals were nearly perfect in form, resembling certain forms of the isometric system. A striking analogy between them and certain forms of meteorites has recently been observed by Mr. O. W. Huntington, of Howard College. In reduction of silicon, the formation of a greenish-yellow substance is frequently observed, and it has been proved by analysis to be a new oxide of silicon—SiO. By fusion with fluxes it is converted into the dioxide, and hydrofluoric acid acts upon it the same as upon the dioxide.

At the meeting of the American Association for the Advancement of Science an ingot of aluminium was shown containing less silicon and iron than the average commercial metal, although no special care had been taken to obtain a pure product. Experiments are now being carried on which it is expected will ultimately result in the discovery of a method of working which will materially reduce the cost of a metal which is so valuable because it is so remarkably useful, and also so abundant in the state of oxide.

A NEW ELLIPSOGRAPH.*

THERE are so many ellipsographs and methods for drafting the ellipse, that a new one can hardly be said to be called for; but the study of the curve is interesting to many from a purely theoretical point of view, and the following device may be new to the subject. It is new to me, both as to its mechanism and its principle.

Four links, *ab*, and its equal, *cd*, *bc*, and its equal, *ad*, are joined together as in the figure, the points *a* and *b* being fixed. As the system is moved about the fixed centres, the intersection of the two crossed links will follow the outline of an ellipse, *fg*, which has the two centres for its foci, and the link *ad* for its major axis.



The figure shows the instrument in rough outline, to illustrate its principle only; but it is easy to see that it would be adjustable for different ellipses if the centres were mounted on slider s, or otherwise made movable on the bars. It would also be a simple matter to attach a double slider that would slide on both the crossed bars and hold a pencil point at their intersection.

HOW TO PREVENT THE FADING OF SILVER PRINTS.†

I CLAIM for my process that it will prevent fading under ordinarily favourable circumstances, and where the prints have been *kept from damp*. I may say that I have never seen any fading in my work when it was fairly treated in the manner I am about to place before you; and I wish to impress upon any who may desire to make trial of it that they should be very particular to follow my method, otherwise I must not be held in any degree responsible for what failures they may meet with.

In the first place, I may state that I prepare my paper and do my printing in the usual way. I have tried many kinds of toning baths in my time, but always fell back upon chloride of lime. My bath is made in this way:—

Chloride of lime	6 grains
Common whiting	20 "
Chloride of gold	15 "
Water	6 pints

Allow the solution to stand aside for a few days before use. It will tone for a long time, and, when it begins to show signs of exhaustion, is reinvigorated by the addition of a little gold at each time of toning. Nearly any description of tone may be had from it, ranging from warm brown to black.

I think it essential always to fix with newly-

* By GEORGE B. GRANT, in the *Journal* of the Franklin Institute.

† By ROBERT IRVINE. A paper read before the Edinburgh Photographic Society.

dissolved hypo. The practice of leaving some of the solution previously made use of I consider a mistake; and though at the moment better results may be thought obtainable, still there is no question but it induces fading. After fixing, I put the prints under a tap furnished with a rose full of very small holes, which, while it helps to keep them in motion, does not break or crush them in any way. The vessel I use for the purpose is a wooden tub, the sides and bottoms of which are pierced with a great many holes, which are fully ¼in. in diameter—care being taken, of course, to see that the inflow is equal to the outflow, so as to keep the prints floating. After washing fully an hour, I take them out and lay them on a thick glass plate, and, with a smooth wooden roller, press all the water out of them, at the same time, I believe, removing nearly all the hypo remaining. I then return them once more to the washing water, and put a good quantity of common salt along with them, which I think effectually helps to neutralise any traces of hypo that may be left. I let them now wash an hour or two, after which it is, and has been, my practice, for a year or two past, to take them out and put them into a fresh water, in which a small quantity of alum is dissolved. After remaining and being moved in this for a short time, I gather them singly, and wipe each print with a soft sponge and water, and then press them in a mass as dry as possible, when they are ready for mounting. The mountant I prefer is gelatine. Starches and pastes easily sour, and, in time, cause prints to fade.

I do not pretend to be even a second-grade photographer, but I can distinctly say that during the twenty-three years I have been in business I never saw my prints fade if I adhered to the method I have just detailed. It has occasionally happened that when I was pushed for time I have omitted to follow precisely the above form; but in usual circumstances it is my invariable practice. I may say that I have prints in my show-cases and elsewhere that have been exposed to sun and frost for a long time, and they will stand examination as to fading, and come well out of it. I have hundreds of prints in boxes that have lain by me for many years unfaded; and I shall be glad if these remarks prove of service to the profession in any degree, because it is one of the great reproaches of our beautiful art that, so far as silver printing is concerned, the effects, no matter how charming they may be to-day, cannot be depended upon to endure for any considerable length of time, and too often but for a very short time indeed, compared with other productions of art and skill.

THE INFLUENCE OF MUSIC ON THE CEREBRO-SPINAL SYSTEM.

It has long been a familiar fact that susceptible, or perhaps we ought to say very impressionable, nervous centres, either of brain or cord, or both may be influenced by music. Whether the influence exerted is not purely physical—perhaps mechanical and of the nature of vibratory movement, of a nature akin to that exemplified by the phenomena of sensitive and musical flames, and obeying the laws of concord and discord which Newton demonstrated as determining the chromatic and diatonic scales respectively, which Groves further illustrated in the induction of his doctrine of the correlation of forces, and which Tyndall has reduced to practice—may be a moot question, but we cannot doubt that it will sooner or later be settled in the affirmative. However that may be, the fact remains that music does act powerfully on the majority of nervous systems, and there is reason to think that the brain is not alone affected. For example, the movements of the lower limbs both in dancing and in marching are distinctly influenced by music, independently of the consciousness. When the brain at first participates in the excitement produced, it may become engrossed with other matters, and rhythmical muscular movements of the extremities, and in a lesser degree of the trunk, will be continued automatically in harmony with the music. Direct impressions on the cerebral centres are probably transmitted through the auditory centre. Thus monotonous and slow music will exert a calming influence, provided that it be not too slow to be in harmony with the nerve habit of the individual, as in that case it may irritate. It is also essential to the success of any endeavour to bring the brain under the control of music that it should first arrest the attention either by its power or sweetness, and then gradually conduct the organism into harmony with itself. A measured cadence of the sort likely to calm the mind is more likely to augment than to allay irritation, unless it begin with a powerful appeal to the brain in a key which accords with that in which the cerebrum is at the moment itself working. This has not, perhaps, been sufficiently well understood in some attempts which have been made, experimentally, to use music as a remedial measure. So with endeavours to rouse the spirits by music, the opening needs to be plaintive and in the key of melancholy which harmonises with the brain state of the patient. The attention being arrested and the cerebrum reached through the auditory centre, the key must be gradually changed, and the time quickened in such manner as to change the brain state. No great progress will be made with the employment of sound, and form, and colour as remedial agents, powerful as these agents really are, until we dismiss the unscientific idea of "mind," and begin to regard the brain as an organ which, like all other parts of the body, obeys physical laws and performs its function by purely physical processes.—*Lancet.*

THE FIRST IRON BOAT.*

The county of Lancaster is already famous as the birthplace of the first practical steamboat, which was placed on the Bridgewater Canal by Fulton, and I think it would not be too much to say that the great majority of the modern machine tools in the workshops of the world have been invented in this shire. It may give us some satisfaction to know that the first iron boat was also made in this county, certainly just inside our borders, at Cartmel, near Lancaster, by John Wilkinson, about the year 1750. John Wilkinson was in partnership with his brother and father, their chief business being in the manufacture of flat-irons for smoothing linen. It is related that John's father bought his iron in the molten state, by the ladleful; it was then carried across the high road to the small foundry, and there run into these smoothing-irons. The Wilkinsons prospered, business increased, for John invented the box iron with its inside heating piece. They erected more extensive works in the neighbourhood, engaged themselves in smelting the rich hematite ores, or what was then called Furness iron. The furnaces were at Nelson House, near Lindal, in the parish of Cartmel. They used the peat and turf of the district for fuel, and to get a proper supply of this to the furnace John Wilkinson designed a short canal which was cut through the turbary, and the iron boat was constructed, which created great astonishment along the whole country side.

This first small iron boat at Cartmel was succeeded by others made by Wilkinson. The pioneers of inland navigation were at work, pamphlets were written, folios were printed to show how the wealth of the country might be increased by a proper system of inland navigation. The Duke of Bridgwater, Brindley, Telford, and other enterprising men had created these waterways, the Manchester and Worsley Canal was being imitated, the Birmingham Canal had been finished, and the Great Staffordshire Canal ran not far off Wilkinson's furnaces.

Wilkinson had heavy contracts, and the boat builders were very busy supplying these new canals with boats; but the arts of peace and the arts of war created a great demand for John Wilkinson's manufacture. He obtained the contract for the Paris Waterworks, which included all the pipes, tubes, cylinders, and ironwork for that enormous undertaking, which was considered the greatest of its kind of that day. His friend, James Watt, having designed the steam engine, and Wilkinson not being able to get boats of wood to convey the materials for the above contract, determined to design boats of iron to go down the Severn and the canals. He was also busy smuggling cast-iron guns 4ft. long into France. These were consigned under the name of water-piping—sometimes merely as metal water-pipes—to be re-cast into guns when they got to France. They were taken from Willey by means of a cast-iron tramway to the banks of the Severn.

The next iron barge that was made was called the *Trial*, and, according to the record of the day, Wilkinson set to work building this at Willey, with John Jones as chief smith—John o' Lincoln he was called.

The *Trial* was finished in 1787, and a great crowd came down to witness the launch of the iron barge, of which Wilkinson wrote in a letter dated Broseley, July 17th, 1787:—"Yesterday week my iron boat was launched; it answers all my expectations, and has convinced the unbelievers, who were 999 in 1,000. It will be a nine days' wonder, and then be like Columbus's egg." Wilkinson went on building other barges. In a letter dated Bradley Iron Works, 20th October, 1787, he says:—"There have been two iron vessels launched in my service since 1st September; one is a canal boat for this navigation, the other a barge of 40 tons for the river Severn. The last was floated on Monday, and is, I expect, now at Stourport with a lading of bar-iron. My clerk at Broseley advises me that she swims remarkably light, and exceeds even my own expectations."

* Extracted from the address of Alderman W. H. Bailey, President of the Manchester Association of Engineers.

POWER ABSORBED IN CUTTING CAST-IRON.

For the purpose of determining amount of power used in cutting iron by different shapes of lathe tools, a dynamometer was attached to a 20in. Fitchburg lathe, the use of which was tendered by T. R. Almond, Brooklyn, N.Y., for a course of experiments. Fig. 1, shows method of attaching dynamometer to lathe. A is the main shaft, H the lathe counter and step pulley. L is the lathe, and I the step pulley on spindle. Pulleys C and G remain as ordinarily used for driving the lathe ahead. The reverse belt was removed from pulleys F and B. A short counter shaft J was mounted back of the lathe, and the dynamometer D placed upon it in line with pulley F. Tight and loose pulleys E received a belt from pulley B, which was moved along the line shaft from A, to where it is now shown. This method of attaching relieves the dynamometer of much wear; the clutch K enabled direct power from pulley G to be

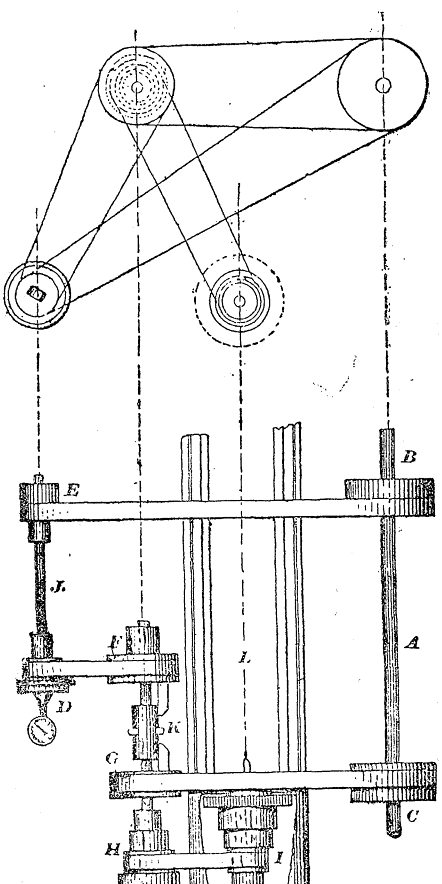


Fig. 1

used in getting a cut ready; when by engaging K with pulley F, the dynamometer reading may be taken at will. The dynamometer used was patented by Horace C. Hovey, Ayer, Mass., and was loaned for this course of test by its present owner, R. H. Gray, of the above named town. The dynamometer shaft is secured to the hub by eight set screws, placed in pairs at angles of 90° in order that the dynamometer may be centred and secured upon the shaft. The shell, or belt pulley, is separated from the hub by a number of rolls, which convert movement between hub and shell from sliding into rolling friction. A bar cast to the hub engages the shell pulley through the medium of springs which are compressed according to the power applied through the pulley E, and applied to the lathe by pulley F. By means of a device similar to steam gauge rack pinion, hand and dial, the movement between the dynamometer hub and shell is registered. In making up the readings upon the dial face, the shaft J was locked to prevent all movement, and a 5lb. weight attached to pulley D by means of a wire and hook which engaged one of the set screw holes.

The figure five on the dial indicates where the pointer stood with a load of 5lb. on the wire. Weights of 10lb, 15lb., and up to 60lb., were placed on the wire, and the position of the hand marked on the dial as before. The dial reading now represents actual pull of the belt in pounds. To

* By James F. Hobart in the *American Machinist.*

reduce it to horse-power, multiply circumference in feet of pulley D, by dial reading, by revolution per minute, and divide by 33,000. It is found upon stopping the apparatus that the dynamometer would return to within ¼lb. of zero, this amount representing resistance of internal friction, and friction of clutch pulley F. When this dynamometer was first tried, the index hand was found to fluctuate excessively at every increase or decrease of resistance. A slight touch upon pulley D would cause the hand to jump up 30lb. to 50lb. upon the dial plate. To remedy this defect, the shell and hub were also connected by an equalising device consisting of a piston 1¼in. in diameter, working in a cylinder full of oil. Two holes about $\frac{1}{16}$in. each in diameter were drilled through the piston, which fitted easily into the cylinder. Before many experiments had been made, it was found necessary to close one of the holes entirely, and to put a piece of wire in the remaining hole which reduced the area to about one-third its original size.

The dynamometer in these tests was run at a speed of 365 to 390 revolutions per minute, thus giving it a capacity of about one horse-power.

In boring a 14in. flange coupling, various conditions of hardness or density were found. The coupling casting was 7in. long, and cored out about 3½in. diameter.

Two rough cuts were run through the casting, leaving the hole 3·75in. in diameter.

A boring bar 1½in. square, *a*, Fig. 2, was bolted to the lathe carriage in place of the usual tool-post, and a cutter *b*, 1½in. diameter, put through a hole,

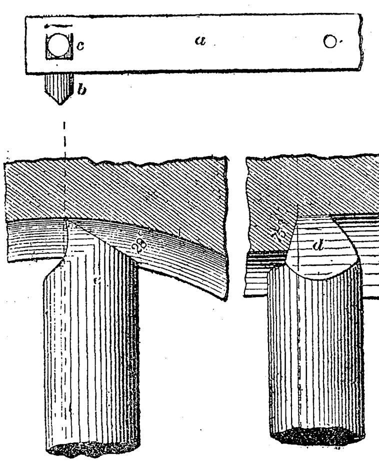


Fig.2

and secured with a set-screw *c*, near end of boring bar. The cutting edge of tool *d*, was ground at an angle of 75° with axis of hole to be bored. The clearance shown at *e* was 28°, and rake of tool 39°. The dynamometer reading at beginning of cut was 15·5lb., of which 8·25lb. was consumed in lathe and countershaft friction, leaving the direct bell pull consumed by cutting tool equal to 7·25lb. The speed of dynamometer was 365 revolutions per minute; circumference of its pulley, 1·7 + feet, giving a belt speed of 620·5ft. per minute.

At point of cutting tool, the diameter of bore being 4·02in., the circumference was 1·05 + feet, and the work making 15 revolutions per minute, taking off a chip ·135in. by ·021 + thick.

From the above data may be calculated the direct pull upon cutting tool to drag it through the iron, or to force the iron over the tool. At the dynamometer 4498·625 foot-pounds are consumed in driving work over the cutting tool, exclusive of 5119·125lb. required to drive lathe and countershaft. At the end of cutting tool the work done is as above, 4498·625 foot-pounds, and as the work travels at a velocity of 15·75ft. per minute, then a pressure of 285·63 + pounds is necessary to force the work over the tool 1ft. per minute.

As the boring proceeded, considerable difference in density of the iron was noticed. For convenience the readings of pressure will be given in pounds pull upon tool at circumference of the work; in all cases the friction of lathe and shafting being deducted and only the resistance of cut being given.

When the cut was first started the dynamometer indicated 7·25lb.; at a depth of 3in., 8·50lb., and at points diametrically opposite the pressure varied about one pound, but this variation gradually disappeared as the tool approached the face of the coupling, which was upward when the casting was made.

The following table shows the number of pounds required at different depths of the bore or towards top of casting, at which place more power was required, although the iron is supposed to be the more dense at the bottom.

BORING TOOL.

No.	Depth of Bore.	Pull on Tool.
1	0⅓in.	285·63
2	3	334·87 +
3	4	305·32 +
4	4½	245·96 +
5	5	256·07
6	5½	275·77 +
7	5¾	305·32 +
8	6	285·63
9	6¼	324·32 +
10	6½	337·87 +
11	6¾	364·41 +
12	7	384·11 +

The variation of one pound at points diametrically opposite, as above mentioned, will make a difference of cutting pressure of about 38·69lb. pull on the tool, and is caused by the variable density of the iron. This condition of the casting will readily explain why holes in gear and pulleys are sometimes found to be oval, and why we cannot always turn up a true cylindrical shape in the lathe. In forcing crank pins into their places after the work has been accurately bored and turned it is sometimes found that the pin is not true with the wheel or crank. How much of a factor may be represented by the above difference in density of iron is yet not entirely known, but must be considerable. With the couplings mounted on 4$\frac{7}{16}$in. iron arbor between centres turned up to 60°, the friction of lathe and countershaft, when dynamometer ran 365 revolutions per minute, and lathe 1 to 43·75 of dynamometer was 8·25lb.

SCIENTIFIC SOCIETIES.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE first meeting of the sixth session was held on Monday, October 11. The president, the Rev. T. E. Espin, B.A., F.R.A.S., occupied the chair. Eighty-one members were elected and ten candidates were proposed. Of the total number, 15 were from Liverpool, 24 from other parts of England, 9 from Ireland, and 43 from North and South America. The Rev. T. E. Espin and Professors Asaph Hall and S. Newcomb were elected Associates of the Society. The secretary announced the deaths of four of the members during the past year. A short account of their lives had, he said, been prepared, and would be published in the *Journal*. The president complimented the Council on their able management. He thought the long list of members which the secretary had just read was without a parallel in any scientific society in the world, and likely to prove by far the most important paper of the evening. To the students of the educational branch he would especially address himself, and he thought he could promise they would never regret their choice of a science. Of all others, astronomy was the most fascinating, and the love of it only increased with its study. As an example of devotion he instanced Sir W. Herschel, who once spent more than forty hours of uninterrupted work in putting the finishing touches on his large speculum, and could not be induced to leave it even for food. It had been said that night work was injurious, but he had never found it so, though last winter he spent many nights knee-deep in the snow. Perhaps this immunity was in some measure due to the clearness of the air, since no astronomer would think of uncovering his telescope in foggy or rainy weather. He had headed this address "Stellar Variation: a Chapter in a World's History," and they would be prepared to hear that he regarded variation as a stage of development through which, perhaps, every star either has passed or must pass. Might not variation be due to stages of axial rotation? Let them suppose in the star's early history, a central heat and external vapours in a cooler state; they had then a spectrum of the third type. Let the axial rotation go on increasing, and the temperature also, then there would be a struggle between the hotter and cooler vapours, and we should have an irregular variable like 19 Piscium. Passing to a time when the rotation had quickened, they could imagine the absorption vapours more and more compressed in area; this would give a long-period variable with great variation in its light. Taking R Hydræ as an example, they would find its period in 1785, 500 days, but in 1825 it was only 461, and in 1870 it had decreased to 437; in other words, its rotation was now 60 days less. Let them suppose that a time would come when, by increased rotation and temperature, the vapour would no longer have power of cohesion, and would be thrown out irregularly all round the star. At this stage they might expect to find a spectrum merging from III *a* or into II, and the light irregularly variable. He forbore to speculate on the origin or the end of such a star, or whether it ever had been or would become a nebula, but these chapters in a star's history were full of interest. In variable stars they might read something of our sun's history. In the geological record had they any hints as to a past history of great variation? Those strata, each showing a higher period of development, were they impressions of contemporaneous solar development? Would our sun ever lose these vapours of absorption and stand out as a star of the first type like Sirius, with its present heat increased a hundredfold? How bright will it then be, and what will be the period of its rotation? Will animal and vegetable life exist under those conditions? Such questions must remain unanswered in our time, and we must be content to observe, to watch, and to record.

In a paper "On the Retardation of Encke's Comet," Mr. W. H. S. Monck, M.A., F.R.A.S., accounted for its slower motion by its passing through systems of meteors, rather than by the generally-accepted theory of a resisting gaseous medium. Wherever meteors existed the motion of any celestial body must be retarded by their influence, because a large majority must be coming from an opposite direction. This would be understood if they considered that in walking along a tram-line they would meet with more cars than would catch up to them; not only so, but the momentum would be greater as their own motion would, practically be added to it. The number of meteors flying about space was greater than most people imagined. It had been computed that the earth receives the impact of several millions in the course of a single day. In the case of a solid body like the earth the shock would be too small to be appreciable; but with a light body like Encke's comet, the effect would be to seriously retard the motion. Collisions with meteors would also be more frequent nearer the sun—at all events, up to the distance that Encke's comet approached it. Astronomers had inferred the presence of a great mass of meteors inside the orbit of Mercury as the only way of explaining certain irregularities in the motion of that planet, and, as both meteors and comets would then be near their perihelion, they would be moving with increased speed, so that the retarding effect would be greater. Mr. W. F. Denning, F.R.A.S., pointed out that in July and August, when the earth is further from the sun, there are quite double the numbers of meteors that are visible in January and February. This alone would go far to negative Mr. Monck's theory that meteors were more crowded near the sun. It should also be remembered that Encke's comet was not a cohert mass of matter, but a collection of very small bodies. The effects of its collision with meteor streams would therefore be of a very different nature to that in which a solid planetary body like the earth was concerned. A meteor stream would probably pass completely through Encke's comet—itself but a highly-condensed group of meteors—without affecting its motion. There would be virtual, but not actual, collision, except, perhaps, in the case of a very few individual atoms of the opposing systems. A solid body presenting a compact front would receive all the force of the impetus, but in the case of a comet and meteor stream there would only be permeation.

The secretary read a paper on the "Search for Vulcan," by Mr. T. W. Backhouse, F.R.A.S. It was of great importance that the existence of an intra-Mercurial planet should be determined, and a systematic watch ought to be kept during the period when, according to Leverrier's calculation, it was possible for Vulcan to be in transit. This would entail very little extra trouble now that the Society had so many observers in both hemispheres, many of whom were constantly watching the sun in the interests of other branches of the science.

Mr. T. G. Elger, F.R.A.S., addressed some remarks especially to beginners. In many respects, he said, a study of the moon presented advantages such as no other celestial body could claim. There we saw the actual surface of another world unobscured by clouds or exhalations, and could contemplate the marvellous details of its structure rather in the spirit of a physical geographer rather than of a telescopist. The beginner would soon see that the moon had been nothing like so exhaustively studied as to leave nothing for small telescopes to do. In commencing this study they should first make themselves acquainted with the more obvious characteristics into which its surface is divided, and in this they would be much assisted by Webb's, Mellor's, or other convenient maps. As a rule, they would find the majority of objects easier to observe when the sun had just risen on them. At those times the surface was brought into strong relief by shadows, the significance of which they would soon learn to interpret.

Mr. K. J. Tarrant counselled beginners not to be discouraged if they could not at once distinguish objects with small apertures. Nowadays, if a man wrote to say that he had picked up such-and-such an object, or had split a close double star, somebody else would be sure to do so with a smaller aperture; indeed, he sometimes wondered whether imagination had not a great deal to do with it. This kind of thing was very disheartening, and no

doubt many a good telescope had been condemned on very insufficient grounds. Of course, a great deal depended upon the air. As an example, there was one abnormally clear night last winter when the fifth and sixth stars of θ Orionis were quite easy objects; whereas on the next night, which was apparently quite as clear, they were not distinguishable.

Papers were also read on the "Classification of Variable Stars," by Mr. J. E. Gore, and on "Cassini," by M. C. M. Gaudibert. Other papers were received on "The Effects of Terrestrial Heat on the Moon," by Mr. W. H. S. Monck; on "Some Remarkable Sunspots," by Miss E. Brown; on "The Masses and Distances of Binary Stars," by Mr. J. E. Gore; on the "Lunar Crater Mädler," by Mr. T. G. Elger; and on "Interesting Facts about Binary Pairs," by Mr. K. J. Tarrant. Arrangements were made to hold educational classes fortnightly, and Mr. J. S. Brown, 274, Upper Parliament-street, was appointed secretary to the branch. A large number of donations of books, &c., were handed round for examination, and a vote of thanks was passed to the donors. The secretary stated that one of the new features of the *Journal* would be a review of the books presented to the Society, so that distant members would be acquainted with these additions to the library.

SCIENTIFIC NEWS.

From Dun Echt Circular No. 128 we learn that Mr. Ritchie, jun., of Boston, Mass., has circulated the following elements and ephemeris of the comet discovered by Mr. Barnard on Oct. 4, and by Dr. Hartwig on the next day: T = Dec. 11·40, G.M.T.; $\pi - \Omega$ 89° 26′; Ω 135° 39′; i 106° 15′—mean equinox, 1886; log. q 9·7763. The ephemeris for Greenwich midnight reads, Oct. 24, R.A. 11h. 23·5m., N. Dec. 4° 28′, brightness increasing up to Dec. 3, when, according to an extended ephemeris computed by Dr. Becker, the greatest N. Dec. (15° 18′) will be reached.

The comet discovered by Mr. Finlay will, according to Dr. Holetschek, of Vienna, arrive at perihelion on the 22nd of November. It is approaching the earth as well as the sun, and is becoming slowly brighter, travelling now in an easterly direction through Sagittarius.

Amongst the Gresham Lectures of the session we note that next week the Rev. E. Ledger will deliver four on the "Astronomy of the Last Twelve Months," on Tuesday, October 26, and three following days. On Tuesday the subject will be the meteors of Nov. 27, 1885, and recent achievements in celestial photography, the latter continued on Wednesday and Thursday, while on Friday the subjects will be recent observations of Jupiter and the great red spot, observations of Saturn, and Prof. Langley's investigations on Heat Radiations of long wave-length considered with reference to the sun, the earth, and the moon. We have indicated only the chief items to be taken up. The lectures are delivered at Gresham College, Basinghall-street, E.C., commencing at 6 p.m., will be illustrated by the limelight, and are free to the public.

It has been understood in connection with the Liverpool Astronomical Society that when a foreign country could count as many as fifty members, those members should be at liberty to form themselves into a branch society of the L.A.S. Pernambuco has, it appears, just sent in its fifty-first member, and it is not unlikely that it will claim the privilege, and Mr. G. W. Nicolls will probably be the secretary of the first branch with probably a hundred members before long.

The death is announced of M. Dubosc, the renowned Paris optician who assisted M. Leon Foucault in the construction of apparatus, and especially in the electric arc lamp which bears his name.

It is understood that a number of members of the British Association will visit Australia (Sydney probably) in 1888, and it is now proposed to hold a meeting of the various scientific societies of Australasia in that year, and to form an Australasian Association for the Advancement of Science on the model of the British Association.

Temperatures recorded by non-professional observers—too often merely copied or accepted on hearsay evidence—are not to be trusted. Not long ago a work was issued in which the extremes of temperature in different parts of the empire were given, and were freely quoted in the newspaper press without a suspicion of their absurdity. Dr. John Rae has politely attributed one of these extraordinary records to the "instruments" rather than to the observer, for in the *Times* it has been recently stated that the temperature ranges in the North-West prairie land of Canada from 58° below zero to 106° above zero in summer—a range of only 164°! It is well-known to observers of experience that thermometers, even when carefully made and tested, require skilled attention, for portions of the spirit become vaporised and detached during the hot weather. Dr. Rae expresses the opinion that the thermometer which indicated 58° below zero in Manitoba was from 13 to 15° in error. An instrument for measuring accurately very low temperatures is wanted as much as a reliable pyrometer for testing the temperatures of molten metals.

The effect of long-continued heat artificially applied to certain vitreous rocks, like obsidian and pitchstone, has been investigated by Mr. F. Rutley, of the Normal School of Science, whose paper on the subject has lately been published by the Royal Society. Thin sections of the rocks in their normal condition and after exposure to heat in a glass furnace have been studied microscopically, and the resulting changes of structure exhibited in a series of illustrations. It is not likely that in nature rocks are ever subjected to absolutely dry fusion; and hence another series of experiments is to be made, with the introduction of water, so as to imitate as closely as possible the actual conditions of nature.

The exhibition of Colonial and Indian woods at the Exhibition has introduced many who can appreciate their value to more remarkable specimens of timber than can be obtained in this country. Mr. Dougall says that from experience gained years ago he is convinced that in the stinkwood (Oreodaphne bullata) of the Cape we have an article of "national importance," if it is used only for the stocks of rifles and guns. It is so remarkably fibry and tough that it cannot be snapped. The sneezewood (Pteroxylon utile), too, is useful for piles, posts, cabinet, and waggon work, as its peculiar smell prevents the attacks of the teredo, and other wood-eaters. Umzumbit, another Cape wood, is admirably adapted for bearings, having, it is stated, a life seven times as long as lignum vitæ

The use of sugar, or a saccharine liquor, for mixing lime and cements has been known in some parts of the world from "time immemorial," and many of those whose business it is to make plaster moulds, or casts, mix the plaster of Paris with a solution of sugar in water. Surgeon-General W. R. Cornish calls attention to the fact that the practice of mixing jaggery, or unrefined sugar, with mortar is very ancient, and masonry properly cemented with such mortar is not easily removed without blasting.

Another petroleum engine—that made under Eteve and Hume's patent—has been recently exhibited, and favourable accounts have been published in the daily papers. The trials were made at the Holderness Foundry, Hull, where four engines were shown at work, two using benzoline, and two common petroleum. We illustrated the improved form of the Brayton hydrocarbon engine so long ago as March 9, 1877, but little has been done with petroleum engines in America since.

The Company of Carpenters intend opening a Workman's Institute and Lecture Hall in Jupp-road, Letts-road, Stratford. In connection therewith it is proposed to establish classes with workshops for carpentry, joinery, plumbing, and other trades connected with building; also cooking classes for young women.

At the meeting of the San Francisco Microscopical Society, held on Sept. 22nd, Dr. Stallard delivered a brief address on "Endarteritis," or morbid development and subsequent degeneration of the interior coat of arteries. The structure of the three layers of tissue of which arteries are composed was described in detail. The interior coat, it was explained, was most liable to become morbidly affected. When the blood is forced through an artery at an abnormal velocity the interior layer manifests a disposition to resist the increased pressure by thickening, and should the pressure be of long continuance it frequently results in the formation of a tissue lining the interior of the artery which, constantly increasing in thickness, obstructs the flow of blood through the vessel more and more, until in many cases the artery is completely closed. This morbid growth is frequently traversed by pseudo blood-vessels, but ultimately becomes completely disorganised, usually by petty degeneration. During the complete or partial obliteration of an artery, nature usually attempts to remedy the evil by a greater flow of blood through the adjacent smaller blood-vessels, and under the unusual pressure these frequently burst. Dr. Stallard exhibited a large number of preparations showing arteries in their normal condition, as well as during the gradual progress of the disease. The preparations were stained with various re-agents, and were much admired for their beauty and interest. The secretary, Mr. A. H. Breckenfeld, exhibited a slide of the beautiful diatom *Arachnoidiscus Ehrenbergii*, the frustules of which had been electro-plated with gold by Dr. A. Y. Moore, of Cleveland. The slide was not only strikingly beautiful, as seen under the binocular microscope with a ½in. objective; but the plating process was evidently of value in rendering the markings more distinct. In this particular case, the true elevation of the radial costæ was much more obvious than in the natural diatom.

USEFUL AND SCIENTIFIC NOTES.

Exhibition at Toulouse.—A permanent exhibition of patented inventions, improvements, and new productions will be opened at Toulouse on the 1st of November, under the patronage of the local Chamber of Commerce. The aim of the promoters is "to centralise on one spot inventions, improvements, and new or useful productions which are scattered in various depots almost without interest and without success; by a constantly attractive exhibition, with free admittance, to bring together those interested from the whole district to visit this industrial, commercial, and agricultural museum; and to concentrate the efforts for publicity and representation of the exhibitors, to obtain, by the power of union, a maximum of results with a minimum of expense."

Large Docks.—The docks of the world 500ft. in length and over are as follows:—Birkenhead No. 1, 750ft. long, with a width of 85ft., and a depth of 25ft. To save repetition it may be said that the figures which follow for the other docks are in the same rotation as those above. Birkenhead No. 2,750ft., 50ft., 25ft.; Portsmouth No. 10, 644ft., 88ft., 27ft.; Portsmouth No. 7, 644ft., 80ft., 25ft.; Carleton, N.B., 630ft., ——, 28ft.; Sydney, N.S.W., 630ft., 84ft., 30ft. 6in.; Gawel, Greenock, 515ft., 70ft. 24ft.; Liverpool, "Canada," 501ft., 100ft., 26ft.; Auckland, N.Z., 500ft., 110ft., 33ft. on the sill; Table Bay, South Africa, 500ft., 68ft., 26ft.; Cadiz, 500ft., 62ft., 26ft.; Quebec, 500ft., ——, 24ft.

Glass, porcelain, and other metals can be soldered by an alloy made as follows: Copper dust, obtained by precipitation from a solution of the sulphate by means of zinc, is put in a cast iron or porcelain-lined mortar and mixed with strong sulphuric acid, specific gravity 1·85. From 20 to 30 or 36 parts of the dust are taken, according to the hardness desired. To the cake formed of acid and copper there is added, under constant stirring, 70 parts of mercury. When well mixed, the amalgam is carefully rinsed with warm water to remove all the acid, and then set aside to cool. In ten or twelve hours it is hard enough to scratch tin. When required for use, it is to be heated so hot that, when worked over and brazed in a mortar, it becomes as soft as wax. In this ductile form it can be spread on any surface, to which it adheres with great tenacity when it gets cold and hard. This alloy is intended to be used to solder such articles as will not bear high temperature.—*American Druggist.*

Chamois skin may be cleaned by rubbing into it plenty of soft soap and then laying it for two hours in a weak solution of soda and warm water. At the end of this time rub it until it is quite clean, rinsing it in clean warm water, in which soda and yellow soap have been dissolved. It should then be wrung dry in a rough towel, pulled and brushed. This process makes the leather soft and pliable. It should never be rinsed in clear water. The soapy water causes it to become soft.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

VEGA AND ITS SURROUNDINGS—PLANISPHERE—α ARIETIS—VISIBILITY OF THE MOON BY EARTH-SHINE—ALLEGED MEASURABLE INTERNAL MOVEMENT OF THE EARTH'S AXIS OF ROTATION—MEASURES OF DOUBLE STARS: STRUCTURE OF THE SIDEREAL HEAVENS, &c.—ABSENCE OF BASIS OF ARGUMENT.

[26389.]—SINCE writing letter 26279 (p. 84) I have returned home, and availed myself of the earliest opportunity of examining the field about Vega, as requested by Mr. Sadler; I regret to say with a practically negative result. Of course, the comites A and B of his map on p. 10 were steadily seen. Sometimes either δ or γ would flash up for a few seconds, but I could not hold it long enough to estimate its magnitude even roughly. I fancied that I caught another of his stars, too (the largest in the southern part of the field); but it may have been merely fancy. The detection of such very minute points is rather beyond my instrumental capacity.

If "Al Farad" (query 60622, p. 141) will reflect a little, he will see that it is impossible to delineate the stars covering the concavity of the heavens on a plane surface save by some mode of "projection." Suppose that this is the equidistant polar one. Then if the Pole were in the zenith (as it would be at the North or South pole of the earth) the plane of the horizon on the map would coincide with the plane of the Equator, and would be a circle. But this would not hold good anywhere else, because the plane of the visible horizon, although, of course, itself a circle, must obviously be inclined to the plane of projection at an angle = the co-latitude, and be projected on that plane as an ellipse whose eccentricity would depend on the latitude. "Al Farad" may get some idea of this if he will first stand a cylinder upright upon a plane surface, when, of course, its base will be circular. If now, though, he inclines his cylinder at, say, an angle of 51° to the original surface, and cuts the bottom of it parallel to such plane, so that it may remain permanently at that altitude, he will find on inspection that the bottom of the cylinder is now no longer circular but elliptical. With reference to his question concerning α Arietis, "Al Farad" will find that Smyth, in the "Bedford Catalogue," gives its position angle as 107°, the difference of R.A. of the components 19·5 seconds of time! and their magnitudes as 3 and 11. Turning now to Loomis's "Practical Astronomy," we find α Arietis among his tests of illuminating power. Of course for this purpose position angles are not given; but the American astronomer, while adhering to Smyth's magnitudes, gives the distance of the components as only 30″. I am quite unable to give any explanation of this discrepancy.

In reply to "Vortex Atom" (query 60625, p. 141) he has been told quite correctly that the visibility of that part of the moon unilluminated by the sun is referable by earth-shine. Five minutes' study of the diagram of the moon's phases which have appeared in every book on astronomy yet published will show that when the moon is "new" to the earth, the earth is "full" to the moon, and as the surface which we present to our satellite is more than thirteen times the size of that which she exhibits to us, at such time she receives light enough from us to render her otherwise dark limb visible. But, of course, as the moon waxes to the earth the earth wanes to the moon, and ultimately sends her too little light to be returned in a visible form. The phenomenon of "The old moon in the new moon's arms," as the country people call it, is visible for a few days both before and after new moon: in fact, the earth-illuminated part of her disc is rather brighter before new moon than after it. The illusion that the sunlit crescent of the moon is larger in diameter than that perceived by earth-shine is an optical one, having its origin in what is known as "irradiation," in virtue of which every bright object appears to encroach upon its darker surrounding. "Vortex Atom" may make a very instructive experiment on this for himself, if he will get a sheet of black and a sheet of white paper, and superposing them, cut out two discs of identical (say 1in.) diameter. If now he will paste his black disc on his white paper, and his white disc on his black paper, the latter will seem so notably the larger of the two that but for the fact that he has cut them out with his own hands he will find it difficult to persuade himself that they are of the same size.

In letter 25273 (Vol. XLII. p. 446) I expressed grave doubt as to the truth of an assertion by M. Folie, the Belgian Astronomer Royal, that the poles of the earth shift measurably upon its surface. In reply to this, "some person or persons unknown" attacked me in the number of *Ciel et Terre* for February 15th, and invited my attention to the (alleged) fact that Maxwell, Peters, and several others had not only calculated but measured the small displacements of the pole. Well, in M. Flammarion's review *L'Astronomie* for the current month, there appears an article on this subject by a very much greater astronomer and mathematician than I am, or even (I write it with fear and trembling) than M. Folie himself—I mean Professor Asaph Hall, of the United States Naval Observatory at Washington, the world-renowned discoverer of the satellites of Mars. In this very valuable essay (which, as it is in French, I trust M. Folie will read for himself) after a short explanation of M. Fergola's projected series of observations to be made at intervals of 50 years, at several pairs of observatories differing but slightly in latitude in various parts of the globe, for the purpose of ascertaining whether there is really any secular change in latitude or not, Mr. Hall goes on to discuss the question whether terrestrial latitudes are subject to alteration in the course of the year; and, after treating the subject exhaustively, comes to the conclusion that they are *not.* Or, at all events, if there is any such alteration, it is of so extremely minute a character, as quite to elude our existing means of observation. This is really in effect the conclusion at which La Place arrived, and which he thus expresses in his "Système du Monde": "Mais toutes les recherches qui j'ai faites sur le déplacement des pôles de rotation à la surface de la terre m'ont prouvé q'uil est insensible." So if I erred—as to which a difference of opinion exists between M. Folie and myself—I have had the satisfaction of doing so in very good company indeed.

Having returned to my books, I will now endeavour to redeem the promise I made to Mr. Atkinson in letter 26279 (p. 84) to reply to his query (60369) on p. 46. Imprimis, with reference to δ Cygni: Mr. Muschamp Perry's own letter, on p. 330 of the *Observatory* for October, will probably have removed all my querist's difficulty with reference to the seemingly great discordance in the measures of this star. Next, the latest measures of 70 Ophiuchi that I can lay my hands on are those of Seabroke, made in 1883·69, when he found the position angle was 43·7°, and the distance of the components 2·77″. But see the *Observatory* for May, p. 199. With reference to δ Herculis, it was measured by Flammarion in 1877, when its position angle was 181·6°, and distance 18·43″. In the same year (1877·66) Jedrzejewics found the quantities to be 182·9″ and 18·1″ respectively. Seabroke measured ξ Scorpii several times in 1883. His last measures (1883·64) gave A B position angle 194·5° distance 1·14″, and A C 71·8° position angle, and 11·8″ distance. Of Σ 2525 Cygni, the three latest measures I can find are those of Schiaparelli in 1876—position angle, 232·2°; distance, 0·43″: of Dembowski in 1877·82—position angle, 238° (?) distance, 0·25″(?); and lastly, of Engelmann in 1883·26—position angle 47·9°, distance 0·234″; whence it is not difficult to understand why your correspondent fails to see it otherwise than single. Sir William Herschel says that the distance of 46 Draconis is about 1½! Finally, the only omission in Secchi's remarks (which are to be found in columns 238 and 239 of Vol. XLI. of the *Astronomische Nachrichten* for 1885) occur where the . . . . appears in the quotation on p. 385 of "Celestial Objects for Common Telescopes." The words suppressed are merely ("car elles supportent très bien l'illumination"). All that Secchi says about Cygnus is this: —"Je signalerai aux astronomes ce que s'observe surtout à 17h. 57m. d'A.R. et 18° 50″ de Decl. Aust., comme une place qui contient une foule de ces particiliarités; même dans le Cygne il y a plusieurs examples." Not a word does he utter, though, about their situation in Cygnus.

I have, on rare occasions, seen some pretty wild stuff in these columns; but I am not sure that, as a specimen of hopeless rubbish anything has ever appeared to surpass letter 26387, on p. 156. Why in the world does not "F. T.," before presuming to attempt to instruct others, get up, at all events, the very rudiments of the subjects of which he proposes to treat. Any shilling book on Mechanics would have saved him from his astronomical utterances; while, concerning his geology, it may suffice to remark that he writes, as, though the various "formations" found in these islands extended round the globe like the coats of an onion!

A Fellow of the Royal Astronomical Society.

SUNSET PHENOMENON.

[26390.]—On the evening of 30th September last, about 6.5 p.m., the sky being very clear and quite free from clouds, I noticed four pinkish streamers radiating upwards from the sun's place; they did not commence exactly at the horizon, but at a height of a few degrees above it, and terminated at an altitude of 10° or 15°. The phenomenon lasted about three minutes and then totally vanished.

I may say that in various parts of South Africa, where a succession of cloudless days and nights prevail for a considerable time, I have seen the same thing, only in a vastly more intensified and glorious phase. There roseate-purple streamers projected on a deep blue sky would extend across the heavens and meet in the eastern sky at a point presumably 180° from the sun's place, and approximately as much above the horizon as he was below it. The rays were so vivid that it was difficult to believe they were not clouds; but their geometrical structure, and the fact that Venus would shine perfectly through them, quite discountenanced the idea of a cloudy origin. I noticed this particularly on 10th October, 1880; but the streamers were not seen regularly, or of the same intensity on different nights.

Perhaps some of your enlightened correspondents can say what is the cause of these streamers. I have never been able to satisfy myself on the subject. Are they due to clouds below the visible horizon through interstices of which the sun's rays are refracted? If so, why should they always appear pink? Or are they due to aqueous vapours in the upper regions of the atmosphere? They are quite distinct from either the "pink glows" or Zodiacal light.

Woolwich, Oct. 16. **E. E. M.**

PARALLAXES OF STARS.

[26391.]—IT will be remembered that the distinguished American observer, Prof. Asaph Hall, published in 1882 a volume containing the results of the parallaxes of Vega and 61 Cygni, which he had found by using the 26in. refractor at Washington. The results he arrived at were + 0·1797″ for Vega, and + 0·4783″ for 61² Cygni; corresponding to light distances of 18·11 and 6·80 years respectively. Prof. Peters, of Clinton, U.S., having pointed out that the correction for temperature to the value of the screw had been applied with the wrong sign, Prof. Hall undertook another investigation with the same instrument, the results of which, together with his determinations of the parallaxes of the ternary star o^2 Eridani and the double star Cygni 6 (Σ 2486), have just appeared as Appendix II. to the Washington Observations for 1883. For both stars the values now found are smaller; that of Vega, from observations extending from May 24th, 1880, to July 2nd, 1881, and comprising 128 different observations, is + 0·134″ ± 0·0055″; and that of 61² Cygni = + 0·270″ ± 0·0101, from 101 observations extending from October 24th, 1880, to January 26th, 1886. This latter value is much smaller than most modern determinations. Otto Struve found + 0·509″, Auwers + 0·564″, Sir Robert Ball, + 0·467″ and + 0·465″. All these are, of course, *relative,* not *absolute,* parallaxes, and some of the discrepancies between the observations may be due to the employment of different comparison stars. It is curious that since the time of Bessel (whose final result was + 0·348″) the parallax seems to have increased, until these latest results of Hall's have again reduced the value. His parallax answers to a light passage of 12¼ years. The only good absolute value of the parallax is that found by Dr. C. A. F. Peters in 1846 from observations at Pulkova, and is fixed by that astronomer at + 0·349″, curiously similar to Bessel's final value. This would give a light passage of just under 9½ years. All modern observations of the parallax of Vega agree very fairly, Hall's corrected value giving a light passage of 24¼ years. The only previous determination of the parallax of o^2 Eridani, a ternary star of long period and large proper motion, is Dr. Gill's, who, with the heliometer at the Cape, found a parallax of + 0·166″, answering to 19·9 years' light passage. Prof. Asaph Hall finds a parallax of + 0·223″, agreeing very fairly with Dr. Gill's; the time taken by light to reach the earth from that star being fifteen years. The orbit of the close distant pair of this wonderful ternary star has been computed by Mr. Gore, who seems to have succeeded Dr. Doberck in Ireland as a successful calculator of the orbits of binaries. He finds a period of 139 years, the masses of the two small stars being together about equal to that of the sun. The distance between the little pair and the great sun round which they

mutually revolve must be something like 380 times greater than that between the earth and sun, and the period something stupendous. The last parallax determined by Prof. Hall in this volume is that of the pretty pair Σ 2486, 6 Bode Cygni, which has an annual proper motion of 0·63″ (that of o^2 Eridani is 4·1″ a year). In the 5th part of the Dunsink Astronomical Researches Sir Robert Ball assigns a value of + 0·422″ ± 0·054 for the parallax of this interesting pair. He remarks, "It will be desirable that this result should be tested by other investigations. I propose to re-examine the question again. Pending the re-examination, I would regard the present determination of the parallax as merely provisional; though I think it can hardly be doubted that a parallax of very considerable amount really exists. It is impossible not to be reminded of 61 Cygni, which is in the same constellation, and has a parallax of 0·4676″ according to the discussion contained in the present Volume. It should also be observed that Σ 2486 and 61 Cygni are each doubles of the same general character, and have each a large proper motion." Prof. Hall, however, finds the parallax, from three different investigations, to be absolutely insensible, the first set giving a *minus* parallax of 0·094″; the second again a *minus* parallax of 0·137″; the third an exceedingly small positive one—viz., + 0·023″. The mean he assigns is − 0·021″ ± 0·0077″, from 54 observations between July 31st, 1883, and April 15th, 1886. It is impossible even to glance cursorily at Prof. Hall's investigations without being struck with the enormous amount of labour involved, and the care taken to exclude systematic and other errors.

October 18. **H. Sadler.**

EGYPTOLOGY.

[26392.]—In reply to "P." (26368), I assert that the Samaritan version is against him. It says: "The sojourning of the Children of Israel in Egypt was 430 years." Well, who were the Children of Israel? Why, the descendants of Jacob, of course—not the descendants of Abraham, as such. But suppose the Samaritan version did say otherwise, would that make Exodus xii. 40 and 41 correct? Certainly not. If the Children of Israel—that is, Jacob's descendants—*did not live* 430 *years* in Egypt, Exodus is clearly and unmistakably wrong, and yet "P." says they did not, and at the same time objects to me for not relying on the statements made.

"P." should compare the four generations before the Hebrews went into Egypt with the four spent in it. At the end of the first four the direct line through Jacob had 70 persons; add Esau's descendants (not followers), say 1,000; add also 2,000 for Ismail (a liberal allowance truly), and so we find at the end of the first four generations 3,070 persons who might be called Hebrews. If instead of one Abraham there had been 35, the result would be a population of 107,450.

In David's time his census states that there were 1,300,000 men—about double the number mentioned in Exodus xii. 37—not to mention the "mixed multitude" that went with them; so when we compare the development of the people *before* or *after* their stay in Egypt, we find their rate of production quite different from what it is alleged to have been when there.

"P." insists on counting 20 generations instead of four; but, even on his own suggestion, he is wrong; as if we allow the length of life to be 100 (long enough, I hope), and each new generation to begin at 25 (his statement), the term for four generations would be but 175 years; but the time to be covered, I must insist, is 430 years, not 175, and the number of generations is only four, so I insist a discrepancy or error exists.

"P." appears to imagine that the second generation must not begin till the first; but that assumption is arbitrary, and, I think, plainly false.

"P." says, "if he insists on four generations, he is confronted by the increased length of a generation as set forth by 'Memnon'"; but as "Memnon" does not believe in the increased length of a generation, there must be some other answer, and that is that the statement *is not historical*, but merely vague and poetic, and cannot be dealt with as a scientific fact.

"P." should remember that the Shepherd kings had an army of 600,000 when driven out of Egypt, and that a tradition may have remained of that number among the Israelites. If the Israelites were left after the shepherds departed, they cannot have been very numerous. Their numbers may have been added, too, when Rameses II. occupied Palestine, and these captives may have been those who had to do brick-making, while the others may still have been shepherds, as they say they brought their flocks and herds out of Egypt, and it is hard to suppose the poor brick-makers had many flocks just then. That a considerable number escaped into the wilderness of Sinai (not then as much of a wilderness as now), and ultimately joined the main body of their countrymen in Palestine, is probable; but to rely on words or numbers seems wholly unsound. **Memnon.**

[26393.]—In reply to "Memnon" (26369), I would ask to be allowed to say—as to Numbers i. and iii.—that all human testimony is more or less imperfect. Testimony respecting what is alleged to be Divinely revealed is no exception to this rule; nevertheless, many important questions upon which life and death, and even the destinies of nations, hang have to be settled by such relatively imperfect testimony. To exclude the testimony of the Bible, which is the obvious design of "Memnon," on this account exhibits the bias of a party. Apply the same rule to the chaos of Egyptian history, monuments, and inscriptions, where it has been discovered that monarchs have effaced inscriptions and then put their own names to deeds and days which they have never seen, and of course we would be required to reject their testimony also, and with much greater reason. That the Hebrews should have handed down to us the genealogies we have received is very remarkable. That there are some links wanting is not remarkable. It becomes us to make the best we can of their testimony, and show fairness, not prejudice, in dealing with it.

I have given what Gesenius held in regard to the Hebrew generations. "Memnon" gives what he *imagines* he would hold. Suppose "Memnon" tendered his imaginations as evidence in a court of justice, what would be thought of it?

"Memnon" has here given us a perfect sample of the methods of the so-called "Philosophical and Critical School," which, by the way, is now on its last legs, and Strauss's theory the greatest of mythics.

No. 4.—"Memnon," by an oversight, makes me follow the Septuagint, which, if he looks again, he will find I do not.

My authority for the "about" in 1 Kings vi. 1 is Fairbairn's Biblical Dictionary.

No. 6. The absolute omission of all mention of Israel in Egypt, if such were the case, as it is not, would not be conclusive evidence against their being there. There are many illustrations of this. Goldsmith's "History of England" makes no mention of the Great Plague or Fire.

No. 7. Israel in Egypt is represented for the most part as living separate from the Egyptians, and as even being an abomination to them.

I may follow "Memnon" obversely, and write good authorities say that the early books ascribed to Moses are written in Hebrew, which show them to be copies of others of the very earliest date; but we have something more reliable than this to turn to. It is a good rule that questions must be settled by the best evidence which we have. In this case we have the following.

Tradition manifestly as ancient as the writings themselves uniformly ascribed the Pentateuch to Moses. The earliest Jewish writings confirm this tradition. The prophets are unvarying in their testimony to the same; Christ and all the writers of the New Testament bear an identical testimony. Josephus and all Jewish historians, as far back as they go, bear their unequivocal testimony to the authenticity of the Pentateuch. There is no counter testimony, traditional or historical, which is unaccountable, and it would seem impossible, if Moses were not the real author of these books. What has been adduced amounts to good proof and sufficient to establish such a fact in law.

The plain honest sense of Deuteronomy xviii. 2., and of the word "necromancer," is that of a person dealing with the spirits of the dead. This proves that Israel believed in a life beyond death, and this, be it observed, is the only natural immortality directly taught in the Old or New Testaments.

As to "Memnon's" idea of what it proves at the Captivity, that is only another piece of imagination of the philosophical and critical school, wholly unsupported by anything that would go for right evidence. I therefore beg to hand over to him the responsibility of *twisting words*, of which he speaks. **Ramases.**

October 16.

[26394.]—If the statements in the Hebrew Bible are followed (without troubling about the Septuagint) there does not appear to be any particular difficulty in regard to the generations, or the 600,000 men of twenty years old and upwards. The prediction is given to Abraham (Genesis xv. 13) that his seed was "to be a stranger and a servant in a land that was not theirs for four hundred years." And Stephen quotes the words again in Acts vii. 6; while the four hundred and thirty years mentioned by St. Paul (Gal. iii. 17) agree with the statement in Exod. xii. 40, 41) that such was the length of the sojourn of the Israelites in Egypt, and are, therefore, not to be understood of the whole interval from Abraham to Moses. The genealogies, which give only four generations in Egypt — as, Levi, Kohath, Amram, Moses (Exod. vi. 16-20); and, again, Judah, Zerah, Zabdi, Carmi, whose son Achan, in Joshua's time, stole some of the spoil of Jericho (Josh. vii. 1), appear on the face of it to be compendiums, in which a name is given for a century, and at the same time legal documents, showing who was the representative of each branch of the families of the chiefs or head men, because in the full genealogy of Joshua, given in 1 Chron. vii. 23-27, we find he was the twelfth in descent from Joseph; so that, taking the 70 persons who went down into Egypt with Jacob (leaving out the households and followers), and giving twelve generations, the 600,000 men of twenty years old and upwards are no more than ought to be. **Dens.**

RAILROAD FARES.

[26395.]—Looking over a file of the *Times*, I have noticed the following table prepared exactly twenty years ago (*Times*, 27th September, 1866). I am sure it would interest many other subscribers to see a similar table brought down to date, and to know whether or not Great Britain still retains its pre-eminence for high fares.

Railroad fares reduced to sterling per 100 miles.

	First.		Second.		Third.	
	s.	d.	s.	d.	s.	d.
Russia...............	14	5	10	10	3	0
Prussia	12	6	10	0	3	2
do. express......	14	0	12	0	—	
Rhine	11	10	8	0	3	10
Norway	13	0	9	0	4	6
Sweden	11	0	7	6	4	9
Bavaria	10	0	7	0	4	10
Belgium	10	3	7	6	5	0
Wurtemburg	10	3	6	8	5	1
Denmark...........	12	0	9	0	6	0
Spain	14	7	10	5	6	3
Austria	13	0	10	3	6	6
Saxony	11	0	8	3	6	3
Switzerland	12	0	9	0	6	8
Italy	14	0	10	6	7	0
do. express	16	0	12	0	—	
Portugal	13	3	10	0	7	0
Holland	14	0	10	6	7	0
France..............	14	6	11	0	7	6
Great Britain ...	18	6	13	4	8	0
do. express......	21	0	16	8	—	

H. B. F.

RAILWAY SIGNALS.

[26396.]—"Libra" has pinned Mr. Stretton into a corner, and the latter is now trying by play of words to avoid a reply direct. I have, in support of my previous assertions, only to ask you to kindly publish the inclosed letter by Driver Edward Bentley, of 33, Stoughton-street, Leicester, which appeared in the official organ of the Amalgamated Society of Railway Servants on the 1st instant, in reply to a report by Mr. Stretton, which will clearly show that the latter's knowledge of signals at his native town is, if not extensive, at least peculiar. Driver Bentley says:—

"Sir,—With reference to the slight collision which occurred on the 8th inst. [Sept.] between Leicester and Knighton Junction, I should, with your kind permission, be glad if allowed space to contradict such gross falsehoods. Your informant says the starting signal was lowered to allow the train to draw forward. The driver put on steam, passed it, and also passed the advance starting signal, which stood at danger. Now, sir, I am in a position to state that there is only one starting signal at this point, and that was off, as admitted by your informant. Then, again, he says both signals, which the driver failed to observe, were obscured by smoke. I am able to give this a flat contradiction, as there was no smoke from a passing train. He says again that the porter saw the home signal, meaning the cattle dock home signal, and applied the continuous automatic brake. I say also this is false, for this brake cannot be applied without the driver knowing, unless the guard applied it at the same instant as I did myself, for a train can so quickly be brought to a stand with steam on, and in this case steam was shut off, and I, as driver, was prepared to stop, and would have done so had not the line been on the curve with a long carriage siding filled with the same been there. By inserting this you will greatly oblige."

Your readers are becoming familiar with the words "law," "solicitors," "libel," &c.; but they must not be misled. At the time Mr. Stretton asked me, through the English Mechanic, to reveal my address he had in his hands the letter I had written to another journal, and was fully aware of my address.

I have declined to take notice of any communication which does not come through a public journal, and must continue to do so.

G. L. Watkinson.

THE LONDON AND N.W.R. ENGINE CORNWALL.

[26397.]—At various times during the past ten years several correspondents of the English Mechanic have asked for some information

as to the working of the engine Cornwall, No. 173, of the London and N.W.R., but this has never yet been forthcoming. The engine itself is absolutely unique, being the only one in existence with driving wheels 8ft. 6in. in diameter, and since the alteration of the B. and E. engines (Nos. 2,001, 2,002, and 2,003), by reducing the diameter of the drivers from 8ft. 10in. to 8ft., Cornwall has the largest wheels of any locomotive in the world; consequently, a good deal of interest attaches to her performances, and I have often regretted that no details were given. "Itzaex" (whose long disappearance from these columns I greatly deplore) promised to send some, but they have never appeared.

I am now able myself to furnish a little information on this subject. During my visit to England last year I had several runs with "Cornwall." She was then stationed at Whitchurch, and was running between that place, Crewe, Shrewsbury, Chester, Birkenhead, and Manchester. Her best work was with the 2.15 p.m. Manchester to Crewe, 3.47 p.m. Crewe to Chester, 12.27 p.m. Stafford to Crewe, and 1.53 p.m. Crewe to Manchester. With the two first-named trains she easily maintained a general speed of 55 to 60 miles an hour after "getting into swing." The 3.47 Crewe to Chester is timed at 49 miles an hour to the ticket platform, and the 21 miles were run in 25 minutes, or at the rate of 50·4 miles an hour. With the 12.27 from Stafford, the distance of 24½ miles to Crewe was done in 29 minutes, including starting and stopping, or at 50·7 miles an hour, the ascent of the Whitmore bank being included in this run. Down the bank a speed of 70 miles an hour was reached. With the 1.53 from Crewe the first length of 17¼ miles to Alderley was accomplished in 19½ minutes, a speed of 70 miles an hour being attained. The engine was remarkably steady at high speeds; indeed, of the many express engines on whose footplates I have travelled at such speeds, I cannot remember any having been speedier than this old Cornwall, now within a few months of being 40 years old, having been built in 1847. Originally she had the boiler slung below the axles, but she was rebuilt by Mr. Ramsbottom in her present form.

I should add that in all the cases referred to above the trains were light, consisting of four to six coaches, and the engine invariably slipped excessively at starting. I never saw her on a heavy train; but her driver, who appeared a very intelligent man, assured me she had taken 18 coaches from Stafford to Crewe in 35 minutes. That, however, did not come under my personal notice, so I merely mention it in passing. The small tractive force of the Cornwall manifestly renders her unfit for heavy loads; but judging from what I saw of her work she ought to do well with light, swift trains on a level road, such, for instance, as the Liverpool and Manchester expresses. I heard, however, at Crewe that next time she needed heavy repairs she would be condemned and placed in a museum as an interesting relic.

Wellington, N.Z. **Charles Rous Marten.**

BODIES FALLING FROM TRAINS IN MOTION.

[26398.]—MR. STRETTON may have experimented with heavy bodies falling from trains in motion, and if he would give the results they would be most interesting; but he surely is wrong in his explanation of the cause of the body not falling on the footboard immediately under the window from which it is dropped. The second law of motion, suggested by experiment, may be thus stated: "A force acting upon a body in motion will produce the same effect on that body in its own direction as if it acted upon the body at rest." I maintain that if the train were running in vacuo the body let fall outside the window would continue to move forward as fast as the train until gravity had brought it to the ground or the footboard, since the body, before being dropped, had the same horizontal velocity as the train and the force of gravity acting in a direction perpendicular to it could not alter this. When, however, the train is moving through the air the resistance of the air does decrease this horizontal velocity. Supposing the body falls 4ft., the time occupied by this would be a little less than half a second. If the train is running at 60 miles an hour, in half a second it would run 44ft., and the falling body, neglecting the resistance of the atmosphere, would move forward 44ft. while it fell 4ft. under the action of gravity. Experiment alone could determine if the resistance of the atmosphere would reduce this 44ft. to 42ft. It is possible that it might; but I am quite sure that any retardation there is, is due entirely to the resistance of the atmosphere. When the body is dropped inside the compartment, there is no horizontal resistance of air to overcome, as the air is also moving forward with the same speed as the train.

T. Perkins.

[26399.]—IT is a well-known and ascertained fact that bodies let fall in vacuo, while upon moving objects, drop quite similarly to what they would do if object they were on were at rest. During the passing of an object from a railway carriage window to the footboard, the air and variation in the speed of the train could alone cause rearward motion—that is, if the object were simply dropped. The possible alteration of speed in a train going fast could but cause a minute divergence. An object in contact with the footboard would probably rebound at an angle about equal to the angle of incidence, and this might increase rearwardness. A simultaneous upward jolt on the part of the carriage would considerably aid it, as would also a rising gradient. If a train ran for some time on the level, after dropping of object, the latter would shake down to lowest level on footboard, the which might be a hollow to the rear. If, again, the train were going up an incline, or the average journey were upwards, the object might take up a rearward position in excess of the result of a simple fall. **Vulcan.**

[26400.]—I CHARITABLY supposed that the suggestion on p. 115 [that the laws of falling bodies (by which I understand the action of gravity) would retard the forward motion of a falling body so that if dropped from a carriage window on to the step it would fall behind the window instead of directly under it], was a mere slip of the pen; but it seems that such is really Mr. Stretton's opinion on p. 155.

I do not for a moment question the possibility, or rather the probability, of a body having attained a position of rest on a railway carriage-step remaining thereon; in fact, I should be rather surprised if it fell off, unless very small or adapted to roll.

A train is generally moving pretty rapidly through the air, so producing what is popularly called a wind, moving backwards relatively to itself—this is what I meant when referring to the "wind"—though it would, perhaps, be more correct to speak of the train moving relatively to the air.

The resistance of this wind is considerable, as may be ascertained by holding a hand outside the window of a railway-carriage in rapid motion, and this "wind," i.e., the resistance of the air, and nothing else, Mr. Stretton, is the sole cause which could make the pistol fall on one side or the other of a spot on the footboard plumb with the point from which it was dropped. I say one side or the other, for if the wind were blowing in the same direction as the train and a little faster, the object would fall in front of the spot on the footboard which I have mentioned.

If the wind were travelling at the same speed as the train, the pistol would fall plumb on to the step, unless it were diverted by the eddies always accompanying a train in motion.

That this is so may, of course, be shown by dropping an object inside a carriage. The air then offers no resistance affecting the direction of motion, as it is moving with the carriage, like the wind in the last example. The object, if the train is moving at a uniform pace, will fall in precisely the line it would traverse were the carriage at rest.

Without trial, I cannot say how much the wind outside the carriage would displace the object as it fell; Mr. Bennett (page 157) might try the effect of dropping a piece of stick from a carriage window. A walking-stick held out of a window is far from offering no resistance.

In conclusion, as Mr. Stretton hints that he may have to give evidence on this subject, I trust that he will first read up the subject in some elementary book of mechanics. See p. 25 of Goodeve's "Principles of Mechanics," 1885 edition, for instance, where the very question is discussed, and the motion shown to be the same as I have stated, if the resistance of the air is left out of account.

It would be interesting to have particulars of the practical experiments to which Mr. S. refers.

Glatton.

LAUNCH ENGINES.

[26401.]—IN replying to Mr. W. H. Taylor (letter 26348) I hope he will not think me discourteous when I say that his design is very poor. As mentioned by "Engineering, Manchester," the type (if, indeed, it may be termed a type) of compound engine with two h.p. and one l.p. cylinders has never given good results, and is very rarely met with. The reason is that the back pressure on the h.p. pistons is very great, and the steam being taken in "snatches" from the receiver tends to make the turning irregular. But with one h.p. and two l.p. cylinders admirable results have been obtained. In this type, owing to the instant "draw" on the receiver, the back pressure on the h.p. piston is greatly reduced. This type of engine has been extensively adopted in the Atlantic steamers such as the *Etruria, Umbria, Servia.* With regard to altering your engine, by all means add a condenser. This will give you a substantial increase of power and economy. And if you wish to compound the engine the best way will be to add two new cylinders 3in. in diameter, and use them as high pressure, retaining the present ones for low pressure. But remember your engine will, theoretically, be rendered no more powerful by compounding, and the only advantage you will obtain practically is a little economy. I cannot recommend you to compound your engine, as I am sure you will be disappointed. I cannot make out from your letter what your boiler pressure is. Remember 60lb. to the square inch is the lowest that will work even a condensing compound engine with economy; pressure of 80lb. is desirable. So far as I can judge from your letter, the addition of a condenser to your engine can easily be made, and I would advise you before altering the engine any more, to see if the condenser will increase its power sufficiently. If not, then publish your address in the "E. M.," and I shall be very pleased to help you again. **G. D. Seaton.**

NON-CONDENSING ENGINES v. CONDENSING ENGINES.

[26402.]—MANY thanks to "Engineering" for noticing my letter. I may say that the idea I had with regard to compounding those two high-pressure cylinders by one low-pressure seemed (from a theoretical point of view) very fair; but as "Engineering" has tested the thing practically, and found it to fail, I must bow to his decision. But at the same time I should be very glad if he would point out the particular points of failure in the system. With regard to placing one high pressure between two low-pressure cylinders, in the case under consideration, it could hardly be done, for the two 6in. high-pressure are fixed very close together on one framework, and any alteration in that direction would be very expensive. In putting the 3in. cylinders on top of the 6in.—that is, an ordinary compound (if I understand it correctly), there would be no gain of power from the existing high pressures, but undoubtedly an economy in fuel. The triple expansion type of engines is a very good idea, but in my case the boiler is only capable of carrying about 80lb. pressure, so it would hardly be capable of driving a pair of triple expansion engines economically.

In re your remarks on compound non-condensing v. high-pressure engines, I have no doubt the non-condensing compound has some advantages over the high-pressure in a greater expansion of steam. But at the same time I doubt whether the advantage is sufficient to cover the extra machinery. Another thing is, you are bound to exhaust your steam above the atmospheric pressure; but if you made your engine condensing you could expand your steam down to 3 or 4lb. pressure, and thus gain so much additional work.

Middleton Junction. **W. H. Taylor.**

THE THREE YEARS' HIRE-PURCHASE SYSTEM.

[26403.]—YEARS ago I advocated this means of acquiring instruments in your paper, and you most kindly and elaborately figured some of Mason and Hamlin's for me. The times are much changed since then, and I would not advise anyone now to pursue the same course. You get 25 per cent. off for cash, and as a three years' customer they kindly put it on. The answer is, The trade must be considered. Well, just now the Canadians have been exhibiting, and there is a fine opportunity to use their advantage in this direction with great development of the hire system, and break through the trade fetters, compelling those who have had a long innings to come down a bit. Money is the consideration with all music people; they might have thousands of instruments housed, instead of warehoused—lying up in ordinary until a changed fashion, by a changeable public, compels a change of front.

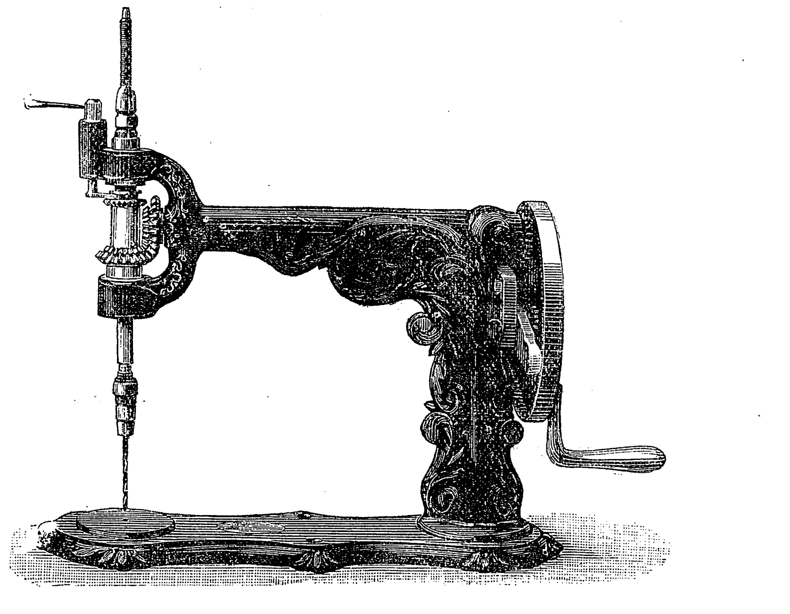
Coalitions in trade can be broken, and venturesomeness is characteristic of the age. It won't do to mend your ways when the Philistines are upon you, so this is a word to all and each.

H. Ussher, B.A., M.B., Surgeon.

BELLADONNA AND SCARLET FEVER.

[26404.]—I SHOULD like to communicate to your journal the great value of Belladonna in preventing the spread of scarlet fever.

There are four little ones in our family, and the eldest was taken with this malady a month ago. Being practically impossible to isolate the other three, I gave them each a drop of the first decimal attenuation in half a wineglass of water night and morning. The patient (treated with the same principally) had a favourable recovery, and the rest are happily showing as yet no signs of the fever, although within its influence day and night. This might be of present or future service to readers of "Ours." Scarlet fever is very prevalent with us just now, and, contrary to our case, is invariably going through entire families when it has once secured an entrance. **Xavier.**



A SELF-FEEDING DRILLING MACHINE.

[26405.]—THIS machine is designed to meet a want long felt by model makers, watch and clock makers, engineers, amateurs, and others, especially where great accuracy and rapidity are required. It will drill holes from $\frac{3}{8}$in. down to the smallest size without fear of breaking the drills; it is self-feeding, and has fast and slow gear to adapt it to the size of the drill. This machine is the only one in which the rising and falling of the drill, as well as the feed motion, are effected by the driving wheel alone, thus leaving the left hand entirely at liberty to adjust the work. It is made with ornamental iron base and arm, gun-metal head, wheels, and fittings, steel spindles and adjustable chuck to take either twist, fluted, or flat-point drills; and as all parts of the machine when at work move in the same direction, the wear and tear is reduced to a minimum. Its action will be understood at once, as all the movement required is the to-and-fro motion of a lever to adust the drill spindle, and the driving wheel for drilling.

F. Greenaway,
Patentee and Sole Maker, Slough.

LATHE MATTERS.

[26406.]—"Two heads are better than one," especially when the one is mine and the second is "Vulcan's." I am obliged to him for pointing out the slip I made in the eccentric motion of the star-guide. As he says, the handle must be attached to the eccentric and not to the strap; also in line 31, page 78, the word "reversing" should be traversing. On page 121 the "end view" shows (at the right-hand end of the traverse slide where the letter *b* occurs) the bearing supporting the end of the screw projecting below the bottom surface of the traverse slide; it must not, however, project, as it would catch the bed.

Most of "Vulcan's" remarks appear to me just, and I could myself add other objections; but though I feel their weight, it is not so easy to avoid them without falling into other and worse difficulties, and the whole design is nothing but a series of compromises. I will take up "Vulcan's" first letter on page 155, as shortly as possible, to save space. Will "V." kindly give sketch to show how he would cover the exposed part of front bush? Yes, I think the splits should be filled with something slightly elastic—say leather. I do not hold much to the flange fitting for mandrel, and would about as soon have the Edmunds model. I like the idea of the spring-tempered mandrel very much, and for my part should be satisfied with bellmetal bushes, which I think we could easily make and renew ourselves.

Taking now the objections in the second letter. (1) The reversed slides: I quite agree with these remarks; yet, on the whole, considering that the two slides of the upper rest may be *quite short*, owing to the convenience of the long under one; considering, too, the convenience of having the screws covered, and the great ease with which the slides can be taken apart—namely, by simply winding back the handles and then pulling them out—that, in this case, they are the best form. (3) Yes, the gib would be rather better the other side. I tried it there first, but altered it because there seemed hardly room to get at the tightening screws of the slide below. Of course the top slide has to be screwed back to get at two of them; but that is easy enough. (4) The ball-turning arrangement was part of the original design. I had lost sight of it, and am glad to have it recalled. (5) My idea is to have the lathe a short one—say, 3ft. 6in. or 4ft. bed, it being intended for fine metal work, including milling and ornamental turning. Of course it need not be short, but long turned shafts, &c., are about the easiest things to put out; it ought, I think, to be long enough to turn a wicket or a table-leg, though that is not quite the work it is intended for, but rather short work done close up. (6) The objection to the single clasp-nut is, of course, quite true; but few, indeed are the lathes with more than one. (7) I think it would be an improvement to make the lower V of the front slide flatter, because it would throw less strain on the screws of gib. I would also make the upper V sharper if it did not too much increase the difficulty of getting at it to get up the surface with scraper. I think the upper one might be made to 45°, instead of 60°, and the lower to about 75°, if that is thought worth while. (8) The sharp edges of the front V's are only $3\frac{3}{4}$in. apart; but it seems hardly fair to take that measurement: I would rather measure from the top corner of the front slide to its bottom edge $5\frac{1}{2}$in. There might be a counterweight hung on at the end of long slide in turning large diameters; but I hope that would not be necessary, especially as the mandrel is only designed and speeded for metalwork up to about 6in. diameter. It is a $4\frac{1}{2}$in. centre lathe, with head-stocks packed up to 6in.. to make room for milling underneath the cutters.

I am in hopes that some of your readers may be willing to join me in a set of planed castings for a lathe of this description, so as to save expense. If only we can agree upon the main features of the design, we might, I think, manage the drawings and patterns between us, and call it the "ENGLISH MECHANIC Lathe," supposing that you, Sir, do not object. There is, of course, no hurry about this, and even if the project ends in nothing but controversy, we shall still learn something.

I forgot to mention amongst the advantages of the vertical slide, that it allowed of a casting to be bored with a bar being bolted upon the milling bed, and adjusted to height by the screws without the very tiresome lining up and fixing with blocks, &c., usually required. The ornamental rest would go on where the metal turning rest is seen, and its screw would gear with the Hooke joints and upper wheel-plate. I should myself prefer the Captain Dawson rest, and this with the geometric chuck in combination would produce patterns and curves *ad infinitum*.

I was much pleased with the device sent by "Simplex" last week (page 132) for setting over the back-centre in turning taper; it is indeed simple. Does he never find it turn round? I should think if the centre were thrown out much it might be liable to do so; and if I make myself one, I should add a tail from the bow to reach down between the shears of the bed.

F. A. M.

HORSEPOWER AND MEAN-PRESSURE DIAGRAM.*

[26407.]—I SEND for publication a diagram which will, I think, facilitate the solution of many queries as to the effect of proposed alterations of cut-off, boiler pressure, &c., which appear in your columns.

I will premise that, given two engines by two makers with the same piston speed, cut-off, and boiler pressure, although the pistons may be of the same size, the power will often vary considerably.

The losses by friction, radiation, &c., are, however, fairly constant for engines of the same general design by the same maker, so that, having found by comparison with the diagram that the latter gives results, say, $1\frac{1}{4}$ time as large as those actually realised, a designer could always estimate his dimensions of cylinder as if for an engine $1\frac{1}{4}$ time as powerful as the one in hand, with some certainty of obtaining a sufficiently near approximation. I do not give the number $1\frac{1}{4}$ as having any virtue: the multiplier will vary from 1·06 (a compound jacketed engine described on p. 276-7 of Vol. XLI. *Engineering*) to $1\frac{3}{4}$ or more.

The diagram gives the same results as column 6 of Table B on p. 292 of Rules and Tables, or the table on p. 129 of your 43rd volume.

Description of Diagram.—To the left is a small scale of back-pressures. I have carried the lines for 18lb. and 5lb. back-pressure quite through the diagram, assuming these to be average values for high-pressure and condensing engines respectively. For any other back pressure the scale will give the height at which the line should be drawn or imagined.

On the right-hand side is a column of figures from 0 to 200lb., representing the pressure of the steam as it enters the cylinder in pounds per square inch *above* the atmosphere (the pressure of the atmosphere being here taken at 15lb. per square inch), being, if the steam-pipe be short and large, the pressure shown by the gauge upon the boiler.

The sloping lines correspond to these various pressures. The vertical lines indicate different points of cut off and rates of expansion, as shown by the figures below the diagram. There is a scale for finding the mean pressures with *any* piston-speed, and another for measuring the theoretical horse-power per square inch of piston *at a standard piston-speed* of 1,000ft. per minute.

For any other piston-speed, multiply the standard horse-power by the actual speed, and divide by 1,000; or, what is the same thing, multiply by the piston-speed and strike off the last three figures as decimals.

I suppose it is scarcely necessary to note that the piston-speed = revolutions per minute × twice the stroke in feet.

Example.—It is required to find the theoretical H.P. per square inch of a piston running at 1,000ft. per minute, steam-pressure being 100lb. = (100 + 15 =) 115lb. absolute, the back pressure 18lb., and cut-off at half stroke.

At the intersection of the line representing a back pressure of 18lb., with the vertical cut-off line for $\frac{1}{2}$ stroke, place one leg of a pair of dividers, and measure the distance up this latter line to the point where it intersects the sloping steam-line for 100lb. steam pressure. (See small sketch to the left.)

With the dividers so set measure the distance between their points on the H.P. scale, and it will be found that the power so read is 2·4H.P. for each square inch of piston, so that if, for example, the piston area was 10 square inches, the theoretical H.P. would be $10 \times 2{\cdot}4 = 24$.

If, without shifting the dividers, they are applied to the pressure scale, they will indicate 79·31b. mean *effective* pressure. Of course, the mean *absolute* pressure may be found, if desired, by measuring, in the first instance, to the bottom of the diagram or line of no back pressure, and using the pressure scale, which will give 97·3lb. absolute mean pressure (= 79·3 + 18).

If the piston speed in the above example were 600ft. per minute instead of 1,000, the power would be $2{\cdot}4 \times \frac{600}{1000} = 1{\cdot}44$ H.P. per square inch.

In a compound engine the number of expansions

$$= \left\{ \frac{\text{area of l.p. piston}}{\text{area of h.p. piston} \times \text{cut-off in h.p. cylinder}} \right\}$$

the stroke being equal in both cylinders. If the stroke is unequal, substitute "volume" and "cylinder" for "area" and "piston" respectively in the formula.

The power is theoretically equal to that of an engine with a single cylinder, equal in size to the l.p. cylinder, in which the steam is expanded the same number of times as in the compound engine with the same percentage of waste of heat. Example: —What is the theoretical power per square inch of the low-pressure piston of a compound engine in which the area of the l.p. piston = three times that of the h.p. piston, the steam pressure being 150lb., the piston speed 700ft., back pressure 5lb., and cut-off in h.p. cylinder = $\frac{1}{2}$ stroke?

The diagram, measured on the vertical line for $(3 \div \frac{1}{2}) = 6$ expansions gives 2·175 H.P. per square inch of l.p. piston at 1,000ft. per minute, or $2{\cdot}175 \times {\cdot}7 = 1{\cdot}52$H.P. per square inch of l.p. piston at a speed of 700ft. per minute.

For those who use slide-rules the following will be found convenient, calling the four scales A B C D, as usual. Below the gauge-point 1·273 on A, place the H.P. per square inch on B. Below the required H.P. on B find the required diameter of cylinder (the l.p. cylinder in the case of a compound) on D.

Suppose an engine running at a given piston speed, and cutting-off at $\frac{3}{4}$-stroke, gives out a certain horse-power, the steam-pressure being 70lb.

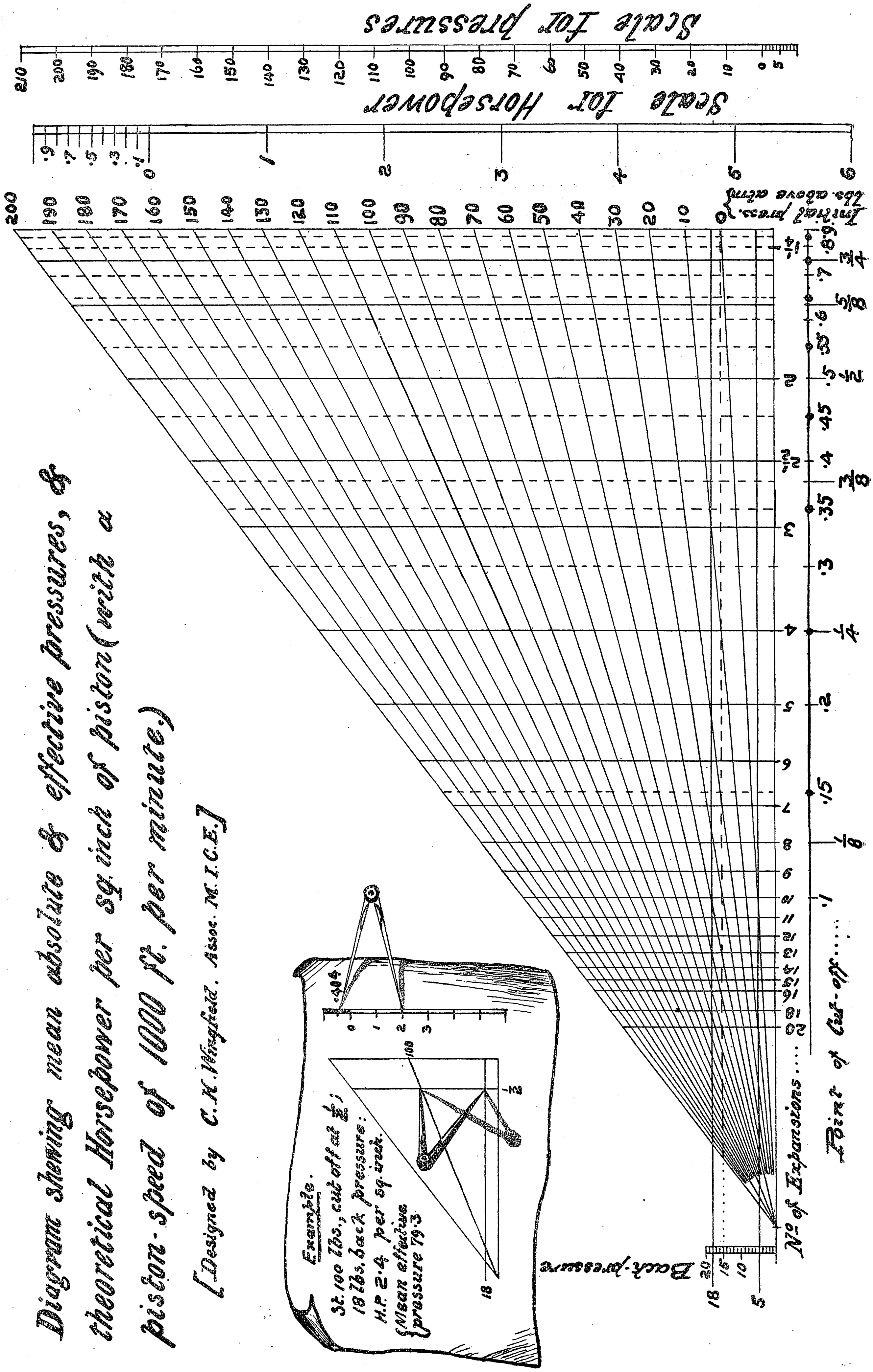


Diagram shewing mean absolute & effective pressures, & theoretical Horsepower per sq. inch of piston (with a piston-speed of 1000 ft. per minute.)

[Designed by C. H. Wingfield. Assoc. M. I. C. E.]

and the back-pressure 15lb. It is proposed to reduce the back-pressure to 5lb. by adding a condenser, and it is required to ascertain the point at which steam should be cut off in order to obtain the same effective mean pressure and horse-power as before, the piston speed being unaltered. Measure along the vertical line for ¾ cut-off the distance between the steam line for 70lb. and the back-pressure line for 15lb.; place one leg of the compasses, so set, upon the line of 5lb. back-pressure, and, keeping the other point over it so that a line drawn between them is parallel to the cut-off line, move the compasses towards the left till the upper point touches the pressure line for 70lb. steam. Both points will be upon the line for ½-stroke,—the required point of cut-off.

If, instead of adding a condenser, the back-pressure was still 15lb. and the cut-off made ½-stroke, a similar trial would show that the boiler-pressure must be raised to 82lb. in order to give the same power. **C. H. Wingfield.**

ON THE SUPERIORITY OF ZINC AND STEEL PENDULUMS.

[26408.]—YOUR correspondent, Mr. Christian Lange, commenting on my paper on the above subject originally published in the *Monthly Notices* of the Royal Astronomical Society, which you have thought worthy of a reprint in your columns, states that "Mr. Buckney compares a very badly-constructed mercurial pendulum to a well-constructed zinc and steel pendulum," and he further says that "such mercurial pendulums (as I used in my experiments) have been out of date many years."

I entirely deny the truth of both these statements, and I would call upon Mr. Lange to show, in your columns, when these very badly-constructed mercurial pendulums became obsolete, and to tell us what is the well-constructed form that has superseded them, and where it is in use.

Thomas Buckney.

SAFETY-LAMPS.

[26409.]—I AM glad to see that my letter has produced two replies. It would have been useful if a sketch of the testing apparatus had been given. Perhaps some correspondent will furnish one.

I notice that Mr. Shippey states that "there is only one really practical safety-lamp in existence"—viz., the "Morgan," and then farther on he admits never having tested the "McKinless" lamp. If he will write to the inventor, whose address is 1, Gore-street, Greenheys, Manchester, he will doubtless obtain the information he requires as to where to obtain a sample lamp.

May I inform "Nemo" that the McKinless lamp in the form I speak of never was submitted to the Royal Commission? That was an old and imperfect model. Again, why does "Nemo" omit to state that Mr. Morgan *failed to explode the McKinless lamp* at the Leigh experiments?

In the *Wigan Observer* of the 18th Sept. it is stated that "the McKinless was brought from Bickershaw Colliery. *It has no gauze.* Mr. Morgan did his utmost to explode it, but in vain."

Of course, it does not matter to me personally which lamp proves to be the best; but I simply desire to get at the facts, and also to see justice done. I notice neither of your correspondents answers my query *re* gauze. Perhaps they will kindly do so. I have always looked upon gauze with distrust, and gladly welcome any method by which we may get rid of it.

By the way, I was present at Mr. Swan's demonstration at Newcastle and heard his paper.

It only seems to be a question of time before we get an electric safety-lamp to give one candle power for 13 hours, and which will not weigh more than 3lb. **Henry Palmer.**

INDUCTION COIL.

[26410.]—A FRIEND of mine, an amateur, has recently completed an induction coil, the performance of which will, I am sure, interest a large section of the readers of the ENGLISH MECHANIC.

I saw the coil frequently while being made, and also since its completion, and it so far surpasses all I have previously seen that I venture to send you the following particulars.

The core is 14in. in length and 1½in. in diameter. The secondary has between 15 and 16 miles of No. 36 double-silk covered wire, wound in sections, and the usual spring brake.

One evening recently I saw it used with one bichromate cell (one zinc and two carbons) 5in. by 3in., and it gave sparks of 3½in., 4½in., 5½in., 6½in., up to 7½in., and it has since given, *with the same battery*, an 8½in. spark. When done with, the elements were lifted out of the solution and immersed in a jug of clean water, and with this it gave sparks 1in. in length, and a shock sufficiently strong to deter anyone from voluntarily getting a second.

With a view of seeing how small a battery would work the coil, a miniature battery, consisting of a silver thimble full of water and one drop of sulphuric acid and a little bichromate of potash, was employed, and with *it* sparks of 1in. in length were readily obtained.

So far the coil has not been tried with either Bunsen's or Groves's battery; but the great power obtained from such a small battery is, I believe, unique. **Joseph Marples**, Oxton.

CHAMBER ORGANS.

[26411.]—I HAVE read the kind letter by Dr. C. W. Pearce with feelings of pleasure, not unmixed with surprise. While I am free to admit that no one is better qualified to pass a reliable opinion on the quality and capabilities of an organ than Dr. Pearce, I feel sure that, in his panegyric on my Chamber Organ, he has been led away by his kindly feelings towards an amateur, who has, perhaps, had a little more heart than is usual in his work. Almost all the effects to which Dr. Pearce so graphically alludes were due to his own masterly manipulation. I have known organists who could produce better musical effects from a single *Dulciana* than others (skilful men) could from an *Open Diapason*. Dr. Pearce is of the former class; but, then, he is a sound musician, and an accomplished composer of music for "the king of instruments."

When I had the pleasure of entertaining Dr. Pearce, my organ was in an incomplete state—the Principale, 16ft.; Euphonium, 16ft.; Tromba, Clarinet, Oboe, and Viol-d'Amore were either out of the instrument or out of order—but all the appliances for the production of expression were complete, and I presume it is to the results obtained by their skilful use that he specially alludes. It is obvious that without the six very important stops above enumerated, the chief elements of grandeur and tonal balance were altogether wanting. Notwithstanding the Doctor's high opinion, I unhesitatingly say that my organ is far short of being perfect; so much so, that I have steadily declined putting its specification and description on record publicly.

I feel much gratified at Dr. Pearce's kind and flattering allusions to the articles on the Chamber Organ, which have appeared in these columns; and I cannot help thinking, as I read the second paragraph of his letter, it is a strange thing that at this late period in the history of organ building it has been left to a poor amateur, like myself, to say anything new or worthy of note on the subject of the Chamber Organ.

Organ builders, and, doubtless, many of the possessors of Chamber Organs of the class I have been compelled to condemn, consider my writings specimens of presumption and impertinent interference with matters beyond my province. Let them do so; and I shall be pleased if they can prove them to be uncalled for and unnecessary in the existing state of the art. Backed by such a man as Dr. Pearce, I feel that I have not been too bold in putting in a permanent form, through the hearty co-operation of the Editor of the ENGLISH MECHANIC, my "Notes on the Chamber Organ." That they are of interest to many at home and abroad is proved by my daily budget of letters, and the correspondence which has already appeared in these pages.

I have often wondered, after the manner of Dr. Pearce's wondering, on turning over the leaves of Dr. Wesley's charming "Pieces for a Chamber Organ," what sort of an instrument he had in his mind's eye when he wrote them. He could never have hoped, even with his cunning fingers, to render them in any worthy manner on the usual Chamber Organs of his day. I presume it has been the miserable condition of the Chamber Organ, generally speaking, which has discouraged the composition of more pieces of a similar class. Let us hope that the art of Chamber Organ building will now and henceforth be properly studied and developed, and that the pen of such a composer as Dr. Pearce will enrich the at present truly scanty musical literature of the Chamber Organ.

G. A. Audsley.

[26412.]—I NOTED Mr. Geo. Landel's inquiry in letter 26335, and the expression of a wish that someone would recommend him a good organ-builder. I would have replied to the question at once, but he gave no address. I beg leave to recommend Mr. David Pearce, 70, Gloucester-road, Regent's Park. This young man is *a genius.* Some ten years ago he was my page-boy. I lived then in Shropshire, and used to amuse myself with amateur organ-building.

This boy evinced such talent for the work that I had him apprenticed to Lewis, of Brixton. He is now working on his own account, and as I know how hard and yet how desirable a thing it is to get a good-tempered organ-builder, I am anxious for Mr. Landel to try my *protégé*, whom he will find not only good-tempered but clever and intelligent, and the neatest of woodmen—which is a great matter. At any rate, I trust Mr. Landel will call and see his work. I believe he has an organ just finished.

(Rev.) **T. A. Crowther.**

St. Joseph's College, Dumfries.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60316.]—**Re Electric Time Ball.**—TO E. CONRY AND "GLATTON."—May I remind Mr. E. Conry of his promise to forward us drawings how to raise time ball by electricity, or, if he is busy just now, would "Glatton" oblige us? My object is to raise and let fall by electric current or clockwork. I do hope some one will come to my aid.—ORIGINAL QUERIST.

[60334.]—**Falling Bodies.**—"R. E. F." will see that the stone is retarded by the earth behind it, if he thinks for a minute; each particle of the earth attracts it, and it therefore goes slower than it would if the earth behind were not in existence. The stone has a horizontal velocity of approximately 1,000 miles per hour, decreasing by attraction of earth and an increasing vertical velocity; and as each of these depends on the distance from centre at any one minute, the solution is complicated (for me). I think it is an ellipse relatively to centre of earth; but perhaps a straight line relatively to the rotating earth, partly, at least.—M. YORK.

[60334.]—**Falling Bodies.**—Such discrepancies as "R. E. F." points out are exactly what, I should say, indicate utility in prolonging a discussion, instead of "no utility." On that I must differ *in toto.* The track of a body through the earth, regarded without reference to earth or plumb-line, but simply to the stars, would be an ellipse, and, of course, with the minor axis "Dubliniensis" says, and I presume it would keep revolving in the same ellipse—that is, one pointing always towards the same star. Meanwhile, as the earth and plumb-line move, the body's track referred to these, or regarding these as fixed, is a very different curve, one closely resembling, I fancy (if the passage through occupies, as he says, 40 minutes), a circular arc of 10°, with its concavity outward, and coming up vertically to the surface, not at the antipodes of its starting-point, but at longitude 170° E., then returning in a similar arc to 20° W., thence again to 150° E., then to 40° W., and so on, always missing the centre by 260 miles, and missing the antipodes by 10°, nearly thrice as much. I assumed the time of describing the ellipse to be equal to that in a circle, however small the minor axis; but it seems, from "Dubliniensis," it would be rather proportional to the length of path, or nearly so.—E. L. G.

[60342.] — **Green Stain for Furniture.**— Aniline green can be used, but the old-fashioned stain is made by putting, say, two ounces of powdered verdigris into a pint and a half of strong vinegar, adding a little sap green and a little indigo. Acetic acid and copper filings is a simple green stain for white woods; but this kind of "staining" is equivalent to dyeing, and any process employed for dyeing vegetable matter green will probably answer. Staining wood means, in the technical sense, making it to imitate the colour of some other wood.—NUN. DOR.

[60344.]—**Loco. Sand Blast.**—There cannot be any advantage in the use of the blast with the sand, if the ordinary pipe is properly placed; but it will be understood that the blast forces the sand directly under the tread of the wheel while the engine is standing, and so enables it to start, by giving adhesion at once without moving more than half an inch. Of course the driver or his fireman could do the same by getting down and placing the sand under the wheels.—J. T. M.

[60345.]—**Brakes.**—I suppose this querist has heard that some stock is fitted with both Westinghouse and vacuum brake appliances. That is for running with stock fitted with either.—J. T. M.

[60356.]—**Fitting Brass Bushes.**—Make them an easy driving fit.—C. K.

[60357.]—**Gulf Stream.**—Experiments of the kind named by the querist have been made many times, and it is probable that he will find an account of them in Lieut. Maury's works, as well as in the "Voyage of the Challenger." I regret I cannot give more definite information.—B. M.

[60363.]—**Phonograph Mouthpiece.**—This query, as stated, is rather incomprehensible. What, for instance, is meant by the "coil," and what can there possibly be difficult in the mouthpiece? Has the querist seen No. 683, p. 157? If not, I would advise him to procure that number.—A. T. E.

[60361.]—**Organ Accordion.**—You want first a stand, which may be anything you like so long as it is firm, and then a pedal with cord or lever to work the bellows. There is an illustrated description in No. 782, p. 42.—N. E. CHILD.

[60366.]—**Tile Setting.**—The tiles should be laid as closely as possible, and thin cement run into the joints where sufficient has not worked up. The base should be well laid and flatted, and then covered for a small area at a time with liquid cement; the tiles being laid in this, with their edges well wetted, will probably have sufficient between them; but if not, any crevices must be filled up. It must not be "swept" into the joints, but carefully applied, taking care to keep it off the face of the tiles.—SAXIFRAGE.

[60376.]—**Trumpet Stop.**—Better submit the obstinate pipes to an expert: there must be something wrong with them.—J. K. L.

[60377.]—**Breaking Strain of Cable.**—It is impossible to give a satisfactory answer to "Sailor's" first query; as to the second, books containing the working tested and breaking strain of hemp, manilla, iron and steel wire ropes and chain cables, together with the tonnage of vessel they are suited for, can be had at almost every bookseller's.—JAMES MCCASH GOVAN.

[60379.]—**Model Schooner.**—The suggested schooner is too small to be of any use even as a model yacht; but the querist will find "lines" which he can reduce in back volumes.—GALATEA.

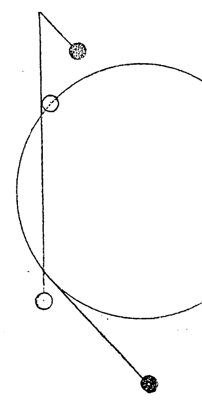
[60404.]—**Condensing Tube for Launch.**—You might do without an air-pump if proper provision for escape of air is made. I do not think you can make a launch-boiler to keep 100lb. steam without artificial blast of some kind; a fan, for instance.—GLATTON.

[60428.] — **Silvering Glass.** — Almost every back volume of the "E. M." contains some information about this. See p. 327, Vol. XXXI., for Mr. Brashear's process.—GLATTON.

[60430.] — **Gravity Daniell Cell.** — TO "WEALD."—I have read your reply again. If you will also read mine again (in. No. 1,123) you will see that I do not ask how there can be free acid present, but "whence the *gain* in free acid?" For you gave me the impression of believing that the solution became more and more acid as the result of electrolytic action in the cell. This is not the case; the free acid formed by reduction of copper sulphate merely makes up for the free acid consumed by union with the zinc. On the whole, we have no gain in free acid: we gain sulphate of zinc and we lose sulphate of copper; free acid as before. The only source of acidulation is from the acid in the crystals as prepared; and even in a saturated solution the proportion of acid is but small, and such as would constitute a very mild acid solution. Dilute sulphuric acid might be mingled much stronger than this (without copper salt) without causing hydrogen to be evolved from amalgamated zinc as in the gravity cell. I wrote my second reply not to obtain instruction, but because I thought your own reply was a little misleading to the querist; and unless you had made some theoretical oversight, imagining that the electric action gave rise to an increase of free acid, I am still at a loss to know how the solution could be or become "too strong in acid," so as to defeat the amalgamation of the zinc. If I am wrong in my conception of the case, you or Thompson or Guthrie or Sprague will do me a most important service in setting me right, as this would be delivering me from unconscious ignorance.—WEALD.

[60446.]—**Bisulphide of Carbon.**—TO MR. GREY, F.C.S.—I am grateful to Mr. Grey for his comprehensive reply to my first query. Perhaps he will allow me to put my second somewhat differently—viz., How much bichloride of mercury would it be necessary to vaporise so that the fumes should be equally distributed all over a room of the dimensions given—viz., 1,000 cubic feet, to the fullest extent possible? I should also like to trespass on his kindness further by asking another question as follows: If bichloride of mercury be vaporised by heat in a closed chamber, assumed to contain organic matter (germs, &c.), and bisulphide of carbon be at the same time burnt, would the sulphurous acid or other gases produced by such combustion combine with the vapour of mercury and prevent its action on the albumen of such organic matter, which is stated by Liebig to be converted (by the action of such vapour) into a compound of calomel and albumen. It seems evident that bichloride of mercury is rapidly taking the place of numerous other substances which have till recently been thought, or assumed to be, germ destroyers, and it is because I have seen contradictory statements published as to its action when vaporised in the presence of sulphurous acid, that I take the liberty of asking so esteemed a contributor as Mr. Grey the above queries.—IGNORAMUS.

[60434.]—**Crank Movement.**—I cannot give "T. C., Bristol," sketch of motion without making all known, as it is but a simple affair. I will, however, show him sketch of how he may obtain half a



circuit without dead point; and when he can complete the same and reverse the motion, he will know how it is as impossible to have a deadpoint as it is pronounced impossible to be without one. One end of beam is pivoted outside of balanced wheel in line with centre, resting at about two-thirds its length on small grooved wheel attached to rim of large one; balance weight on end of beam with one on large wheel. That is the problem I started with, and found by taking a short cut round the circle I got the same power in less time. —SCOTTY

[60434.]—**Crank Movement without Dead Point.**—It would not be difficult to connect a hand-lever with a crank so as to avoid a dead-point, e.g., by causing fulcrum to move in a sloping slot; but if you mean that your piston would keep its full speed up to the end of stroke, then suddenly reverse and start at full-speed back, I reply that the engine would probably shake itself to pieces in a short time.—GLATTON.

[60467.]—**Falke Torpedo Boat.**—The *Falke* was built by Yarrow and Co., of Poplar, London, for the Austro-Hungarian Government. She is built of galvanised steel, and is 135ft. long, extreme breadth 14ft., 9ft. deep, and 88 tons displacement. The other particulars, together with the diameter and pitch of screw, could only be ascertained from the builders, unless their sizes and distances could be worked out to scale from a drawing which, from the nature of his queries, I presume "Isle of Dogs" has. In any case, I do not see how it is possible for any one to make a model of a ship unless he has her "lines" to work from.—JAMES M'CASH GOVAN.

[60469.]—**Hygrometric.**—TO MR. WM. JOHN GREY, F.C.S.—I should be very much obliged if you would work out an example. Pressure, 739 millimètres; weight of air, 534·22 grains per cubic foot; also of the actual amount of moisture contained in the same. How does the great pressure of absolute moisture in Bombay, Calcutta, and Madras affect the wood of English articles manufactured of well-seasoned wood and metal combined, such as guns, &c.—POSTULATA.

[60484.]—**Twilight.**—I think "E. L. G." must have mistaken the point at issue, for I do not question the accuracy of his figures for a moment, but I maintain that for practical purposes they are quite useless. The theory that twilight lasts until the sun is 18° below the horizon is pretty nearly absolete now, nor is it necessary to go to the tropics to show how fallacious it is in practice. For instance, on October 17th twilight should have lasted about 110 minutes, instead of which it was considerably under an hour's duration. It would scarcely be more absurd to predict the amount of sunshine on any given day from the latitude of the place and the sun's declination! If "E. L. G." still doubts that tropical twilights are extremely short, I must refer him to the works of the celebrated Baron Alexander von Humboldt, especially those treating of the northern portion of South America. It is certainly rather strange to find "E. L. G." quoting "F.R.A.S." as authority for his statements, since "E. L. G." himself has commented on the "entirely fallacious way" that gentleman treated another problem (p. 553 of last Vol.) and as "a hundred-fold exaggeration would not surprise" him, might not "F.R.A.S." be wrong on this point also, even if his error were only ten-fold? I have to point out two errors in "E. L. G.'s" would-be correction to my definition of astronomical twilight; but as I suppose he will persist in them, as also in the correctness of the axis minor of his ellipse (p. 20) which is only 30,000 times too small, I make these corrections for the benefit of the querist. First of all, I did not write "the *first* sixth magnitude star," (whatever that may mean), but the "moment a sixth magnitude star appears." Then we are gravely told that it is the "faintest ones," but as these *are* sixth-magnitude stars, this is a distinction without a difference. Next, we are told that the spot selected is near the N. or S. horizon, and not the zenith, which is quite wrong, if we may believe Dr. Robert Mann, F.R.A.S., who says that the star is to appear in the sky directly overhead. Obviously, a star low down on the N. horizon may be obscured by mists long after another star of the same magnitude has appeared at the zenith.—R. E. F.

[60499.]—**Waterworks Pressure.**—In answer to "Niagara," the average pressure in Glasgow is 40lb. per square inch. Most probably some other correspondent will be able to supply the rest of the information you ask.—JAMES M'CASH GOVAN.

[60503.]—**Photography.**—I beg to offer my sincerest apologies to Mr. Bottone for having by an error in the name attributed Mr. Bennett's mistakes to him. Mistakes, however, they are; and if Mr. Bennett will look at any dealer's *recent* price list, he will find that I am not specially favoured in the price I pay for my plates—he or anyone else can now get "Ilford" or "German" quarter plates for a shilling a dozen. By Ilford, I mean those made by the Britannia Works Company, formerly sold by Marion as Britannia. The reduction in price was made, I believe, after the trial Mr. Bennett alludes to. Several other makers have reduced their prices within the last few months. Among the plates will be found Fry's "German." Hinton and Co.'s list is before me, from which I quote. It was sent to me in the early part of the summer.—T. PERKINS.

[60511.]—**Boys' Marbles.**—I fancy that the description of the manufacture of these, which I gave on p. 138, requires supplementing, thus:—The grooves in the lower stone are not only "circular" in plan, but shallow arcs of circles in section, and gradually of less width, or deeper, as they are nearer the centre. The process commenced in the outmost groove would be continued by moving the partly-formed balls from groove to groove as they advance towards true sphericity. At the same time, I may say that I have heard doubts expressed by practical men as to whether marbles could be produced by the process described. I think that after the preliminary roughing they would require to be treated a great many at once in a rumble or revolving cask to rub off the corners, and that it would be difficult even then to make them roll between the stones, unless there were grooves in the upper as well as the lower one. It is possible that glass might be similarly treated in, say, a copper grinder with emery; but I think only a rough approach could be made in that way to the accuracy required in a lens, and I should doubt the economy of the process, as, for making more than two at once, large spheres of glass would be required, and large masses of suitable glass are enormously expensive; then they would require not "splitting," but slitting—that is to say, cutting off from the mass with a lapidary's slicer, which would surely be much more expensive than taking a flat piece of plate, and rounding one side on a grindstone preparatory to figuring and polishing it. I do not remember ever seeing an agate "marble" with an even, smooth surface, though they are often highly polished. My recollection of them is that they bore all over the marks of the flat grinding disc on which they had been rolled about in all directions, and that these marks were at best only partly obliterated by the subsequent polishing on buff wheel, and sometimes not at all. Agates are, I believe, always treated singly. Since writing the above I met with half a dozen agates at the Soho Bazaar, after a voyage of discovery lasting two hours, and bought one of them to examine. It bears out what I said above, only more so, as it cannot compare for accuracy with even the common stone ones. As to boxing balls, my figure 212 is, of course, a mistake for 512; the sizes of boxes that I gave were puzzled at, more with a view to ascertaining how the peculiar number 501 was capable of being stowed away at all, than to demonstrate more or less close packing. I see I was wrong in stating that my box No. 4 is closer than No. 2, for No. 2 is 518 cubic inches, and holds 629; so No. 4, with 585 cubic inches, should, in like proportion, hold 710, whereas it does only hold 704.—J. K. P.

[60522.]—**Evaporation.**—From $\frac{1}{12}$th to $\frac{1}{10}$th of an inch per diem.—GLATTON.

[60525.]—**Bewitched Barometer.**—If "Bunting" is able and willing to write a few letters on the weather and how to forecast it, on the lines of his reply on p. 159, I am sure they would be of interest and use to many of your readers.—GLATTON.

[60529.]—**Polishing Paste.**—I purchased from one of the advertisers of recipes, in the Sixpenny Sale Column, the recipe for the German polishing paste, and found it exceedingly good, and a very great saving in cost. I do not feel at liberty to publish the recipe under these circumstances, but

no doubt it may be still obtained.—E. THEOBALD.

[60512.] — **Mathematical.** — "R. E. F.'s" answer to this involves an "unknown." I would suggest the following solution:—

For simplicity put 5 for a, and 3 for b, then—

$$\left.\begin{aligned} x^2 + y &= 5 \\ x + y^2 &= 3 \end{aligned}\right\}$$

$$\therefore\ x^2 + y^2 + x + y = 8 \ldots\ldots \quad \text{(i)}$$

$$\text{and } x^2 - y^2 + y - x = 2$$

$$\text{or } (x - y)(x + y - 1) = 2 \ldots\ldots \quad \text{(ii)}$$

Put u for $x + y$, v for $2\,xy$

$$\therefore\ u^2 - v + u = 8 \ldots\ldots \quad \text{(i)}$$

$$\text{and } \sqrt{u^2 - 2\,v}\,(u - 1) = 2 \ldots\ldots \quad \text{(ii)}$$

Squaring (ii) (and thus introducing roots which do not strictly belong to the original equations).

$$(u^2 - 2v)(u^2 - 2\,u + 1) = 4 \ldots\ldots \quad \text{(iii)}$$

But by (i)

$$u^2 = 8 + v - u$$

$\therefore$ Eliminating u^2 from (iii)

$$(8 - v - u)(9 + v - 3\,u) = 4$$

Eliminating v by $v = u^2 + u - 8$ we get

$$(16 - 2\,u - u^2)(u^2 - 2\,u + 1) = 4$$

$$\text{or} \quad u^4 - 19\,u^2 + 34\,u - 12 = 0$$

By guess—

$$(u - 3)(u^3 + 3\,u^2 - 10\,u + 4) = 0$$

$$\therefore\ u = 3 \text{ and then } v = 4$$

$$\text{whence } x = 2$$

$$\text{and } y = 1$$

—H. B. R.

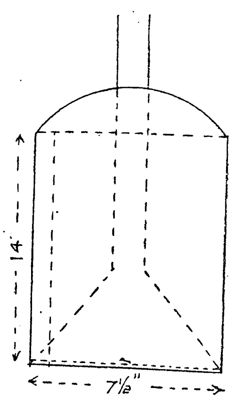
[60512.]—**Mathematical.**—There is a mistake in the solution given by "M.I.C.E., Bath," in issue of October 15. The series should be—

$$\pm\sqrt{b}\left\{1 - \frac{x}{2\,b} - \frac{x^2}{8\,b^2} - \frac{x^3}{16\,b^3} - \&c.,\right\}$$

and generally $\frac{x^n}{b^n}$, not $\frac{x^n}{b}$, as printed.—F. E. R.

[60533.]—**Crystal Slides.**—A few are described in Lancaster's "Half Hours with the Microscope," 2s. 6d.; and in Davies' "Preparation and Mounting of Microscopic Objects," 2s. 6d.—GLATTON.

[60548.]—**Copper Boiler.**—To "T. C., Bristol." —The above is what is described as a conical flue boiler; cylindrical in form, the joints are all



riveted with copper rivets. I herewith send you rough sketch.—A COUNTRYMAN.

[60548.]—**Copper Boiler.**—If very well brazed, and the ends of proper strength, which cannot be ascertained from your description, and if the boiler is round and of 7½in. diameter, the rule given on page 235 of Vol. XLI. gives a working pressure $= 500\,\frac{t}{d}$, where t = thickness, and d = diameter in inches. $500 \times \frac{\cdot035}{7\cdot5} = 23\cdot3$, or, say, 24lb. per square inch. In any case, you should not work the boiler under steam until you have tested it with cold water and a force-pump to fully double the intended working pressure. Your engine should run with 1lb. or so of steam, if not doing any work.—GLATTON.

[60557.]—**Honours Exam.**—The advice given by Mr. Bottone in last week's paper is very good. Do not, however, be frightened by his remarks about mathematics. I passed the exam. with only a very moderate knowledge of mathematics, and even that was not required to answer the questions. —L. M.

[60561.]—**Polish.**—The best way, to my mind, to ebonise and varnish, or rather to polish is this:—Get some gas black—this is easily got by hanging a flat piece of copper over a gas-jet, and I dare say you might obtain some at a coffee tavern, where they heat tea, &c., in copper boilers—and rub this on along with French polish in the usual way. "Colombo" might try this, and report.—GAS ENGINE.

[60577.]—**Preserving Apples.**—Make a number of shallow wooden trays (3ft. or 4ft. by 2ft. or 2½ft.) with latticed or open wickerwork bottoms. On these place a thin layer of dry straw. Place the apples singly, stem downward, on the straw, nearly touching each other. Stack the trays in an open-work wooden frame erected in a dry, well-ventilated room, where an abundance of cool air is always circulating. Keep out frost. Examine each tray of apples frequently, and pick out every apple that shows the least sign of decay.—G. E.

[60584.]—**Blueing Steel without Heat.**—Spades and axes are painted with thin lacquer coloured with Prussian blue. Is this what you want?—GLATTON.

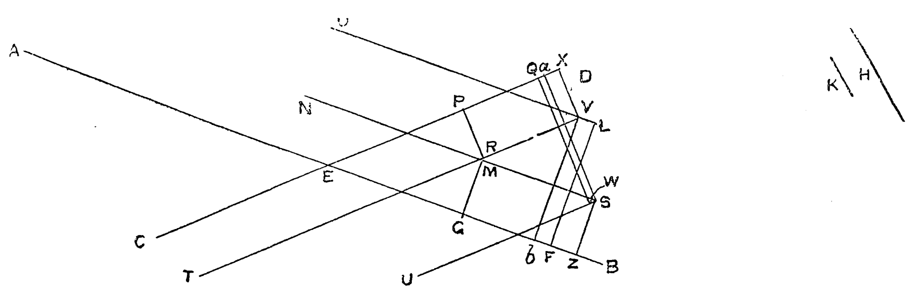
[60585.]—**Laying-in Cold-Water Pipes.**—Good brick or puddling clay free from grit must be obtained for this purpose. No oil is needed. Temper the clay by mixing with it a small quantity of water to a moist but non-sticky consistency. This can be done with a shovel on a board or other flat surface; afterwards knead with the hands, and compress until it can be worked through them in a tough but pliable roll. "Force Pump" says nothing about "packing." To do this, first lay in with a caulking tool a packing of spunyarn or oakum between spigot and flange to prevent the lead from running through to the interior of the pipe, seeing that it is placed a parallel distance all round. Now lay the roll of clay evenly round end of flange, leaving a hole at the top for the molten lead to be poured in. When this has set, remove the clay and hammer the lead in tight with a flat tool, afterwards cutting off with a chisel, flush with the end of the flange, any superfluous lead. This is far from a complex operation, but I should advise "Force Pump" to get an experienced man with the proper tools to make his joints, especially if his pipes are to stand much pressure.—GUILLAUME BOIS.

[60585.]—**Force Pump.**—In laying some gas-pipes with which I was interested, ordinary brick-clay was used, moistened with water, though I found that any clay would do. The lead should be poured in slowly, to prevent spurting.—W. C.

and hair-spring, and balance perfectly free, the watch should now take a good motion.—J. H. D.

[60591.]—**Hardening Spring Steel.**—Verily, my masters, we have here a most monstrous wittye forme of ye anciente British joake. Methinks ye sticke had been putte to hys propre use if diligentlye applyde to ye dustynge of ye sprynge-rubbynge springald. Seriously, someone appears to have been talking nonsense while professing to teach E. Hoare. Steel is usually hardened by heating to a bright red and suddenly cooling in water. It is then partly softened or "tempered" by being heated to a much lower temperature than before, and again cooled. For details of the process, vide back numbers.—SPRINGEE.

[60595.]—**Geometrical.**—To find a point such that the perpendiculars let fall from it on two given straight lines shall be respectively equal to two given straight lines, and also to determine how many such points there are: Take it for granted that A B and C D are of unlimited length, and also that they are not parallel; if they do not meet, produce them till they cross at point E. Let A B and C D be two given straight lines crossing at E. To find a point, or points, such the perpendiculars let fall from it on them to A B or C D shall be equal to the two given straight lines K and H, in E B take any two points—F and G. At the point F in E B draw F L at right angles to E B (Bk I. 11); at the point G in E B draw G M at right angles to E B (Bk I. 11), and make G M equal to K and L F to H; through M and L draw M N and L O parallel to E B (Bk I. 31). In E D take any points—P and P. At the points P and Q in E D erect P R and Q S at right angles to E D (Bk I. 11), and make P R equal to K and Q S to H; through R and S draw R T and S U parallel to E D (Bk I. 31). Produce T R to meet O L at V, and produce N M to meet U S at W (O L and U S produced, if necessary). Then W and V are two of points required. Through V draw V X parallel to P R (Bk I. 31), and through W draw W Z parallel to E B (Bk I. 31).



[60588.]—**Verge Watch.**—I think your escapement is too shallow; make it a little deeper by filing a shade off the dovetail and counter-potance. If this will not do, you should take it to a practical man, as there are a great many things to look to in repairing a verge escapement properly.—A READER.

[60588.] — **Verge Watch.** — The reason that your watch gains time is evidently that the escapement is shallow. Now, this might be cured by very simple means; that is if the watch kept time before. Pushing in the follower a little would likely do this, if such has been the case. But supposing escapement to be bad before it was cleaned, I will endeavour to tell you how to repair it. In the first place, if verge is much worn it might require a new one. But supposing it will do, first see that escape-wheel teeth are all of an equal length. If not, put collet on escape-wheel, and put in turns, and take a little off ends of teeth until they are perfectly "true." Now take balance-wheel file, and file teeth up to nearly a point again, being always careful not to touch the fronts of the teeth; but to take it off the backs, thus—/|. Now take brush, on which a little rottenstone and oil has been placed, and take off the burrs left from the file. Now do up edge of escape-wheel first with oilstone-slip, afterwards with burnisher. Now put escape-wheel and verge in plate, and see if the points of escape-wheel teeth come up nearly to, but without touching body of verge. If not, a little taken off front pivot of escape-wheel would effect this; but unless "A. B. C." has a lathe he will find this impracticable. Either the potance-wheel sunk a little, or a little taken off potance-face will do the same thing in an easier manner. Now see that "drop" is equal: that is, that the amount of drop on one pallet is equal to the amount of drop on the other. If not so, shift dovetail a little either one way or another, until the drop is equal. Now you can alter bankings by, in your case, moving the balance round a little to the side on which the train runs. If the verge is not too much worn, and the top and bottom verge-holes nicely "bottomed" out, and the other holes connected with escapement not too wide, and the verge

From W draw W a at right angles to E D and from V draw V b at right angles to E B.

Proof— $\because$ P R V X is parallelogram
$\therefore$ P R = X V
but— P R = K (const.)
$\therefore$ X V = K
again— $\because$ V L F B is parallelogram
$\therefore$ V b = L F
but— L F = H
$\therefore$ V b = H
and— $\because$ the $\underline{|\,\text{P R V}}$ of parallelogram P R V X is a right angle (const.)—Bk I. 34.
$\therefore$ $\underline{|\,\text{P X V}}$ is a right angle
$\therefore$ V X is a perpendicular to E D
and— V b may be shown in the same way at right angles to E B
$\therefore$ V is one of the required points

and in the same way it may be shown that the point W is another of the required points, and in the same way it may be shown that there are two of the required points in each of the four angles D E B, D E A, A E C, and C E B. $\because$ there are 8 of the required points (Q.E.F.)—ERNEST B. MARTIN.

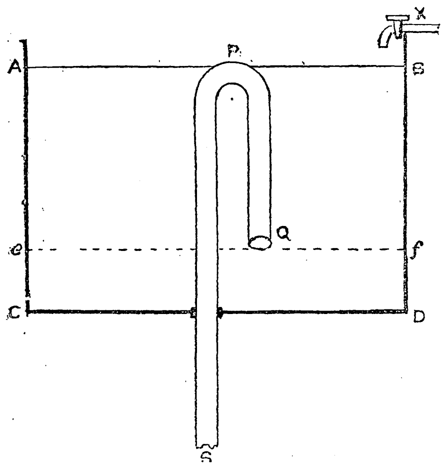
[60600.]—**Musical Intervals.**—Perhaps this querist will understand this matter if it is pointed out to him that if mid C is sounded by 264 vibrations, D will be given by 297, and E by 330. If, now, he divides 264 by 8, 297 by 9, and 330 by 10, he will see where the ratios come in. If further, he will remember that if 330 vibrations sound E, 352 will sound F, and 330 divided by 15 gives the same quotient as 352 divided by 16, he will have all the ratios of the tempered scale. I write the above as supplementary to what appears on p. 161; but it is not clear what the querist wishes to know. —N. E. CHILD.

[60601.]—**Battery for Electrotypy.**—Two or three Daniell cells of two-gallon capacity—better still, a good electro-plating dynamo machine.—G. E.

[60613.]—**Sanitary.**—If "Country Bricklayer" will communicate with us, we will give him full particulars respecting our flushing siphons. We shall be glad to have particulars as to how he has

fixed it, as if these siphons are not properly fixed, it sometimes causes them to fail in action.—DOULTON AND CO., Albert Embankment, S.E.

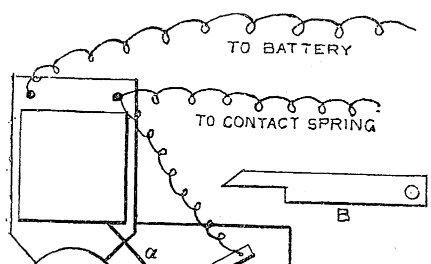
[60613.]—**Sanitary.**—There is a flushing siphon of the following description, but I am not sure



whether it is Doulton's:—A C B D is a tank of some sort, X a tap which is continually running, S P Q is a siphon, and S is the delivery. As soon as the water rises above the top of siphon P, the water will commence to flow out through S, till it reaches the level, *e f*, when it will stop. Of course, the flushing may be regulated by how fast the water is allowed to flow in by the tap. If the flushing is required to be frequent, the water must run in fast; if not, only slowly.—E. C. F.

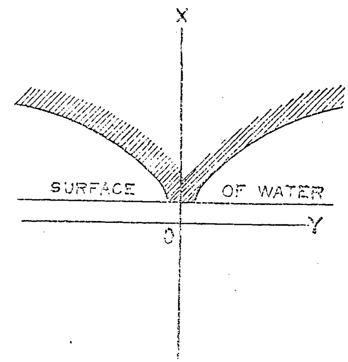
[60617.]—**Electric Light.**—I have looked up my reply, and I am sorry to say that I can only supplement my last week's note by giving you the size of the cell in question, which was a three-pint cell of the usual construction. If anything should come under my notice while experimenting I shall communicate at once with "Ours."—W. HOLDER, Newport, Mon.

[60620.]—**Electric Bells.**—The gauge of wire for the coils of a 6in. bell is No. 20 or 24. Doors and windows are connected to bells by means of contact springs, which are made for the purpose. Cheap and efficient ones can be purchased at any dealers; but if the querist wishes directions to make one himself, I shall be glad to give them. Annexed is a sketch of an arrangement by which



the bell will continue to ring, supposing the door or window has been opened and then closed. The hammer of the bell, *a*, has a piece of metal soldered to its centre, which projects outwards about ½in. A brass arm *b*, is loosely attached to a screw, from which a wire leads to the bell, as shown; *c* is a metal pin, from which a wire leads to the battery. The loose arm, of course, rests on the piece of metal projecting from the hammer. On the bell being rung the arm falls on *c*, and completes a new circuit, thus ringing the bell till *b* is lifted up. The shape of the arm is shown at B, the whole arrangement being mounted on a small board E.—BOBADIL.

[60631.]—**Hydrostatics.**—The accompanying sketch shows the shape of a body which will fulfil the conditions given by "Torbay,"—viz., that when gradually pushed below the surface of water, the submerged portion will always vary as the square of the depth. The exact curve may be calculated by the integral calculus thus: Let O be the origin of co-ordinates, X and Y the axes; suppose the two curves to be produced so as to meet at O, and let S = length of one of the curves, measuring such length to correspond with a length x measured along O X. Then, by the conditions of the problem, $x^2 = 2s$. I am supposing that the ends of the floating body may be ignored for the present. Our object is to find a relation between the co-ordinates



x and y, in order to describe the curves. Referring to Todhunter's "Int. Calculus," p. 104, our given function of x or ϕx is $\frac{x^2}{2}$, which $= s$; and $\phi^1 x = \frac{ds}{dx}$ will therefore be x. Therefore (as shown by Todhunter) $y = \int \sqrt{x^2 - 1} \, . \, dx$. This expression, when integrated, becomes—

$$\tfrac{1}{2}\left\{x\sqrt{x^2-1} - \text{hyp. log}\,(x + \sqrt{x^2-1})\right\} + C = y,$$

where C is some constant which we proceed to find. It will be seen from the above that when $x = O$ the expression is impossible, as we have the square root of -1; when $x = 1$, the expression becomes O, so that the curve begins when $x = 1$. Now to find C, we have $\frac{x^2}{2} = s$, and we have seen that S has no value when x is less than 1, but when we make $x = 1, s = \frac{1}{2}$; therefore, when the expression for y is made to vanish by making $x = O$, we must make $C = \frac{1}{2}$, so that y, C, and S are the same, and the curves will therefore start from points at a distance ½ on each side of the point where $x = 1$. This is rather difficult to understand, but I think I am right. The flat bit thus formed between the two ends of the curves will, of course, form part of the submerged surface.—P.S.: I find an error in my reply to this query. It will not do to consider the floating body as of indefinite length; in fact it can only be of a length equal to unity, the areas of the vertical ends when added to that of the curves will thus be greater than the square of the depth; but by stating the conditions of the problem a little differently, the calculation will hold good, thus, "required the shape of a floating body whose submerged areas (omitting those which are vertical) shall be equal to the square of the depth, when the body is pressed down to various depths." However, a more satisfactory reply to the question will be found by taking an inverted cone: the area of the surface submerged for any depth x will be found to be π tan. A . sec. A x^2, A being angle between axis and sloping side. Now, if this is to equal x^2, π tan. A . sec. A must be equal to 1, from whence we find that A = 16° 55′ nearly.—M.I.C.E., Bath.

[60632.]—**Spiral Steel Springs for Electric Lighting.**—I don't know, but I think, if "P., London," makes a small trough or basin, and fills it with water, and dropping the spring in immediately, pours a full broad stream of water in till cold, the cooling will be sudden enough: but a great drawback is the passing from fire to water through the air; make the distance as short as possible. With the above simple apparatus two will do the work better than one—one to pour. The answers on p. 160 are, I think, beside the point.—M., York.

[60634.]—**Safety-lamps in Mines.**—I am very glad to see your columns open for the discussion of so important a subject as that of safety-lamps. Mr. Shippey's statement that he can explode any lamp but the Morgan when using Mr. Morgan's test is misleading, because at the Leigh meeting Mr. Morgan himself failed to explode the McKinless lamp, and this, in all fairness, ought to be stated. In my opinion the Morgan lamp is of too complicated a construction—i.e., there are too many parts—to allow of its coming into general use, and I hold that simplicity of construction is a most important consideration when dealing with safety-lamps. For unless this is the case there is great danger (where several hundred lamps are being dealt with) of some part being left out, and the safety of the lamp thus impaired. In the Morgan lamp an omission of this sort would not easily be detected. "Nemo" says that the McKinless is not a practicable lamp in the pit. Now I have for some time past been using it daily, as also have many miners under my charge, and both the men and myself are so pleased with it that it is being adopted for the miner's use throughout our collieries. The lamp is not more difficult to handle than any Mueseler that I have yet seen, and, indeed, will stand more canting and knocking about than most Mueselers. I have no interest whatever in the McKinless lamp; but from my knowledge of it, obtained not in the lecture-room, but down in the mine, I must give my vote in its favour. It cannot be exploded, even by Mr. Morgan. There is no gauze to perish (and I find that gauzes in bonneted lamps have only a short life). It is simple in construction, cannot be put together wrong, and is easily taken to pieces and cleaned. I believe it is a fact that the lamp tested by the commission was not the improved McKinless, which, like the improved Morgan, was sent in too late. Whilst allowing that safety-lamps should be able to withstand almost any test, still, I do not think the blowpipe arrangement of Mr. Morgan a condition at all likely to occur in working coal.—PRACTICAL.

[60634.]—**Safety-Lamps in Mines.**—To me the Leigh experiments are no awakening, for my own have during the last two years taught me things that it is well for my peace of mind I did not know when daily travelling the pits. I am afraid I cannot help Mr. Henry Palmer to very much information as to the structure of the apparatus used; but from descriptions by persons who were present, I judge it to be a blowpipe with a foot-bellows, and the gas-feed delivered under pressure. If Mr. Palmer will refer to the Transactions of the Manchester Geological Society for the early part of this year, in a paper by the undersigned, he will find described and illustrated an apparatus of something of the same kind; and also another and larger one in which I saw the Morgan lamp fired on Friday, Oct. 8, at the Weepsend Gas Works, Sheffield, in about a minute. It fired again on Oct. 11 with a less explosive mixture in 2 minutes 38 seconds. On the last occasion the experimenter was Mr. Arnold Lupton, M.Inst.C.E., &c., lecturer on coal mining at the Yorkshire College of Science, Leeds, a well-known mining engineer. It is somewhat surprising to me that no one present at the Leigh experiments (*for there were dissenters*) seemed to see that the tests were unequal—that with a small jet of gas Mr. Morgan's lamp has a great advantage over any lamp, in testing which the jet can be directly impinged upon the wire gauze through the holes *in or at the base of* the single bonnet or cover. In Mr. Morgan's new lamp the holes in the outer bonnet or shield are in no case opposite the slots in the inner one, so that a jet driven through one hole or one group of holes in the outer shield strikes the inner one in a solid place, and is dispersed and deflected over a large area, and the velocity at which it enters gauze is diminished in the same ratio as the area of such entry increases. Now, put this lamp in a large volume of inflammable gas moving at great velocity, then the whole of the holes (or at least, those on the windward side of the lamp) are filled to their utmost capacity, and it fires readily with the most explosive mixture—even at a comparatively low velocity gas burns within the gauzes. The Morgan lamp has very considerable staying power, and I should say is quite safe at the highest *normal* speed of the ventilating currents of a colliery, the four gauzes giving it great power to condense heat. Some persons inquired at the Leigh meeting whether the lamps fired—particularly the Mueseler—were of the pattern giving the greatest amount of safety, or substantially to that effect; but the answer was not definite. If there are any of our fellow-readers who were present at the meeting, we shall be glad to hear further details. It is no part of my intention to controvert the statement put forth, that the four lamps specially commended by the Royal Commission on mine accidents were fired on this occasion. I know they can be fired—some of them very easily. The Gray and the Marsaut have been repeatedly, and Evan Thomas occasionally fired in velocities of 52ft. a second and under at Aldwarke Main Colliery by Mr. C. E. Rhodes, a gentleman whose experiments and research have contributed more to accurate knowledge of safety-lamps than those of any other individual living or dead. A Lancashire colliery owner, who is also a mining engineer of eminence, offered to light the gas in his office with a Marsaut safety-lamp in the presence of the writer about ten days ago. I saw another colliery man actually light the gas with a so-called safety-lamp of another inventor—not one of the four lamps commended, but a lamp in use in mines more fiery than the average of those with locked lamps. Now, going a little beyond the tests at Leigh. It is reported in the *Bolton Journal* that Mr. Morgan stated that a certain offer of £500 still held good. I do not quite understand whether the offer was in the shape of a premium for the best lamp—something like that lately held out by Mr. Ellis Lever—or whether it was the offer of such sum as a wager—the Morgan lamp against all comers. I rather judged the offer to be of the nature of the latter. On principle I do not bet,

but I will engage to produce a safety-lamp that shall give fully as large a light as Mr. Morgan's, and that shall be self-extinguishing in the most explosive mixture of gas and air, moving at a velocity and tested under the same condition that fires Mr. Morgan's lamp. The tests to be public, and the party failing to make good his claim to superiority to pay the expenses; or as each person's opinion is the result of honest conviction, let each pay one-half. The experiments to be conducted by responsible mining engineers and scientists.—W. CLIFFORD.

[60639.]—**Balloons.**—"First catch your gas" in a bladder, with a stopcock and nozzle fitted to it. Having done this, attach the balloon to the nozzle, and squeeze the bladder, which will naturally drive out the gas, whatever the pressure of indiarubber may be.—R. A. R. BENNETT.

[60639.]—**Balloons.**—Make a pump of 1in. and ½in. rubber hose, as illustrated in "E. M." of last week. Connect one end to main and the other to balloons, and work away with the foot as described. This is a very good substitute for an ordinary pump.—T. C., Bristol.

[60639.]—**Balloons.**—I do not know what may be the easiest way, but paper balloons can be filled by putting the gaspipe to them at the bottom, and leaving a small opening in the top—say, a piece of quill or tobacco pipe—through which the rising coal gas may expel the air. When the gas rises through this top opening strongly enough to light up and burn, the balloon is full. Indiarubber ones require an air-pump.—E. CONRY.

[60640.]—**Heating Apparatus.**—Carry up a vertical steam-pipe, and take branches off for each room; lay the pipes so as to drain back into the vertical pipe, to return the condensed water to boiler.—T. C., Bristol.

[60640.] — **Heating Apparatus.** — This condensation of water in the pipes is one of the greatest troubles of the hot-air engineer. The pipes are usually laid as straight as possible; but where bends inevitably occur, a tap (steam-tap) should be provided to drain off the water before putting the steam through. As soon as the pure steam begins to blow out the tap is closed, if it has not been done before.—E. CONRY.

[60641.]—**Horse-Power.**—Assuming the cut-off to be at ⅝in. the stroke, the effective pressure will be, say, 48lb.; area of cylinders combined = 1,021·4in. You do not give number of strokes per minute, so $\frac{48 \times 1{,}021{\cdot}4 \times 7 \times \text{number of strokes}}{33{,}000}$ = H.P. of engines.—T. C., Bristol.

[60642.]—**Dynamo Building.**—TO S. BOTTONE, &C.—Try to run the armature the other way—viz., against the brushes. Have you magnetised the field in any way by coupling up to a battery, or other dynamo, for a few minutes? If not, do so.—S. BOTTONE.

[60642.]—**Dynamo Building.**—Will you give the exact connections of your machine, and say whether you have tested the circuits right through with a galvanometer, to see if they are all right and a good connection everywhere? If the machine is made all right according to "Xero's" instructions, and you find the circuits are all right and the connections, where movable, are all screwed down tightly, yet when running you cannot get any spark on, take a short bit of fine wire, and touch it on both brushes, so as to short-circuit the armature for an instant; this often makes an obstinate dynamo start when nothing else will. If this will not make the machine "build up," get one or two large cells of a primary battery or some small ones coupled in parallel, or an accumulator or two, and put their current round the field magnets for an hour, as the iron of these may have got demagnetised, or perhaps has not in it (on account of quality) enough residual magnetism to make the machine start.—E. CONRY.

[60643.]—**Electrical.**—The resistance of coils and armature in a series-wound machine should be as follows:—Armature, 1; field magnet coils, ¾ to 1; outer circuit, 2. Shunt-wound machines:—Armature, 1; field magnets coils, 400; outer circuit, 20. The compound-wound machine will vary in its resistances, according to whether it is built to give constant current and varying E.M.F., or constant E.M.F. and varying current.—S. BOTTONE.

[60643.]—**Electrical.**—The field-magnets of a series-wound dynamo should be of slightly less resistance than that of the armature; the proportions should be about $\frac{9}{10}$ to 1. In the shunt wound the relative resistances vary greatly according to the shape, winding, and other matters; but, generally speaking, the proportionate resistance of the field-magnets should be rather less than the above, say, $\frac{16}{20}$ to 1. The above applies only to ring armatures connected in series. Compound winding generally does not make much difference in the proportions, I believe, but what difference it does make is rather in the direction of increasing the F.M. power by more ampère turns, or less resistance of F.M. circuit, according to the nature of the machine.—E. CONRY.

[60643.] — **Electrical.** — *Series Machines.*—The resistance of the field-magnets should be a little less than that of the armature. *Shunt.*—To obtain 90 per cent. efficiency, the resistance of the shunt must be at least 364 times that of the armature. *Compound.*—For constant potential, when only one lamp is running the shunt wire on the field alone maintains the magnetism, practically speaking, and therefore the resistance of the shunt must be the same as in a shunt machine. The turns of series wire serve to counteract the demagnetising influence of the armature, and the number of them is in reality always determined experimentally. You can find the formulæ in S. P. Thompson's "Dynamo Electricity." Bear in mind that the magnetic circuit is just as important as the electric circuit of the machines, and that you will not make a good dynamo merely by putting the proper length of wire on the cores. You would find it instructive to compare the figures given in the catalogues of the various makers. Other considerations than high efficiency influence the results.—BARKER AND CO.

[60644.]—**Heating Surface.**—Surface of crown of box = 8 × 8 × ·7854 = 50·26in., and of vertical surface = 8 × $3\frac{1}{7}$ × 10 = 251·2; the total will therefore be 301·46in., or about $2\frac{1}{7}$ square feet of surface.—T. C., Bristol.

[60644.] — **Heating Surface.** — The firebox being cylindrical, area would be—

$$2\left(\frac{\pi d^2}{4}\right) + (\pi \times 8) \times 10 \text{ sq. in.}$$

i.e. $$2\left(\frac{3{\cdot}1416 \,.\, 8^2}{4}\right) + (3{\cdot}1416 \times 8)\,10$$

or $$2\,({\cdot}7854 \times 64) + 31{\cdot}416 \times 8 = 125{\cdot}654 \text{ sq. in.}$$

The area of any circle is 3·1416 (or as it is called for convenience π, pronounced "pie") multiplied by the diameter, and the product divided by 4. The circumference of any circle is π × diameter, and therefore the area of any cylinder, excluding top and bottom, which we have already reckoned for, is the height × π × diam.—E. CONRY.

[60646.]—**Cracked Gongs.**—They are practically useless now. Better sell them as old metal. They may be melted and recast.—W. HOLDER, Newport, Mon.

[60646.]—**Cracked Gongs.**—Cut along the cracks with a metal saw—a fret saw will do—until the sound metal is reached. The object is to separate the edges of the crack, and prevent them rubbing against one another.—SAML. RAY.

[60646.]—**Cracked Gongs.**—If the cracks are at the edge and not very long, drill a small hole at the bottom of the crack and then saw down the crack to the hole; in other words, remove the edges, so that they do not touch when they vibrate.—T. C., Bristol.

[60646.] — **Cracked Gongs.** — They can be mended by running melted metal into the crack, in the same way that Big Ben, the Westminster bell, was mended; but I think you would find it more trouble and expense than the things are worth.—E. CONRY.

[60647.]—**Music Stand.**—If querist will look at a common article of furniture to be found in most houses and furniture shops, called a what-not, he will see at a glance how the pillars of his music stand should be placed.—DOCTOR MEDICINÆ.

[60647.]—**Music Stand.**—I have seen camp furniture put together by making one leg, the upper, for convenience, with a strong screw in it, which passes through a small hole in the horizontal wooden shelf and screws into a screw-hole bored and threaded for it, in the top of the corresponding under pillar, so that the shelves are nipped between the top of one pillar and the bottom of the next, when the two are screwed up tight.—E. CONRY.

[60648.]—**Transparency.**—Put a negative into a printing frame (you can cut them the right size with a diamond), and a plate behind it—film to film. Expose them to a lighted candle flame, about half a foot distance, for about 20 secs. If it is a good, dense negative, the best developer is said to be ferrous oxalate; but, if you can't manage that, sodic sulphite gives first-rate results. Thick negatives make the best transparencies—i.e., those with plenty of contrast. A sodic-sulphite developed negative gives a better transparency than a pyro-ammonia developed one. Will give you more information if you like to write to me.—R. A. R. BENNETT, Walton Manor Lodge, Oxford.

[60648.]—**Transparency.**—TO S. BOTTONE.—If W. W. Railey will make up some fresh ferrous oxalate, by mixing fresh iron sulphate solution with fresh potash oxalate solution, both saturate, in the proportion of one of the former to three parts of the latter, I have no doubt but that he will succeed. To the developing solution he must add bromide of potassium, in the proportion of five or six grains to each ounce. By so doing, the development will be very slow, but the shadows will be quite clear, and the colour excellent. Contact printing must be adopted, but it must be done, not by daylight, but by the light of a single burner, either paraffin or gas; and the greatest care must be taken that no light fall on the picture or plate at any time except that of exposure.—S. BOTTONE.

[60649.]—**Low-resistance Lamp.**—TO MR. BOTTONE.—Yes, a 20c.p. lamp of the Bernstein type would suit your dynamo very well.—S. BOTTONE.

[60650.]—**Geometry.**—For the same reason that the bisectors of the interior angles meet in a point, so do the bisectors of the exterior angles. Bisect all possible exterior angles, and produce the lines and you will see "why."—M., York.

[60651.]—**Electric Signals in a Mine.**—This is a query which can only be answered in a practical way. You had better employ a respectable firm who will undertake the work and guarantee it. If your wire eats away, why don't you speak of it to the people you obtained it from. For the signals you want, the best materials and workmanship should be used. A single well-insulated wire should be run to each of the levels you want to communicate with, and an earth return used. This will enable you to communicate singly. If a single wire is used each bell will ring at one time, and different signals must be used to denote the level you want to communicate with. Single-stroke gongs are generally used, but it does not signify. The price is best obtained by consulting a list. The push button would make no difference to the barometer.—C. D. R.

[60651.]—**Electric Signals in a Mine.**—Your letter is interesting, and I feel sure that many readers of "Ours," in common with myself, would like to hear further particulars, if you would furnish them, as to the description of guttapercha, wire, the gauge of the wire, and thickness of the covering, and whether the wire was tinned or not; if not tinned, it should have been, as the tin covering is an immense preventative of oxidation. It seems that the gases of the mine penetrated through cracks in the guttapercha covering, and attacked the copper, probably aided in their work by acids of some sort in the guttapercha itself. This latter always oxidises the surface of untinned copper wire. I should think the best wire for your purpose would be tinned indiarubber, and double-cotton covered and paraffined; it is a wire made specially for bellwork, and both the inner covering of soft, brown indiarubber and the paraffin are first-rate materials for resisting the action of corrosive substances. The insulation is also very good for resisting scraping, cutting edges, or other unintentional method of making contacts. It is not easy to see from your words whether you run the wire in casing or otherwise. If in casing, I should say No. 20, as above, would do; but if the wire is run on insulators, or in any other way exposed to the open air, I should recommend No. 18 at least, and as thick a covering of indiarubber and paraffined cotton as the manufacturers have. Look up some names in the directory, and write for samples. You would want a separate wire for each level, but one return would do for the lot. Either trembling bells or single-stroke will do, and there is not much difference in the price. The "push" would not have any effect on a barometer and thermometer. I should think an ordinary vibrating indicator would be as good as anything. I should think a latch indicator would not be safe, nor yet an electric motion and reversal indicator, because the working of both kinds depends on a nice adjustment of small moving metal parts, which might get out of order with the gases of the mine, and you could then arrange a system of signals by strokes of the bell. If you want more than this, I should advise telephones, or simple telegraph instruments like the letter telegraph (magnets) instrument in use in the P.O. service. I gave in last number a diagram of telegraph connections—if that will be useful to you.—E. CONRY.

[60652.]—**Small Dynamo.**—The dimensions given are not very good. I should advise you to have a laminated Siemens armature, about 8in. long by 2½in. diameter. Let this be wound with about 1lb. No. 20 or 18. The commutators to be in two sections only. Each limb of the F.M. should be cast in one piece with the pole-piece and lug which form the yoke, of this shape ┌ nearly, the lower extremity having the semicircular pole-piece cast on it. The distance between the pole-pieces should be only just enough to let the armature rotate between them. The height of F.M.'s about 4in. from pole-piece to yoke. Wire on F.M.'s about 7lb. No. 16.—S. BOTTONE.

[60653.]—**Rust Joints for Socket-pipes.**—I do not know if it is wise to use a rust joint for so high a pressure as 100lb. on the square inch; but I have used it for steam up to 50lb. with every satisfaction. For the method, put the end of your pipe into the socket, lap two or three turns of old rope, or thick, soft cord, round the pipe, and drive this

down to the end of the socket with a wooden wedge, or something similar; then with a wooden or iron wedge, or any conveniently shaped tool, drive into the socket all round, as tightly as you can, iron filings, or small borings and turnings (these are best), thoroughly wetted with weak solution of sal-ammoniac and water, not much stronger to the taste than sea water. The great mistake of most people in making rust joints is making the solution too strong, so that the iron filings, instead of being rusted, are entirely rotted away by rust. When the socket is almost as full as it will hold, jam in a turn of old rope, so as just to keep the filings in till they are set. I do not see any reason why rust-joints should not be used for even 100lb. pressure. —E. CONRY.

[60653.]—**Rust Joints.**— Iron borings, mixed with 1 per cent. by weight of sal-ammoniac, and ½ per cent. of flowers of sulphur. Moisten and caulk in tight with suitable tool, and let it rest two or three days. But 100lb. pressure is rather high for rust joints.—T. C., Bristol.

[60656.]—**German Ph.D.**—At what university? At that of Weissnichtwo you pay your fees, and pay a Grub-street hack, called there a "Professor of Allerlei-Wissenschaft," to write you a thesis on certain recondite phenomena of microcosmic agglutinations.—NEPHESH.

[60657.]—**Battery for Lathe Motor.**—You can fit up a motor yourself if you have a knowledge of tools and lathe. Motors and their construction have been described several times in these columns. To drive a lathe you will require a very large battery, either bichromate or Bunsen. It will mean a large expense and a great deal of trouble.—C. D. R.

[60657.]—**Battery for Lathe Motor.**—Three or four large double-fluid bichromate or chromic acid cells would do you probably as well as anything. There have been several descriptions in recent numbers. I described a small motor in "E. M.," Oct. 1st, which I think would do for you; but I should advise making it larger, say double the dimensions given, everywhere, and put two more layers on field-magnets, and as much more on the armature of the same wire already given for it, as it will hold. Keep the faces of the armature as close to the pole-pieces of the magnets as you possibly can short of touching. You would, of course, have to start the lathe or grindstone by hand.—E. CONRY.

[60658.]—**Indiarubber Solution.**—If too thick, put in naphtha. If the use you put solution to is applying it to the worn parts of stocking to make waterproof, two or three coats will do that; but the solution will not stand wear like vulcanised rubber, of which the stocking is made.—R. N.

[60660.]—**Electric Light.**—TO MR. BOTTONE AND OTHERS.—One 2½c.p. lamp would do, if placed close; but a 5c.p. would be much more satisfactory. If the lamps are properly arranged so as to make up the same resistance as the eight 20's, you can run sixty-eight 2½'s, or thirty-four 5's. About 1½ H.P. will drive the dynamo easily. Lamps cost about £3 per dozen. I could make such a dynamo for about £8. A laminated Pacinotti would suit best.—S. BOTTONE.

[60660.]—**Electric Light.**—One 2½ c.p. lamp would not give anything like enough light. One 10c.p. to each machine would be nearer the mark. I am sure you could not do with less than this for such small particular work. If the res. of the 2½c.p. lamps will allow of five of them in series making up about the res. of one 20c.p., then the same dynamo would do; but if the dynamo is a shunt-wound machine you can make it light lamps of very widely differing resistances by adjustment of speed and resistances in the machine. You do not say what the voltage of your lamps is; but if about 40 volts, then the eight would take together about 450 watts in the dynamo, or about 1 H.P. in your engine driving-wheel. The cost of the lamps depends on the makers. At sales you can often get them for 1s. 6d., 2s. a piece, but the best would be about 50s. a dozen. I should think the Patterson and Cooper "Phœnix" to give about 60 volts and 15 20 amps. would do for you as well as any, and as cheap; or you might try Mather and Platt's "Manchester" machine, which is a good one.—E. CONRY.

[60661.]—**Electro-Motor.**—See reply to No. 60657. You can have no idea as to the cost and trouble of a motor to give out two or three horse-power. It is not practicable to use primary batteries; the expense is enormous. Don't bother about it—you had much better put a steam-engine in. The only near approach to practicability would be to use secondary cells, and to charge these you would require a steam-engine and dynamo.—C. D. R.

[60661.]—**Electro-Motors.**—If you really require your motor to develop 2 or 3 horse-power you have a difficult task before you, and it would be advisable to commence on a smaller scale—say, 1 man-power. Trouvé, of Paris, has been very successful in propelling boats by electricity, with bichromate batteries as the source of power. You cannot do better than follow his general arrangements, particularly those relating to the battery. His motor is of the Siemens H pattern, with speed-reducing gear attached; but this type is out of date now. If you like to communicate with us direct, we can supply you with working drawings of a four-pole motor. (See our advertisement.)—BARKER AND CO.

[60662.]—**Solution of High Specific Gravity.** —The liquid used was "Sonstadt's solution," which was described in Vol. XXVI. p. 327, in a paper by A. H. Church, M.A., who gave its sp. gr. as 3·01. To prepare it, "Mercuric iodide and potassium iodide are alternately dissolved in a saturated solution of the latter salt until no more of either compound is taken up. The resulting liquid may be diluted at will with water." I did not measure the sp. gr. of what I made for finding the diamond, but flint glass floated on it.—J. BROWN, Belfast.

[60663.]—**G.E.R. Locos.**—The reply to this query would require a lot of space. If G. Head will write to me, I shall be happy to give him the information.—E. INNES, 66, Finsbury Park-road, London.

[60666.]—**Card and Wood-Cutting.**—Henry Mills, of Bodega-passage, Birmingham, is well known to printers as the maker of knives for cutting fancy shapes in paper and cardboard, but I do not know whether they could be used for wood.—A PRINTER.

[60667.]—**Magneto-Electric Call Bell.**— There are several forms. The best consists in a small magneto-dynamo, which generates current on rotating a handle. This current is led to the electro-magnet of the bell, the same as if it were from a battery. The magneto is almost the same as a medical magneto, except that a commutator is put on the armature spindle of such a kind as to send the currents all in the same direction.—S. BOTTONE.

[60669.]—**Gut Driving Bands.** — Taper the ends so as just to enter. Grease the end, and then screw into the hook. Cut off any that comes through, and screw up as far as it will go without cutting the gut. I have always found above to answer. The gut should not unravel if it does not rub anywhere.—T. C., Bristol.

[60669.]—**Gut Driving Bands.**—Hooks and eyes are secured to gut bands by simply screwing them on to the ends of the gut; both the hooks and eyes have a screw thread purposely provided for this. They should, of course, approximate the size of the gut. If they are too small, just file the gut, taper a little, and then screw them on; properly made gut does not unravel—if yours does so, get some better quality.—C. D. R.

[60670.—**Electric Tram.**—TO MR. BOTTONE. —Cores C-shaped, 3in. long, 1in. wide, ¼in. thick, wound with four layers No. 22 s. c. wire, armature Gramme pattern, 1in. internal diameter, also wound with No. 22.—S. BOTTONE.

[60672.]—**Battery.**—You have tried the best known batteries for this purpose. The only thing you can do now is to get a dynamo.—C. D. R.

[60672.]—**Battery.** — Any double-fluid bichromate, such as the Fuller's, will answer perfectly. But all batteries are expensive and messy. Why not have a small dynamo?—S. BOTTONE.

[60672.]—**Battery.**—According to the accounts given in the last volume, you cannot have a more serviceable battery than that illustrated on p. 561, No. 1,117; but I suppose you have looked up back numbers before sending such a query.—F. I. C.

[60672.]—**Battery.**—The working cost of Daniell cells is about half that of Bunsens, and though both are troublesome, you would find the Daniell least so. There is, however, a modification of the Leclanché cell now being introduced for lighting purposes, which has an internal resistance of only about ·03. The patentee is Octavius March, care of—C. D. BARKER AND CO.

[60673.]—**Mechanics.**— If the joists are 1¼in. wide they would be strong enough; but you had better use nothing under 1½in., and brace them at that.—T. C., Bristol.

[60673.]—**Mechanics.**—The breaking weights of beams of rectangular section increase as the squares of the depths and as the breadths increase, and decrease as the lengths increase. Therefore the breadth must increase as the length and weight increase, and decrease as the square of the depth increases. Then, the length, depth, and weight being given, the required breadth will be $\frac{8064 \times 144 \times 2^2 \times 2}{2000 \times 50 \times 10^2} = \cdot 93\text{in.}$ Where 8064 is six times the number of pounds in 12cwt., 144 is 12ft. in inches, and two is the depth and breadth of the experimental beam; 2,000 is twice its centre breaking weight in pounds, 50 its length in inches, and 10 the depth of the given beam in inches; 1,000lb. in the centre of 4ft. 2in. × 2in. × 2in. is rather a high breaking weight; 750lb. is nearer the weight for timber taken as it comes in the market.—J. S. C.

[60675.]—**Fire.**—Much depends on the coal you use. I have found that known as Ilkeston Brights keep in through the night in an open grate with little or no poking. This coal burns away to the last mite, leaving no cinder, but only ashes.—W. A. S.

[60675.]—**Fire.** — A new invention called the Edford briquettes would probably be of use to "E.G." and others wishing to keep a fire burning all night without attendance. Two of the briquettes broken into a few pieces will keep burning for 24 hours without any attention, and for this reason they are specially useful in the sick-room. I shall be happy to inform any reader where they may be obtained if he advertises his address.—S. E. MCNAIR.

[60675.]—**Fire.**—This query should really state whether the "fire" is a furnace, or merely a house fire, and even then whether kitchen or parlour. Anyway, sufficient coal must be put on, and that kind known as Derby Bright is better than Wallsend, as it is termed, which will certainly go out unless the poker is applied. What is "throughout the night," though? How many hours? If from, say, 12 p.m. to 6 a.m., there is little difficulty if the grate is carefully packed with small pieces, and the top is covered slightly with dust.—SAML. RAY.

[60675.] —**Fire—Keeping Alight.**—"E. G." does not say what kind of grate or fireplace he has; but, presuming it to be an ordinary one, he might try the following. Cut a piece of sheet-iron to cover the bottom of grate. Fill up to level of top bar with pieces of coal the size of Macadam stones (largest at bottom); on this place paper and wood, with some cinders and a few small pieces of coal. Light, and let it burn downwards. If the grate is large enough to hold a fair supply of coal, you will get a glowing fire that will keep in a long while. I have also seen a sort of cloth made of asbestos, which was placed on the top of the coals to keep the fire in. Both plans act by checking the draught.—D. G.

[60678.]—**Varnish to Harden Paper.**—Soak in linseed oil, and when dry, coat with copal. Probably wood has been found cheaper and more trustworthy than papier mâché.—SAML. RAY.

[60678.]—**Varnish to Harden Paper.**—I think querist will find what he requires in Willesden paper, made by a company at Willesden, London, which can be had from the thickness of writing paper to ⅛in., and as hard as a board.—DOCTOR MEDICINÆ.

[60678.]—**Varnish to Harden Paper.**—Let "Photo" dissolve orange shellac in spirits of wine till thick as treacle. If two coats are given, and two pieces are put together when they get in a nice sticky condition, they make a good slide. They are put under pressure between two flat surfaces to dry straight.—LIGHT-WEIGHT.

[60679.]—**Ink for Window Tickets.**—Grind up any of the desired pigments with gum water, and use with a "pencil"—that is, an artist's paint-brush. If weather hot and dry, add a little glycerine; but you need not if it is like what it is while I write this—damp and miserable.—SAML. RAY.

[60680.]—**Field Magnets.**—This querist reminds me of Charles II. and the fishes. The armatures in the best machines do actually revolve in the field of the greatest density; it is only in defective machines that anything else takes place. Has not this querist quite misunderstood the winding of the Elwell-Parker dynamo? If "Ampèremeter" will turn to the ENGLISH MECHANIC, Vol. XLII., page 85, he will find an illustration and explanation of the mode of winding a drum armature; and if he does not understand this, I shall be happy to lend him a small model.—S. BOTTONE.

[60680.]—**Field Magnets.**—The circuits of the magnetic lines of force are completed through the paths of least resistance. The iron cores of the armature in a well-constructed dynamo nearly unite the two poles, the layers of wire and the clearance space being the only part of the magnetic circuit that is not iron. The lines of force that do not take this path are wasted, but they are few in comparison with those that pass through the armature. You must be mistaken about the Elwell-Parker machines. The poles are wound the same as in other machines. The diagrams for winding drum armatures certainly require careful study, but they are the best means of explanation short of a demonstration.—BARKER AND CO.

[60682.]—**Leclanche Batteries.**—It is quite possible to charge with too strong a solution. The best under all circumstances is a half-saturated one of salammoniac. Are you sure the solution contained nothing else but this salt? What sort of zinc have

you used? If this is impure, and of bad quality, it will cause a great deal of trouble. Empty your cells and recharge as above, and if the zincs are bad, exchange them for good.—C. D. R.

[60683.]—**Electric Bell Indicator.**—From the description given, this is a polarised needle movement, and, I should say, of very common make. Try and ascertain if the indicator movements will act without the bell; if so, you must increase your battery power until both bell and indicator act together. I presume that the indicator is coupled up correctly. It should be wire from carbon to bell-pull to terminal marked carbon on indicator. The rest of the terminals will, of course, be connected to the different push wires, and form these to the zinc.—C. D. R.

[60687.]—**Screw-Cutting.** — You do not give the pitch of your leading screw. The screw is $\frac{89}{18}$ of an inch, and you will, therefore, require a special wheel of 89 teeth, although it is possible to do it with a 90 wheel; but the "game is not worth the candle." See Holtzapffel for the method.—T. C., Bristol.

[60687.]—**Screw-Cutting.**—To cut 18 threads in 22¼in., use a driver having same number of teeth as lead-screw has threads in 22¼in. (or 44½in. as the case may be)—i.e., 89 and 18 would naturally be your screw wheel, but 89 and 18 are not workable. If leading screw is ¼in. pitch, use screw 36, stud $\left\{\begin{matrix}\text{driver } 89\\ \text{driven } 20\end{matrix}\right\}$, mandrel 40, driving the 20 by means of two idle stud wheels of suitable size to the lathe.—H. O., Glasgow.

[60687.]—**Screw-Cutting.**—You omit to state the pitch of your leading screw, but I assume four threads to the inch. If there are two threads, you must halve one of the drivers, or double one of the driven. You want 18 threads in 22¼in., and the leading screw having 4 per inch contains 22¼ × 4 = 89 threads in 22¼in. Hence the ratio is $\frac{89}{18} = 4{\cdot}944$, which are the ratios of the screws, and therefore of the drivers and driven wheels which are to be sought. To cut these absolutely correct you must have the special wheels 89 and 18, or multiples of the same; but you can cut with sufficient approximation for most purposes by taking instead $\frac{90}{18}$ and deducing suitable wheels; $\frac{90}{18}$ gives a ratio of 5, but by conveniently reducing by 1-18th we get $\frac{84}{17}$, whose ratio is 4·941, which is very near the mark. Deducing the wheels $\frac{7 \times 12}{17 \times 1} = \frac{70 \times 120}{170 \times 10}$ substituting $\frac{70 \times 120}{85 \times 20} = 4{\cdot}941$ ratio, and 70 × 120 are drivers, and 85 by 20 driven.—J. H.

[60687.]—**Screw-Cutting.**—The following is offered as a variation of the ordinary rules for finding change wheels. If worked out step by step, it gives an analysis of the possible changes that few others give. Set the number of threads to inch required on the mandrel, or set down the number of inches to a thread, as the number of teeth to be put on the screw, multiplying this by the number of threads to inch of leading screw. Put intermediate wheels as having an equal number of teeth for trial. Multiply or divide any two numbers which gear into one another by any suitable number until the wheels are of such numbers as are usually supplied. Thus: required, 18 threads in 22¼ inches; say, leading screw 4 threads to inch. Then 18 on mandrel, 22¼ × 4 = 89 on screw. Put intermediates at 20 each, then diagram:—

Mandrel 18 gears, 20
||
20 gears 89 screw.

Multiply the first pair of gears by 5; then mandrel 90 gears, 100
||
20 gears 89 screw.

Unfortunately, no available wheel number will go as factors into 89 (prime number). Had 18 turns in 22½in. been required, then 90 — 100
||
20 — 90;

but as 90 here occurs twice, halve the first pair; thus 49 — 50
||
20 — 90.

Should leading screw be one or two threads to inch, multiply one of the drivers (or divide one of the driven) by 4 or 2 respectively; thus, last gear, 80 — 90, or 40 — 90.—Nephesh.

[60688.]—**Nickel Silver.**—You would probably get the information from Cooper Brothers, Don Plate Works, Sheffield, or from other manufacturers of nickel silver. The metal is rolled into sheets; but cannot say as to wire.—Nephesh.

[60689.]—**Silvering Glass.**—It is generally the usual Rochelle salt process, which has been described over and over again. I see by the last index there are several references to the subject, and there is certainly no "patent" in it. Called patent merely to distinguish it from the old mercury process.—Nun. Dor.

[60690.]—**Wood Carving.**—Illustrations of the tools are given in such lists as that issued by Melhuish, of Fetter-lane, E.C. A "few hints" would be no use; better procure a handbook of the art and—practise. But if you want to make a living at it, rest assured there is no room except for the artist workman.—Scorper.

[60691.]—**Wood Naphtha.**—To one gallon add 3½lb. dried and hot pearlashes, agitation repeated every hour for a day; decant. If not free from water as you would like, repeat with fresh ashes.—R. N.

[60691.]—**Wood Naphtha.**—Let this stand for some time in a tall vessel, and the spirit will separate and rise to the top, whence it may be siphoned off. Or it may be distilled over.—T. C., Bristol.

[60695.]—**Model Marine Boiler.**—Solder or braze these in. Have the tubes as large as you can get them in, and look in almost any optician's window at one of these model boilers; that will be better than a sketch.—T. C., Bristol.

[60697.]—**Electric Lighting.**—If "Amateur" looks at the craters of his carbons he will instantly be able to say whether the current through the lamps is or is not reversed. The lamps are probably burning with the positive pole at the top, but from bad regulation burn the carbons irregularly. By making a slight difference in the regulation a lamp that burns the upper carbon too fast can be made to burn the lower one too fast. See that the proper current passes through each lamp, and that it burns steadily with an arc of the normal length, and your difficulties with the carbons will disappear.—Barker and Co.

[60698.]—**Lathe Speed Pulley.**—Your question does not give size of wheel and distance of centres. If the grooves in wheel have a difference of 1⅝in., I believe you will be suited. Say 21in. and 19⅜in.—T. C., Bristol.

[60700.]—**To Draughtsmen.**—Step it out with dividers is by far the most workmanlike and quickest way.—Nephesh.

[60703.]—**Galvanism.**—As I have been suffering from a complaint strangely like "R. J. T.'s" in symptoms, treatment, and results, I look forward with much interest to Mr. Bottone's reply. In the mean time, may I be allowed to state, for "R. J. T.'s" information, that I recently heard of a homœopathic remedy, "Cimicifuga," and have derived more benefit from its use than from all the other remedies put together?—C. M. C.

[60703.]—**Galvanism.**—To Mr. Bottone.—Although not a medical man, I think I may safely advise you to use the intermittent current from a magneto machine or medical coil. Place a good large copper plate on the back, in connection with one electrode, and pass a large spoon, connected to the other electrode, with a stroking motion along the affected ribs, side, and shoulder. It does not matter much which electrode is connected to the plate in this case.—S. Bottone.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

60125. The Steam Yacht *Rosalind*, p. 539.
60127. Subscription Sales, 539.
60144. Railway Locomotives, 540.
60145. Picture-Frame Gilding, 540.
60146. Brass Tubes, 540.
60151. Doubling Chenille, 540.
60172. Testing Steel Wire, 540.

60338. Legal, p. 45.
60340. M.R. and G.N.R. Locomotives, 45.
60350. Large Field Eyepiece, 46.
60353. N.W. Drivers and Postal Trains, 46.
60355. Vitriols, 46.
60358. Spherical Trigonometry, 46.
60371. High Pressure Gauges, 46.
60372. Boiler for Steam Launch, 46.

A French authority gives the following recipe for transparent cement:—The advantage claimed is the absence of the slightest yellow tinge, so that the addition of the cement is imperceptible, while it possesses an extreme degree of tenacity: Mix in a well-stoppered bottle 10 drachms of chloroform with 12½ drachms of non-vulcanised caoutchouc in small pieces. The solution is easily effected; when finished add 2½ drachms of mastic, and let the whole macerate from 8 to 10 days, but without heat. A perfectly white and very adhesive cement s thus produced.

QUERIES.

[60704.]—**β 63, and 178 Dolphin.** — Will Mr. Sadler kindly inform me of latest measurement of β 63, and 178 Dolphin. On the 6th Oct. I looked once more at these, and, to my delight, saw β 63 clean apart. I did not know the P. angle or distance, only that it was a small co. and difficult, as I had looked at it unsuccessfully scores of times with 8½, 10, and 12in. mirrors. I booked it at 350° P. angle, and found it in Gledhill's Burnham list as 6·11 mags., 340° 0·7″. I saw it well with a Browning E eyepiece, on 10in. of 12¼ Linscott mirror, my J Browning mirror being in town for new silvering. Then I looked at 178, and saw the small pair not separated, estimated angle at 45° or 225°, and it is nearly that in Gledhill. Air much better than usual, but would not bear 500 at stars low down. With 500 Cooke eyepiece, I saw very finely OΣ 371 Lyræ at 0·8″, and Σ 2491 extremely clearly on 10in. of 12¼; also 16 Vulpis at 0·7″ and 2 Vulpis with the E eyepiece and the triple 6968 Lyræ. Too quickly the wretched cirrus came from S.W., spoiling definition long before it was visible near the stars; then all over. I constantly see the star centre in Neb. 37 H IV. Draconis, mentioned by Mr. Knott in the "E.M.," and notice the disc-like appearance; but it shows best in very clear air, not hazy, as real stars often do.—Bramley.

[60705.]—**Dutch Language.**—I wish to study the Dutch language, but have difficulty in obtaining the necessary books. Could any correspondent inform me of any elementary course or work on the subject suitable for a beginner?—M. C. Z.

[60706.]—**American Medical Law.**—I shall be much obliged if some of our numerous correspondents will give me the particulars of what States the M.R.C.S. (E.) and L.R.C.P. (London) are qualifications for medical practice without other exams.? The names of the different licensing bodies, and in what States their qualifications are available? What their diplomas are, and the rough outline of their curriculum? If a man going over from England, having passed his primary exams. for the above-mentioned qualifications—e.g., materia medica, chemistry, anatomy, physiology, &c., with his full curriculum of lectures, &c., attended, would he be required to pass again in those subjects or to attend medicine and surgery lectures with hospital practice a second time, provided he went over with good credentials from the authorities here? Is there any opening for a man who is well up in the demonstration of histology and microscopical morbid anatomy with first-class credentials? Any information on above points will oblige—Microtome.

[60707.]—**Dynamo.** — To Mr. Bottone. — Many thanks for answer to query 60476. I join the two ends of wires on fields to brushes, and get very little current on outer circuit; but if I join the beginning ends of both limbs to one brush, and the finishing to the other, I then get a good current, and the dynamo drags heavily. Both limbs are wound right-hand, which I think should make N. and S. fields. Will you please put me right if I am wrong?—D. B. S.

[60708.]—**To Mr. Bottone.** — I am thinking of making a Wimshurst machine the same as you have described in the English Mechanic. As I have been given to understand that the steel spindle carrying the discs should be in one length so as to bring the neutralising rods in metallic connection with each other, do you think the machine would give as good results with the spindle in two parts as you recommend, thus insulating one neutralising rod from the other? Do you think very thin sheet brass about the thickness of common tin plate would do better for the sectors than tinfoil? I thought of sticking them to the discs with good tricycle cement. Do you think the bichromate paste you recommended some time ago would be better for attaching the discs to the bosses than tricycle cement? Would you kindly tell me of some simple way of testing the quality of the glass jars and discs? An early answer will greatly oblige—J. R.

[60709.] — **Electro-Metallurgy.** — I hear that several large firms of copper smelters and refiners in Swansea have adopted the dynamo system for the extraction of copper and zinc in a metallic condition from the ore; and that this plan is replacing the old one of smelting. I have been experimenting on both copper, iron, and zinc. I have succeeded with the copper, but not with zinc. My zinc ore contains a large percentage of Pb, Fe, Si, and a little Cu. I have used thin sheet-iron plates for anode and cathode. I have ground up my ore and then covered it with a dilute sol. of HCl, and then neutralised by caustic soda sol.; but I get no result. Why and in what direction have I failed? Any hints will be most acceptable.—A. B. H. Faudelle.

[60710.]—**German Universities.**—I am thinking of sending one of my sons to a German or Prussian University, and as I am quite ignorant of the "mode of procedure," I shall be glad of any information. Are there any books (in English) from which I could glean any information? Is it needful that the youth should know German before going? I have been told that it is not, and that he would "pick it up" very easily while there. My idea in sending him is to get a good scientific training and the Ph.D. deg. What is the probable cost?—A. B. H. Faudelle.

[60711.] — **Rendering Ground Glass Transparent.**—Can anyone help me in the following? I have two panels of ground glass in a door. Can I, by varnishing the "ground" side of the glass, render it transparent, or nearly so, previous to decorating the other side with imitation stained glass (glacier)? If so, what varnish should I use? Any hints from any of "ours" who have used the "glacier" process would also be very acceptable. The door is in a passage, so that neither side of the glass would be exposed to the weather.—D. G.

[60712.]—**M.R. Engines.**—Could anyone tell me the dates of M.R. engines 1326, 1347, 1432, 1451? Also, how many single engines has the M.R.?—F. A. Holmes.

[60713.]—**Hose for Fire Hydrants.**—I have a private hydrant under my charge for use in case of fire. The standpipe is screwed for 2½in. brigade hose. My hose is 2in., so I reduce it at the stand pipe from 2½in. to 2in. Should I get a better supply and throw water higher with the same size nozzle if I had 2½in. hose? The pressure in

main is 35lb. to the sq. in. I should feel obliged if some kind reader of "ours" would give their experience to—WATCHMAN.

[60714.]—**Testing Ventilators.**—Will one of "ours" kindly inform me the method they have of testing ventilators that are fixed on the roofs of buildings, such as Boyle's or Buchan's?—GEORGE MCFARLANE.

[60715.]—**Motor for Canoe.**—I have a Canadian canoe that just holds two, in which I want to fix a motor of some kind. It does not draw enough water for a screw, and paddlewheels are out of the question, so I thought of fixing horizontally two small force pumps to propel the boat by forcing water out of two pipes, one on each side of the rudder. The pumps could be worked by the occupant with two levers, one in each hand. Will someone say what should be the size of the pumps and the probable speed of the boat? Would one large pump do instead of two small ones, and would it be necessary to have an air chamber? Is it the quantity, or the force, of the water that propels the boat?—ANGLO-CANADIAN.

[60716.]—**Choral Top.**—A toy called the "choral" top is now quite common. It consist of a large humming top of a brilliant white metal, containing a circular plate, to which are fitted a number of cheap acordion tongues, or vibrators. When the top is spun, a soft chord is heard, which soon changes to another chord, and at intervals the chords change. Now I would wish to know of what metal is the top made? Is it a homogeneous white metal, or is it some kind of alloy subsequently nickel-plated? The colour is very good, and the polish brilliant. It is evidently spun in two or more pieces on the spinning lathe. Can a flat dish of metal, previously nickel-plated, be spun in the lathe without destroying the nickel-plating? By what contrivance is the chord made to change automatically while the top is spinning?—S. S.

[60717.]—**Hot Dynamo.**—TO MR. BOTTONE AND MR. EAVES.—We have a dynamo at our place—a six-pole machine, Elphinstone and Vincent. It drives 150 lights, being a 400-lighter. The brushes and collector heat very rapidly after starting; also magnets heat so much that at the end of five hours run we can only just bear to touch them. How is this? The brushes go like tallow candles. Is it because of being shunt wound too much current runs through the shunt coils. Would more lamps in circuit stop this? It sparks badly. The lamps are 50-volt, two in series, then arranged in parallel arc. A friend of mine said it is caused by there not being sufficient lamps in circuit, causing too much current to run through shunt coils. Engine tenter said it was not so, because if more lamps were put in it would cause more current in the magnet coils and more heating in them. Which is right? I think the first. The machine runs at 720 a minute.—FIREMAN.

[60718.]—**In Beat.**—TO "F. W.," "ALFOJOE," OR OTHERS.—I have seen in a back number that a correspondent put a watch into a saucer and the beat was clear and distinct. I have tried this, and fail to see the advantage. Is there any ready means of increasing the sound? I am familiar with the screwdriver between the teeth and in contact with movement.—AMATEUR.

[60719.]—**Balance.**—Will "Fellow Workman" kindly tell me if it is necessary to remove hair spring from cylinder or staff when cleaning balance? I have seen in a back number his method of protecting spring of under-sprung watches, but do not see that it is applicable to over-sprung watches. Also if it is best to oil pivots or holes, if the latter is to be done after putting together?—AMATEUR.

[60720.]—**Zirconia Cylinders.**—Are they a satisfactory substitute for lime? Do they give as good a light? Do they crack? Will they stand good pressure of mixed gases? Must they be revolved? Are they durable and thoroughly dependable? Must they be kept air-tight when out of use?—LIME-WEARY.

[60721.]—**Push.**—TO MR. E. THORNTON.—I am desirous of fixing electric bell connection to large gates at a works entrance, and I wish to have a push that shall ring three bells from the one wire and one battery; bells to be in different places; total length of wire (to be overhead) 370 yards, bells to be 4in. dia.? Can I not use something much lighter than the iron wire used by telegraph companies?—ACCRINGTON.

[60722.]—**Astronomical.**—(1) By what t are $\triangle c$ and $\triangle c'$ multiplied to produce $t\triangle c$ and $t\triangle c'$ respectively? The Greenwich nine-year catalogue for 1872 gives the $\triangle c$ of γ Orionis $= + 0{\cdot}002$, and $\triangle c' = + 0{\cdot}04$. In finding the $t\triangle c$ and $t\triangle c'$ of this star for—e.g., 1 Nov., 1886, how must I proceed? (2) Why is it that the correction of R.A. of stars of southern declination comes out greater when using the independent quantities than when employing the B.A.C. constants with Bessel's day numbers, or the Greenwich constants with Airy's numbers?—VEUTON VEOR.

[60723.]—**Temperature.**—For reduction of barometric heights, C. scale, is 5508 the co-efficient to be substituted for that of 9990 F.?—POSTULATA.

[60724.]—**Circular Saw Bench.**—Would our friend, "O. J. L.," or any of "ours" who have had experience, tell me which would be the best arrangement to get power to drive a circular saw? I have got a wooden bench and saw spindle. What I should like to know is which is best, treadle and gear, or belt and pulley with large flywheel? If by treadle, what size wheels and best pitch should I require to get a speed on the saw of 1,000 revs. a minute? It is only to cut pine $1\frac{1}{4}$ deep, nothing thicker.—J. C. D., Liverpool.

[60725.]—**Insulation.**—Would any of your correspondents please inform me if there is any rule relating to the thickness of the insulation on electrical wire, or whether there are any conditional reasons why some wires are loosely covered and some comparatively tight, some covered with a single layer of cotton and some double? Others again are covered with flax, and more with silk, some of which you may press your thumb nail through and expose the wire $\frac{1}{8}$in. or more. Why not insulate small wire with cotton? Why use silk? Would a wire perfectly covered with No. 50 cotton answer as well as if it was covered with No. 16 cotton? What is the object of double covering?—PERPLEXED.

[60726.]—**Cement.**—Can any reader inform me of a cement for fixing leather to cloth under following conditions? Cement will not undergo any strain, but must be waterproof and applied to the leather only; when set the articles to be united by the application of warmth.—D. W. W.

[60727.]—**Government Returns.**—Could any reader say whether there is any book published for the information of the public containing the lists of expenses incurred by the Government in institutions or establishments throughout the country—for example, the expenses in connection with the Royal Indian Eng. College?—COOPERS HILL.

[60728.]—**Steel or Iron Tubes.**—Could any of your readers kindly give me a rule for finding what thickness of metal is required for making wrought-iron or steel-riveted tubes of a given diam. to stand a given internal pressure? A few days ago I wanted to know what thickness to make a 12in. dia. single-riveted iron pipe to stand a pressure of 90lb. per sq. in. I asked three friends. One said $\frac{3}{8}$in. plates, another 3-16, and the third 17 W.G. Now which is right? Should be glad if any of your readers could tell me. Also a 16in. dia. single-riveted steel tube to stand a steam pressure of 30lb. per sq in. What thickness should it be?—PERPLEXED.

[60729.]—**Driving Belts.**—What amount of slip is generally allowed in belts per foot per H.P. transmitted—i.e., a 5in. belt 38ft. long drives a 7in. pulley 1,600 revs. from a pulley 50in. about 20H.P.? Is 10 per cent. sufficient to allow in this case for slip?—MILLER.

[60730.]—**Turning Small Cylinders.**—Is it possible for me to turn true a small steam cylinder 1in. dia. on a very small lathe which has no tool holder—that is, in which the tools are held in the hand? If I can do so, will someone kindly tell me how to fix it?—COLOMBO.

[60731.]—**Drill for Small Work.**—(26340 p. 132.) I was going to make a small drill myself, but was puzzled how to fix the lever for raising drill. I saw your sketch, but cannot exactly see how you attach your lever. If it is not too much trouble, will you explain this, for I am rather dull?—COLOMBO.

[60732.]—**Gas-Engine.**—As gas-engines are now coming to the fore, and are superseding steam-engines for small powers, I think it would be acceptable to many to have some practical and theoretical instructions on them. Perhaps some of your numerous correspondents will supply them. In McGregor's book it says: "The combustion is faster, and consequently the explosion pressure is greater, as the velocity of the expansion increases." Does that mean as the speed increases? It also says: "The efficiency of a hot cylinder is greater than that of a cold one." Then why cool it? In what way does the Otto fall short of the ideal gas-engine? Can anyone sketch Whitworth's machine for measuring to millionths of an inch?—GAS ENGINE.

[60733.]—**Take a Postcard.**—Would someone kindly say what is to prevent some evil-disposed person from making coins in lead of the same size and weight as pennies, and inserting them into the postcard and paper envelope and stamp boxes placed about the streets of Manchester and elsewhere, and thus obtaining the same merely at the small cost of old lead, instead of the coin of the realm? If exact size and weight is necessary, of course a solid lead penny would weigh more than the same size in copper; but a core of some light material might be cast in the lead pennies, thus making them of the same size as copper pennies and of the same weight.—G. M. S.

[60734.]—**Wimshurst Machine.**—Would Mr. Bottone kindly say why it is necessary to varnish the discs of a Wimshurst machine? Also, should they be varnished on both sides? Should the sectors be fixed on the outer side only of the discs? In his directions given in last issue of "E. M.," he says leave $\frac{1}{4}$in. of clear glass between the periphery of the discs and the circle of the sectors. Is this portion of the disc not to be varnished?—AMATEUR.

[60735.]—**Electric Gas-Lighter.**—Would Mr. Bottone kindly give instructions for making an electric gas-lighter on the induction principle?—AMATEUR.

[60736.]—**Small Light Magnets.**—In constructing an article, I want a few permanent magnets about as powerful as 6in. horse-shoe ones; but unless they weigh about one quarter of their (the horse-shoe ones') weight only, and be, say, 4in. long by any breadth inside of 4in., they are of no use to me. Can such light magnets be made by any means, and at the same time be powerful enough to raise about 1oz. to $1\frac{1}{2}$oz.? I do not want them attached to a galvanic battery.—A. G. G.

[60737.]—**Mathematical.**—Solve the following equation:—

$$x^3 - y^3 = a$$
$$x + y = b$$

a and b are known numbers. Find the value of x and y in a and b.—A. CLEGG.

[60738.]—**Great Eastern Engines.**—On page 394, Vol. XLIII., "Baltimore" mentions a report of some new single engines coming out on this line. Perhaps someone can kindly say if this is so, and if any are likely to commence running shortly.—W. H. THURLOW.

[60739.]—**Continued Fractions.**—Can anyone explain how to calculate logarithms by means of continued fractions? I believe it is explained in the second volume of Francœur's "Mathematics"; but the book is very old, and I have not been able to obtain a copy.—R. E. F.

[60740.]—**Universal Chuck.**—Will any reader kindly explain how the square jaws with triangular notches, figured at page 232 of Holtzapffel's fourth volume, are prevented from travelling on their round centre pins when holding work?—R.

[60741.]—**Mensuration.**—What is a ready means of ascertaining whether a vessel having the shape of a truncated cone is approximately half-full of liquid, and does it matter whether the smaller or the larger diameter is the base? A practical method is required, without the aid of any apparatus.—CONIC SECTION.

[60742.]—**Propeller for Launch.**—What diameter and width across the blade, screw propeller (four blades), would a two-cylinder engine, 4in. stroke, 2in. bore, drive, working at a pressure between 80lb. and 100lb., and at what angle with the boss should the blades be set? Also how to work out this query: What length and beam (depth no particular consequence) load for sea use in fine weather would the above engine drive effectively?—A FITTER'S APPRENTICE.

[60743.]—**Cast-iron Piston Rings.**—Will any of my brother readers assist me in the above? How are they put on the piston? Are the pistons made in halves? Which way are they drawn? Wilson's are drawn by laying the rings on the anvil and tapping the inside edge with a hammer. Are the cast-iron rings drawn the same way? Diam. of piston, $8\frac{1}{4}$in.; ring, $\frac{1}{2}$ by $\frac{3}{8}$ thick.—H. W. G.

[60744.]—**Question in Dynamics.**—Can any reader solve and explain the following problem? A weightless string passes over a pulley (neglect both weight and friction). To one end is fastened a weight, of mass m; to the other a monkey, also of mass m, clings. The monkey suddenly begins to run up the string with velocity. What will be the resulting motion?—HUMBUGGED.

[60745.]—**Lead Valley.**—I have a valley on my house laid with 6lb. lead, and descending at a swift slope. The heat of the sun has caused the lead to blister and then crack in several places, and although I have had it several times repaired with solder it still leaks when winter comes on. A valley board would be unsightly, and it would be a serious matter to rip up the roof and lay new lead. Perhaps some kind reader can suggest a remedy.—DOCTOR MEDICINÆ.

[60746.]—**Valves.**—I am anxious to find out a really reliable full-way 6in. valve which shall be efficient under a pressure of 50lb. of steam and yet be readily opened and closed. Will some of the readers of "Ours" kindly give me their experience of those made by J. Hopkinson and Co., of Huddersfield?—FITTER.

[60747.]—**New Caledonian Single Engines.**—Will some correspondent kindly say if it is correct that these engines are the first combining in their design single driving wheels, inside cylinders, and a leading bogie, and also give a sketch of same? I notice principal dimensions have been given on pages 20 and 43 of present Vol. and page 538, Vol. XLIII. Have any of them yet commenced running on the fast-through Scotch trains?—W. H. THURLOW.

[60748.]—**Electricity at the Science and Art Exams.**—Will any of "ours" kindly say what qualifications are necessary to pass the advanced stage in "electricity and magnetism" in connection with the Science and Art Department? Is any mathematical knowledge necessary? Is the examination a stiff one? Any particulars bearing on the subject will be esteemed a favour. I may add that I passed the elementary stage a few years ago.—ZERO.

[60749.]—**Chamber Organs.**—Will "G. S." (letter 26364) say on what principle he has scaled the pipes in his answer to Mr. G. Landel, as the octaves do not appear to follow the same ratio?—F. F. R.

[60750.]—**Glass for Fish Tank.**—What thickness of glass shall I require for tank of 6ft. cubic capacity?—A. B. C.

[60751.]—**Wiped and Blown Joints.**—Will Mr. P. J. Davies tell me the reason the New River Water Co. will not allow a blown joint on their connections when it is well known they are stronger than the wiped joints?—YOUNG TURNER.

[60752.]—**Turning Balls.**—I have 25 gun-metal balls to turn of the following diameters: Five $2\frac{1}{4}$in., five 2in., five $1\frac{1}{2}$in., five 1in., and five $\frac{1}{2}$in. They are for valves. I have a lathe, no slide rest, but plenty of tools and chucks; but I lack the necessary knowledge. Will any practical sub. kindly assist?—YOUNG TURNER.

[60753.]—**Light.**—TO W. G. PENNY.—Referring to end of letter 26361, when looking at a star, are the rays more perpendicular to the retina than when looking at the side of it? The retina is not flat, and, besides, the rays in both cases are all oblique (except the centre one).—M. YORK, M.I.C.E.

[60754.]—**Artificial Horizon.**—What would be the simplest way to make an artificial horizon? Would water in a vessel, covered with either gauze or muslin, do to protect it from the wind? What would be the best way to fix either muslin or gauze? Any hints will be useful.—JACK.

[60755.]—**Professor Trusses' Valves.**—Will Mr. P. J. Davies, or any sub., kindly tell me the action of the above ball, bib, stop, and water-waste preventers for closets? Are they durable when made properly, and do Farmiloes, of Clerkenwell, supply them, and can the joints be wiped or blown without taking them to pieces?—YOUNG TURNER.

[60756.]—**Battery and Lamp.**—Will Mr. Bottone kindly aid me in the following? I wish to construct a battery to work incandescent lamp, sufficiently powerful to admit of reading comfortably, at about 2ft. or 3ft. distance. I do not want to charge more than once a week, using it two hours each night. Can you suggest anything that will meet the above case? As regards the solution, please let me have the solids by weight and the liquids by measure; also the smallest size and number of plates and jars necessary to satisfactorily accomplish the end in view.—THORS.

[60757.]—**Revolving Wood Stand.**—I wish to make a circular revolving wood stand of three tiers for light fancy articles in shop window, 18in. diam. at base. I shall be very glad if anyone will kindly give me advice (and sketch) (1) how to make, and also (2) whether an electro-motor would be suitable for working it, and (3) whether two Fuller's cells would be sufficient to run a motor for the purpose.—REVOLVER.

[60758.]—**Small Launch.**—I am making small launch for river, 12ft. long. Can any reader tell me if I could burn petroleum instead of coal in firebox, and how? I propose using vertical boiler about 3ft. by 18in.—PETROLEUM.

[60759.]—**Aniline Dyes.**—What will discharge a stain in white flannel caused by one of these dyes? Chlorine, chloride-of-lime water, and the chloride itself do not bleach it. The last has made the stain worse, and has made the unstained part yellow, and it formed a soapy lather when applied.—J. S. C.

[60760.]—**Boehm Flute Making.**—TO "VULCANITE" AND OTHERS.—I thank you for your two replies to

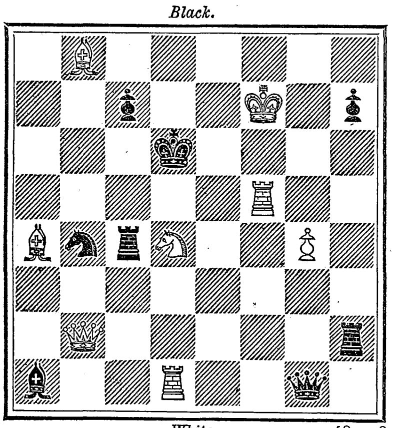
my former queries; but as it is not practicable for me to advertise my address, and as I require full directions, I hope you will be kind enough to write a letter on the above subject.—J. G. BARTEL, Nelson, New Zealand.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXIV.—BY E. J. WINTER-WOOD.
(From "Chess Souvenirs.")

Black.



White. [8 + 8

White to play and mate in two moves.

SOLUTION TO 1,012.

White.	*Black.*
1. B-Kt 5.	1. Q takes B (*a*).
2. Q-Q 6 (ch).	2. K takes Kt.
3. Kt-K Kt 2, mate.	
	(*a*) 1. P takes Kt (*b*).
2. Kt-B 3, &c.	
	(*b*) 1. Kt takes Kt (*c*).
2. Kt-K 7 (ch), &c.	
	(*c*) 1. K moves (*d*).
2. Q-Q 4 (ch), &c.	
	(*d*) 1. Kt-Q 8 (*e*).
2. Q-Kt 5, &c.	
	(*e*) 1. Any other.
2. Kt-B 3 (ch), &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,012, by A Beginner. G. T. Stringfellow (but 1. $\frac{\quad}{\text{P takes Kt}}$ wrong), A. Dean, A Beginner; to 1,011, by J. Thompson, G. A. A. Walker. Avon, G. T. Stringfellow, A. Bolus, A Beginner.

J. MACKENZIE AND G. A. A. W.—The reference was to 1,009.

G. T. STRINGFELLOW.—How do you mate in two moves altogether if 1. $\frac{\quad}{\text{B-R 4}}$? By second solution we intended to indicate that the author's solution was not sent. Your other attempts seem failures, as if 1. $\frac{\text{Q-Kt 6}}{\text{Kt-Q Kt 6}}$, and if 1. $\frac{\text{B-Kt 6}}{\text{Kt-Q Kt 6}}$, how do you proceed with these defences?

WHITE PAWN.—You have not given Black his best defence in your attempt at 1,012. If 2. $\frac{\quad}{\text{K-K Kt 5}}$ there is no mate. Again if 1. $\frac{\text{Q-Q Kt 5 (ch)}}{\text{K takes Kt}}$, and how then?

A BEGINNER.—We do not think the solution to 1,011 was received; but, after your statement, we have allowed you full marks for it. We have noted your corrected solutions of 1,012.

American Guns.—The United States Ordnance Department is much pleased, the *Army and Navy Register* says, with the performance of the new 8in. steel gun at Sandy Hook. "This gun, which weighs 13 tons, and whose length of bore is 30 calibres, was manufactured at the West Point Foundry. The tube and jacket were obtained from Whitworth, and the hoops and the breech mechanism forgings from the Midvale Steel Company. The gun was first tried with the German brown prismatic powder, when the following results were reached:—With a charge of 100lb., and with a shot weighing 182lb., the muzzle velocity was 2,145ft., and the pressure 29,500lb.; with a 235lb. shot the velocity was 1,942ft., and the pressure 32,250lb.; with a shot weighing 286lb. the velocity was 1,795ft. and the pressure 32,800lb. The gun was next tried with Du Pont's brown prismatic powder, the charge being the same. The velocity with a 235lb. shot was 1,937ft., and the pressure 32,950lb.; with a 286lb. shot the velocity was 1,820ft., and the pressure 35,450lb. The gun has been fired thirteen times, and will now be turned over to the Testing Board. It is worthy of remark that when this gun was designed the computed velocity with the 286lb. shot was 1,825ft., and the computed pressure 36,000lb. This is almost exactly verified by the firing with the Du Pont powder."

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 20, and unacknowledged elsewhere:—

R. C. MOORE.—A. J. Herbert.—Mawson and Swan.—W. H. Nelis.—E. Broderip.—H. Dowsett.—H. Le Brasseur.—A Regular Reader.—E. Conry.—Flavius.—W. Drechsler.—Geo. Bell.—Manchester.—J. H. D.—Student.—B. R.—A. L. K.—Volta.—Geo. Landel.—G. W. A.—E. L. G.—F. L. Striffler.—D. Gillies.—H. Sadler.—J. E. Gore.—J. Wimshurst.—H. D. R.—W. H. Hardie.

PRACTICAL. (There are many recipes in back volumes, but no doubt the numbers containing them are out of print. You do not mention what colour is required, but a good pale lacquer can be made by dissolving seed lac in pure methylated alcohol, and adding dragon's blood, saffron, annatto, aloes, or gamboge to colour. A common recipe is to one gallon of methylated spirit add 5oz. of shellac, 4oz. of sandarac, and 1oz. of elemi; expose to a gentle heat for a day or two and strain. Add half a gallon of spirit to the sediment and treat as before. Unless wanted in large quantity it is always cheaper to purchase lacquers of the kind required.)—W. R. D. (The sun does not "put the fire out." The contrary assertion is easily disproved by an experiment, but unfortunately there is not much sun now.)—A. W., OLDHAM. (A fragment of sodium is inclosed in the tinfoil.)—L. FINCH, LONGFIELD. (We have not seen one, and so can express no opinion; but xylonite seems a suitable material for such a purpose.)—M. P. (Britten's "Watch and Clockmaker's Handbook," Kent and Co., Paternoster-row, and Saunier's "Watchmaker's Handbook," Tripplin, Bartlett's-buildings, E.C. See also the indices of the back volumes for really practical instruction.)—VILLAGE ORGANIST. (Procure lists from Novello and Co. Berners-street, W., the *Musical Bouquet* office, High Holborn, and other dealers.)—H. R. (See hints Nos. 4 and 5. Such a list can be made by consulting the directories. The query is altogether unsuited to our columns.)—G. B. CRESWELL. (We do not know, but if we wanted one we should write to Prof. Pickering, Harvard College, Cambridge, Mass. Perhaps Mr. Wesley, bookseller, Essex-street, Strand, has them on sale.)—DIDO. (The surface of the lead is oxidised unless covered, and it should be skimmed off before pouring. 2. Flour rubbed smooth in water and then boiled. Add a little alum.)—AN OLD READER. (Gum is dissolved in water. What would you dissolve it in?)—H. J. AND CO. (Several electric fire-alarms in back numbers. See p. 495, Vol. XLI., and p. 12, Vol. XLII.)—PERPLEXED. (It is prepared by adding soluble Prussian blue to a good gall ink. Sulphindylate of potash or ammonia dissolved in hot water and the liquor decanted when cold.)—NOVICE. (See p. 400 last volume for directions how to relacquer.)—WEAK NERVES. (It is not beneficial to the nervous system.)—N. W. C. (Maxton's "Manual of Engineering Drawing," Crosby Lockwood and Co., Stationers' Hall-court, E.C., 3s. 6d.)—TEIGN. (Apparently a chloride of silver cell, but no one can say without inspecting it. Try a little water first.)—J. C. W. K. (Nothing better than leather—consequently nothing cheaper. Calf, oil dressed, is the best leather for smith's bellows. 2. Screws are made by machinery. Finishing with such an apparatus altogether too expensive.)—D. BOOTH. (A furnace for melting brass was illustrated on p. 373, No. 1,031. See also the index of Vol. XL.)—G. H. B. (As there is no such thing as perpetual motion, it is not easy to say what it means; but if you can make a machine which will keep on the move without anything whatever being done to it, we suppose that will be "perpetual motion," even though some of the parts may wear out. We have no space for the discussion or description you require; but you will find a good deal of information in Dircks's "Perpetuum Mobile," published by E. and F. N. Spon.)—B. ("Light" and "shade" in such a connection are not technically accurate terms; but they are well understood—the former meaning passages in which the theme rings out clearly, the other in which it is subdued by the accompaniment.)—R. W. J. (See p. 561, last volume, for an illustration, and look at Hint No. 4 above.)—A. Z. (See indices, as there are many suggestions in back volumes. A good sized sheet of black twill, lined with some yellow material, will answer if you can arrange it on temporary legs as a sort of tent.)—J. M. (Any working optician would repolish your mirrors.)—KAPLAN. (It means exactly what it says—that it is not only given to her but to her heirs, executors, &c. If she dies before you, better make a new will.)—COOPER. (Do not know of any book on patterns; but Campin's book on "Hand-Turning," published by Spon, we think, will probably answer your purpose.)—A. B. H. FAUDELLE. (Watt's "Electro-Deposition," Crosby Lockwood and Co., Stationers' Hall-court, E.C. 2. No other that we know of, as you qualify the question by the word "Home.")—A FITTER'S APPRENTICE. (You can get at the flue tubes from the firebox; but as to the water tubes, better ask the maker for his idea how they are to be cleaned; perhaps they can be taken out. It seems rather a peculiar boiler, for the furnace flames can play on the unprotected metal of the shell, according to your drawing. Surely the plates are protected by water.)—JNO. T. LAWTON. (Nos. 605, 608, 611 contain papers on the Magic-Lantern—how to make and use it. They are out of print, but may possibly be obtained from Mr. Sladen, 33, Cank-street, Leicester.)—JNO. GLOAG. (See previous answer. No work giving details of construction.)—J. S. W. (See p. 419, No. 1059. Clean the bones from all flesh, put into running water, and bleach in the sun.)—IGNORAMUS. (You will find all about the "storm-glass" in back numbers, especially in No. 1059, p. 405.)—J. W. R. (We believe we answered you not long ago. Such portions as are suitable for insertion have been answered many times. See indices, and the Hint No. 4 above.)—YOUNG IRONFOUNDER. (No; bisulphide of carbon is not "animal carbon." The latter is obtained by subjecting any carbonaceous substances of animal origin to heat while protected from the action of the air.)—QUIS EST. (See the various works on Astronomy likely to deal with such a subject. It may be said to seem certain that the earth will eventually be something like its moon.)—DOUBTFUL. (It depends on the price of gas; but there are many mills and factories now lighted by electricity, with economy, or, at least, with advantages which gas does not give.)—W. A. (The question has been answered over and over again, even in recent numbers. For a suitable battery, see p. 561, No. 1117.)—TRITON. (If received, it will be inserted or acknowledged.)—ARTHUR M. EDWARDS. (We do not remember a letter; but a query on the subject was received, and appears on p. 162, No. 60640.)—TRANSFER. (A similar question was answered so recently as Sept. 24, p. 90.)—HEATH. (Study the principle in any textbook. It consists of a tube in which are three mirrors running along the length and inclined at an angle of 60°. One end is closed with a cap containing a ground glass cell with small bits of coloured glass, and the other with a cap having a hole in its centre. The Debuscope has only two mirrors, which are simply pieces of glass blackened on one side in the common toy.)—WINDERMERE. (If you have not access to back numbers you will find most of your electrical questions answered in the textbooks. They have been answered in recent back numbers. There is no advantage in the use of asbestos. The cost varies with the place. Apply to dealers. Paraffin wax has been recommended for coating wooden vessels, and so has a mixture of guttapercha and pitch. You cannot treat vulcanite in that way. As to the ecclesiastical questions, you should consult the secretary of the bishop of the diocese in the one case, and the table in the Prayerbook in the other.)—SOLAR RADIANCE. (Would it not be better for you to procure the publishers' lists? Try Piper and Carter, 5, Furnival-street, Holborn, E.C.)—G. R. (You will find an illustration of an improved Æolian harp in No. 1048, p. 163.)—COMUS. (For glazing photographs see p. 345, No. 1108; the indices generally, or any of the cheap manuals. 2. Was not the tube at the South Kensington Museum marked? See pp. 414, 425, Vol. XXXVIII. Decoction of the bark of the horse-chestnut, and solution of sulphate of quinine, alcoholic tincture of chlorophyll, of the seeds of stramonium, and of turmeric.)—R. (It is scarcely likely that any bona-fide reply would be received. There are two engines of the kind in the market which you can, we believe, see at work.)—P. R. I. (See the first answer on p. 141, and apply to the Superintendent, Steam Reserve Office, Chatham.)—J. J. K. S. (If you want a lamp, see p. 395, Vol. XXXIII.; but if a furnace, look at the illustration of the Shipman engine on p. 419, No. 1087. 2. They are all hydrocarbons—that is all that can be said without examination, as trade names define nothing at all in that connection. Petroleum should mean the crude oil—kerosene and paraffin the refined or "burning" oils.)—C. R. (It is not illegal to quote mere "passages" from an author's works; but when they are likely to be numerous or extensive it is only courteous to ask his permission if they are to be published in another work.)—CONSTANT READER, America. (Try G. L. Fairbanks, Worcester, Mass., or Fay and Scott, Dexter, Maine, for the lathe; but as to the castings of model engines, it might be cheaper to get them here, unless you want a quantity.)—R. SMITH. (A thumb-screw for attaching any article to a table or other support is rather too old to form the subject of a patent, or even a claim in a patent.)—OMPAX. (1oz. avoirdupois is equivalent to 28·34954 (say, 28·35) grammes.)—NASAL. (Red noses are produced by indigestion more frequently than by drinking. The only cure is to remove the cause, and you do not give any idea of what that is.)—S. ARLIDGE. (From any dealer in metallurgical specimens, or from the foreman of any lead mine.)—F. M. (You first issue a summons; the case is heard; if proved, the judge will order the defendant to pay in a week. If he does not pay, you issue an execution on his goods; if he has no goods, you apply for a judgment summons, and the case comes again before the judge, who, if satisfied that the defendant can pay, will commit him to prison in default. The committal does not cancel the debt.)—ANXIOUS. (In type.)

The English Mechanic

AND WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 29, 1886.

NOTES ON THE CHAMBER ORGAN.—VII.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

HAVING in the preceding six articles touched upon matters relating to the general appointment and disposition of the Chamber Organ, as I desire such an instrument to be understood; and having enlarged somewhat on special details connected with its tonal structure, and the means to be adopted to impart the maximum powers of expression to its different departments; I may, in conclusion, direct attention to some remaining matters of not a little importance and interest. I shall, out of consideration to my readers, be as brief and direct in my remarks as possible.

Internal Design.

It is almost needless to remark that in connection with an organ for the reception or accommodation of which so little floor space and height are commonly provided, the greatest ingenuity and care must be expended in internal planning and arrangement. Let there be a studious avoidance of unnecessary complexity and crowding in any part; and let every exercise of skill be resorted to to arrive at the simplest forms of mechanical action. Do what one may, a Chamber Organ, with only two manuals, pedal clavier, two swells, and the full complement of couplers and other mechanical accessories, must turn out to be a seriously complicated affair—difficult to put together in its most perfect form; and, unless most beautifully made and of the finest materials, difficult to keep in satisfactory working order. It is not too much to say that absolute perfection of material and workmanship must obtain throughout; and that nothing must be passed over carelessly as of minor importance, for the use of the smallest piece of unseasoned wood, or the careless fitting of the most insignificant pin, may cause a train of annoyances, and the loss of temper and much valuable time.

In all matters relating to the construction of the organ, the builder, professional or amateur, should neither be "penny wise and pound foolish," nor pound wise and penny foolish. The saving of a penny may cause pounds of unexpected and unnecessary expense. To summarise the matter, the following six golden rules may be addressed to the organ-builder:—

1. Use, from first to last, the best and most suitable materials money can buy, for such a course is cheapest in the end, and altogether the most creditable.
2. Do not leave a single article in an unfinished or slovenly state. Whatever you do do with all your might.
3. Put everything together accurately and securely as if your life depended on the successful result of your work.
4. Protect everything liable to become impaired by the action of damp and dust by the best means which can be devised for that end.
5. Reduce the friction of all moving parts to the minimum, and take all precautions to prevent noise and undue wear.
6. Give every article as graceful and as pleasing a form as is compatible with its utility, for there should be beauty as well as morality in every work of a true artist. Whatever is worth doing at all is worth doing well.

On purely practical details connected with the mechanical and constructive parts of the Chamber Organ I do not at present propose to speak; but, in contemplating the internal design of the instrument, I may advise careful attention to be paid to the planting of all pipes, and to the provision necessary to be made for their convenient tuning. In both these directions Chamber Organ builders have too often displayed want of thought and sense. I cannot, however, say they are invariably to blame, for a deficiency of adequate space for the instrument has too often rendered internal cramping and crowding imperative. Let it be understood, once for all, that a cramped and crowded Chamber Organ can never be a successful instrument from a musical point of view; and those who insist on having a large instrument in a position totally unsuited for it must not marvel if it proves unsatisfactory. On this subject, I cannot give better advice than this: If the room is built, let an organ be constructed to suit the room; if the organ is constructed, let a room be built to suit the organ.

Notwithstanding my resolution to avoid speaking of purely practical matters, I feel it is desirable to say a few words respecting those portions of the Chamber Organ, on the proper construction of which the power of expression of the instrument chiefly depends. I allude to the swell-boxes.

There are two conditions on which the excellence of a swell-box depends—namely, its capabilities of confining sound when closed, and giving it free egress when opened. To secure the first condition of excellence it is necessary that the entire box should be carefully constructed of materials which are bad conductors of sound. The most convenient materials are wood, felt, linoleum, straw-board, and thick brown-paper. The best way of using these will shortly be hinted at. Great thickness of material is not so necessary in the swell-boxes of Chamber Organs as in those of church and concert-room instruments, in which high pressures of wind and loudly-voiced stops are introduced. While sides and tops of 3in. in thickness are necessary for the swells of the usual types of church and concert instruments, those for the swells of Chamber Organs are ample at $1\frac{1}{2}$in. to 2in., especially if a proper mode of construction is followed.

For a Chamber Organ swell-box, the sides and top may be formed of $1\frac{1}{2}$in. thick framed and flush-panelled pine; covered, on the inside, with several layers of stout, fibrous brown paper, securely pasted on, and painted with four coats of oil paint and well varnished. The hard, glossy surface thus produced becomes a good reflector of sound. If the swell-box is out of sight, or does not require to be treated in any ornamental fashion, the addition of a covering of linoleum, well-glued and tacked on the outside, or coatings of brown paper, painted, will prove of great advantage. A more satisfactory swell-box may be made of sides and top formed of two 1in. thicknesses of wood, screwed together with a layer of thick, coarse felt between them. The inside should be papered and painted, as before directed. Stout straw-board or linoleum may be used instead of the felt, but not with so good a result.

The shutters or louvres should be made of wood not less than $1\frac{1}{2}$in. in thickness, and have thin felt on their edges. They should invariably be made to open towards the room, so that the sounds from the pipes may come directly on the ear. This is an all-important matter, for if they open in the contrary direction, the most refined *nuances* are quite lost, and much of the brilliancy of the swell is destroyed. Too much thought and care cannot be devoted to the construction of the swell boxes of a Chamber Organ. Let the reed stops be planted close to the most accessible sides of the swell-boxes; and let small doors be provided which can be removed for tuning without otherwise opening up the boxes. The great convenience of such an arrangement is obvious. As balanced Expression levers are used, the louvres should in all possible cases open vertically. When horizontal louvres are imperative, the action must be balanced by a counterpoise, and a certain amount of friction put on the connecting rods to prevent any swinging or undesired return.

However well an organ may be built, it is in the nature of things that it should require frequent attention and tuning, and occasionally adjustment and repairs. To render these operations easy, care should be taken, in planning the interior of the instrument to provide ready means of access to all parts. It should never be necessary to remove one part to get at another, or to disarrange one portion to readjust an adjoining one. Special conveniences for tuning should be schemed, otherwise much annoyance and disappointment will accrue.

External Design.

As an architect, it may reasonably be expected that I should go at some length into the subject of the artistic treatment of the exterior of the Chamber Organ; but I confess it is with some reluctance that I essay to pass even a few remarks on it, simply because it is a subject far more vast and complicated than anyone unacquainted with designing and decorative art can at first thoughts realise. Besides, in all such matters tastes differ so widely, that what to one man is pleasing is, very probably, to another man objectionable. I shall, however, not go into any questions of style in these Notes; but confine myself to a few remarks of very general application.

It will certainly be conceded that a Chamber Organ, on the construction of which the greatest skill and a considerable sum of money have been expended, should be a work of art, and that refined taste should set its seal on a work of so much thought and labour. What do we observe in the generality of cases? Let my readers think of the Chamber Organs known to them, and answer the question. I would rather not waste space by giving the results of my survey in answer thereto.

In designing the exterior of an organ, the artist should recognise all the conditions imposed by the peculiar nature of the instrument. He should neither make it look like a Grecian temple nor a Gothic church. The peculiar features of an organ are its pipes—conventional objects, which admit of no liberties being taken with them in matters of form or size beyond very circumscribed limits—and these the artist, both for the sake of his own honour, and the utility of the instrument, must make much of. He is the greater artist who best fuses these stubborn materials into his alloy of artistic elements.

It is the duty of the organ builder to place at the disposal of the artist pipes beautifully made of perfect materials; and it is the duty of the artist to arrange and combine them, in his conception, so as to produce a harmonious design, and to decorate them, when decoration is required, in a manner consistent with their forms and materials. Pipes formed of tin or fine "spotted metal" require little or no decoration in gold and colours; but they should invariably be protected by a coating of colourless oil varnish. Partial decoration in gold and colours, with the bright metal as a ground, has a pleasing effect. It must, however, be applied with great judgment and taste, so as to appear as if it belonged to the pipes. Wooden pipes, on the other hand, absolutely demand the labours of the decorator, and admit of many modes of treatment. When they occupy prominent positions in the design, they are best gilded, on their exposed faces, and delicately diapered or otherwise ornamented with black, brown, or some such dark colour. Any light, quiet tint may be

used instead of gold as a ground for the ornamentation.

If the pipes are beautifully made of some choice and nicely-coloured wood, they may be varnished only, and the black or other coloured ornamentation applied directly to their surface. Such a treatment is a perfectly consistent and rational one, and may reasonably recommend itself to all lovers of simplicity and truth. In the construction of all wood pipes which are intended to be displayed, great attention should be given to their general finish, and to the formation of their mouths and caps, and also of their feet if they are to be shown. By the exercise of a little taste, a row of wooden pipes, usually a very commonplace affair, may be made to speak the language of art as well as pleasant musical sounds.

The association of metal and wooden pipes in one design has a very pleasing effect, and, to my eyes, it is preferable to that produced by the exclusive introduction of cylindrical metal pipes. But, as I have already said, this, like other matters of design, will always remain a matter of taste and opinion. I have fairly tested the combination in the external design of my own organ, and I venture to think with a satisfactory result.

In the matter of case-work a great diversity of opinion is certain to obtain. Some persons hold that there should be hardly any beyond that absolutely necessary for the inclosure of the mechanism and claviers, while others believe in an elaborate system of case-work, inclosing everything save a few small metal pipes, displayed with the purpose of preventing the organ being mistaken for a huge wardrobe or some such formidable piece of furniture; perhaps, the golden mean between both of these extremes is most desirable in nine cases out of ten. It must be borne in mind that the great use made of the swell-box renders a further wholesale system of inclosure unnecessary, if not positively destructive to the tone of the organ; and that if the swell-box is ornamentally treated a further casing is not desirable on purely artistic grounds. There is no difficulty in making the swell-box a very ornamental and pleasing feature of the general design of the instrument; and even the louvres may be so treated as to assume a dignified position in the scheme of decoration.

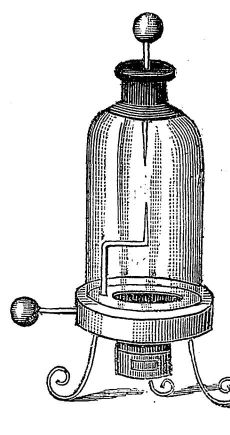
The lower portion of the organ, which contains the chief part of the mechanism, calls imperatively for some sort of inclosure; and here taste and ingenuity may display themselves. In the choice of woods, and in their combination, and in their partial decoration with appropriate musical subjects or refined ornamentation in colours and gold, the artist may show any degree of skill, and produce an almost endless variety of effects. The woodwork here and, indeed, throughout the entire instrument, must be put together in the strongest possible manner; otherwise most objectionable and irritating vibrations are sure to take place when certain pedal pipes are held speaking for a second or more. Let every joint likely to vibrate be covered with an edging of cloth, and firmly screwed or otherwise secured. Care exercised in these matters never goes unrewarded.

The position of the claviers now claims some little attention. In Chamber Organs, as in church and concert-room instruments, it is held desirable, by some builders, to locate the claviers in a "detached console," placed at a convenient distance from the organ proper. There is something to be said both for and against the detached position. Taking the disadvantages into consideration first, it will be found that the detached console is attended with considerable expense—firstly, because the action is rendered much more complicated; and, secondly, because it necessitates the floor of the room being constructed or materially altered to admit of the passage of the connecting trackers, rods, &c.;—the tubes, if the action is on the pneumatic tubular system; or the wires, &c., if the action is electric. Further, unless the apartment is spacious, the detached console, with its Pedal clavier and stool, will be an inconvenient fixture, if not an eyesore, wherever it may be placed. It is an expensive, and not altogether an easy, matter to make the console an elegant article of furniture. Now, turning to the advantages attending the adoption of the detached console, it is argued that it is favourable to the performer—firstly, because it allows him to face his listeners, or the artists he may be accompanying; and, secondly, because it enables him to realise more clearly the musical effects he is producing. These, I believe, are the only advantages which have been claimed for the detached position. Personally, I do not advocate the adoption of the detached console; for, as I shall endeavour to explain in my concluding article, there is an important advantage in the attached claviers, with their attendant simple mechanism—so great an advantage that I shall always advocate, for the Chamber Organ, the attached, in preference to the detached, position.

(*To be continued.*)

ELECTRICAL DEPOSITION OF DUST AND SMOKE.

THE remarkable behaviour of dust and smoke when subjected to a strain set up in an intervening dielectric has of late attracted much attention, and we therefore have great pleasure in illustrating a convenient piece of



apparatus designed and constructed by Messrs. King, Mendham, and Co., Western Electrical Works, Bristol, by means of which the interesting phenomenon of the deposition of dust and smoke may be produced and observed. It consists of a bell jar, through the top of which is fitted a brass rod carrying a brass ball at its upper extremity, and terminating in a point within the jar. Opposite to this is placed another rod, which passes out through the base of the apparatus. Each of these rods is intended to be placed in metallic connection with an electrode of a Wimshurst electrical machine. The bell jar is mounted on three supports, and beneath the base is a cylindrical box in metal, in which the fume can be produced. Smouldering brown paper is placed in this metal box, and when the smoke has completely filled the jar, the machine is started, and the smoke, which at first appears to be greatly agitated, is observed to be quietly vanishing, leaving the jar perfectly empty.

PAIN'S IMPROVED SIGNAL LIGHTS.

IMPROVED signal-lights for use at sea or elsewhere, which are believed to be thoroughly damp-proof, have been recently patented by Mr. J. Pain, of Walworth-road, the well-known pyrotechnist. Signals of the kind are required to be not only damp-proof in all climates, but to be free from risk of spontaneous ignition. The "red flares" are more especially applicable for use on board fishing vessels whilst trawling, but have their uses wherever signals of the kind are valuable. The ingredients specified by the patentee are:—Strontian sulphate, 6 parts; strontian carbonate, 6 parts; kowrie or copal dust, 6 parts; chlorate of potash, 30 parts; and infusorial earth, half a part. These substances are reduced to powder separately, intimately mixed, and then rammed into cases in the usual manner for making signal flares of the kind.

ASTRONOMICAL NOTES FOR NOVEMBER, 1886.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 43 42·48 AM	14 26 30	14 30 33	14 42 47·15
6	11 43 46·35 ,,	14 46 16	16 3 28	15 2 29·92
11	11 44 10·70 ,,	15 6 23	17 29 39	15 22 12·70
16	11 44 56·25 ,,	15 26 52	18 48 17	15 41 55·47
21	11 46 3·08 ,,	15 47 41	19 58 35	16 1 38·25
26	11 47 30·29 ,,	16 8 51	20 59 46	16 21 21·03

The method of finding the Sidereal Time at Mean Noon at any other Station will be found on p. 353 of Vol. XLII.

Spots and faculæ now appear at rare intervals, and in greatly diminished size and numbers.

The Moon

Enters her First Quarter at 5h. 5·2m. in the afternoon of the 3rd, and is Full at 7h. 6·5m. p.m. on the 11th. She will enter her Last Quarter at 10h. 40·3m. on the night of the 18th, and be New at 7h. 18·5m. p.m. on the 25th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	5·2	4 26·4 p.m.
6	10·2	8 14·8 ,,
11	15·2	11 59·3 ,,
16	20·2	3 34·1 a.m.
21	25·2	8 4·1 ,,
26	0·7	0 28·5 p.m.

The Moon will be in Conjunction with Saturn at 1 p.m. on the 16th; with Jupiter at 1 a.m. on the 23rd; with Venus at 2 p.m. on the 25th; with Mercury at 9 p.m. on the 26th; and with Mars at 2 p.m. on the 28th.

Mercury

Is an Evening Star throughout November, attaining his greatest elongation East of the Sun (22° 29′) at 5 p.m. on the 13th. He is, however, just about as badly placed for the observer as he well can be, and, if he is to be seen at all, must be caught in the telescope in bright daylight when he is close to the Meridian. His angular diameter steadily increases from 5·4″ on November 1st to 9·6″ by the last day of the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	15 44·3	22 5·2	1 1·4 p.m.
6	16 12·3	23 43·5	1 9·6 ,,
11	16 38·1	24 49·0	1 15·7 ,,
16	16 59·6	25 17·1	1 17·5 ,,
21	17 12·5	25 1·7	1 10·7 ,,
26	17 10·7	23 54·6	0 49·2 ,,

The path shown above commences on the confines of Libra and Scorpio, and extends across the last-named constellation into the Southern part of Ophiuchus, whence the planet retraces his steps, but is still in Ophiuchus on the 30th. He is rather less than 2° North of

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
1	*d* Sagittarii	5	†5 15 p.m.	N. by W.	187	195	.			
3	B.A.C. 7263	6	3 16 „	Dark	81	56	4 32 p.m.	Bright	302	288
7	4 Ceti	6	5 45 „	Dark	61	32	6 32 „	Bright	346	321
7	5 Ceti	6	6 0 „	Dark	77	48	7 1 „	Bright	331	311
7	B.A.C. 5	6	6 23 „	Dark	115	89	7 42 „	Bright	295	281
9	ν Piscium	4½	6 4 „	Dark	96	60	7 9 „	Bright	309	277
12	48 Tauri	6	7 18 „	Bright	101	61	8 18 „	Dark	291	251
12	γ Tauri	4	9 17 „	Bright	92	55	10 25 „	Dark	302	271
13	75 Tauri	6	2 38 a.m.	Bright	138	162	3 37 a.m.	Dark	242	275
13	θ^1 Tauri	4½	2 46 „	Bright	36	62	3 57 „	Dark	342	17
13	θ^2 Tauri	4½	†3 6 „	S. by E.	9	39				
13	B.A.C. 1391	5	3 39 „	Bright	82	115	4 46 „	Dark	293	332
13	Aldebaran	1	6 27 „	Bright	124	165	7 16 „	Dark	245	284
14	115 Tauri	6	4 2 „	Bright	108	139	5 11 „	Dark	257	295
22	46 Virginis	6	4 42 „	Bright	107	72	5 31 „	Dark	207	176
22	*k* Virginis	6	†4 58 „	S.S.W.	337	304				
22	48 Virginis	6	6 36 „	Bright	127	104	7 8 „	Dark	182	163
23	B.A.C. 4647	6	4 42 „	Bright	61	24	5 40 „	Dark	255	222

† Near approaches.

Greenwich Mean Time of the Greatest Eastern Elongations of the Five Inner Satellites of Saturn.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
2	Enceladus	10·1 p.m.	15	Enceladus	6·1 a.m.	27	Mimas	4·5 a.m.
4	Rhea	6·0 a.m.	15	Mimas	9·1 p.m.	28	Mimas	3·2 „
4	Enceladus	7·0 „	17	Enceladus	11·9 „	28	Dione	6·8 „
6	Tethys	4·9 „	20	Dione	1·6 a.m.	28	Tethys	8·6 p.m.
7	Enceladus	12·8 p.m.	22	Enceladus	2·6 „	28	Enceladus	11·0 „
8	Tethys	2·2 a.m.	23	Tethys	4·7 „	29	Mimas	1·8 a.m.
9	Dione	2·9 „	24	Enceladus	8·3 p.m.	29	Mimas	12·5 p.m.
9	Tethys	11·5 p.m.	25	Tethys	2·0 a.m.	30	Enceladus	7·9 a.m.
13	Rhea	6·9 a.m.	26	Enceladus	5·2 „	30	Tethys	6·0 p.m.
13	Enceladus	9·2 p.m.	26	Rhea	8·0 p.m.	30	Mimas	11·1 „
14	Mimas	10·5 „	26	Tethys	11·3 „	30	Dione	12·3 „

Antares on the afternoon of the 8th; but this is the only conspicuous star he approaches.

Venus

Is a Morning Star, but is approaching the Sun, and is in that phase in which she is absolutely destitute of any interest as a telescopic object, presenting, as she does, a very nearly circular little disc of only 9·8″ in diameter. Indifferently placed for the observer at the beginning of November, her position in this respect daily deteriorates too.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	13 57·6	10 45·0	11 14·9 a.m.
6	14 21·6	12 58·8	11 19·2 „
11	14 46·0	15 4·7	11 23·9 „
16	15 10·9	17 1·1	11 29·1 „
21	15 36·3	18 46·2	11 34·7 „
26	16 2·2	20 18·4	11 40·9 „

The path indicated by the above ephemeris lies mainly in Libra, though towards the end of the month Venus will have crossed the boundary into Scorpio. On the 25th the planet will be about ½° South of β Scorpii.

Mars

Is invisible, as for the purposes of the observer is

Jupiter

too; but

Saturn

Rises before 9 p.m. at the beginning of November, and a little before 7 p.m. at the end of it; so that although, as far as his meridian passage is concerned, he is a Morning Star, yet he may be fairly well observed before midnight. His angular equatorial diameter increases imperceptibly from 17·2″ on November 1st to 18″ by the 30th. The observer will note that the rings are now sensibly less open than they were last year.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 37·1	21 17·6	4 55·5 a.m.
6	7 37·1	21 17·9	4 35·8 „
11	7 36·9	21 18·7	4 16·0 „
16	7 36·5	21 20·0	3 55·9 „
21	7 36·0	21 21·7	3 35·7 „
26	7 35·2	21 23·8	3 15·3 „

The very short retrograde arc described by Saturn during November lies wholly in Gemini, some 7° South of Pollux.

Uranus,

Like Mars and Jupiter, is invisible for the observer's purposes.

Neptune

Is in an excellent position, coming as he does into opposition to the Sun at 7 p.m. on the 18th. He is, in fact, practically visible all night long.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 40·1	17 45·0	12 55·2 p.m.
6	3 39·5	17 43·1	12 34·9 „
11	3 39·0	17 41·1	12 14·7 „
16	3 38·4	17 39·2	11 54·5 „
21	3 37·8	17 37·2	11 34·3 „
26	3 37·2	17 35·3	11 14·1 „

The almost imperceptible arc indicated in the above ephemeris lies in a wholly blank part of Taurus, about 6° South of the Pleiades.

Shooting Stars

Are, as it is very well known, both numerous and conspicuous in November. The Leonids, so-called from their appearing to radiate from the constellation Leo, are the best known, and are visible in the greatest numbers between midnight on the 13th and dawn on the 14th, although outliers of the stream may be looked for from the 11th to the 15th inclusive. The story of the connection of this stream of meteorites with Tempel's comet (Comet I.) of 1866 has been often repeated in these columns. The meteors which represent all that is left of the vanished Comet of Biela may also be watched for on the night of the 27th. They appear to radiate from a point in the north-eastern part of Andromeda.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the Night of November 1st, 1886.

Star.	Souths.
	h. m. s.
α^2 Capricorni	5 28 4·59 p.m.
α Cygni...	5 53 49·02 „
α Cephei	6 32 1·95 „
α Aquarii	7 15 59·29 „
Fomalhaut	8 7 16·39 „
Markab...	8 14 59·29 „
ι Piscium	8 49 53·94 „
α Andromedæ...	9 18 14·27 „
α Cassiopeiæ	9 49 43·37 „
Polaris	10 33 56·75 „
α Arietis	11 16 10·07 „
α Ceti	12 11 35·21 „
α Persei	12 31 25·76 „
η Tauri...	12 55 51·71 „

The method of finding the Greenwich Mean Time of Southing of either of the Stars in the above list for any other night in November; as also that of determining the local instant of its Transit at any other station, will be found on p. 355 of Vol. XLII. It must be noted, though, that the rules there given are not rigidly accurate as applied to Polaris, or any other close circumpolar star; although they will probably be found quite sufficiently so in practice.

THE ROBERTS PEROXIDE BATTERY.

A FORM of peroxide battery has been recently described by Mr. I. L. Roberts in the *Electrical World* (N.Y.), which may be of interest to some of our readers. Mr. Roberts says:—

It is probable that when coal is consumed in oxygen or a metal is burned in chlorine or fluorine, the action is electric, or, in other words, all chemical action first produces a current of electricity; but as we do not know how to attach binding posts to such elements, the current is not made manifest to our senses. As the currents thus made are entirely short-circuited on themselves, they produce only the phenomena of heat, as does the current in an ordinary battery when short-circuited on itself. As soon as we are able to get some way of conducting away the current from simple chemical union, then we will reach the ideal method of producing electricity. The ideal battery is one which will not deteriorate on open circuit, and will be constant on closed circuit. Both these qualities have been attained, but not in the same cell. Chromic acid as a depolariser is constant enough, while sal-ammoniac, as a single fluid, will not destroy on open circuit to an injurious extent. I think I may venture to say that the nearest approach to the ideal battery that has come before the public is one recently invented by myself and known as my Roberts peroxide battery. The main feature in this battery is the peroxide of lead which is used as a depolariser. It has been known in electro-chemistry for some time that peroxide of lead is one of the most powerful depolarisers, as used, for instance, in the secondary battery. But no commercial use has been made of it in primary batteries; because, first, it was a powder and difficult to apply to the purpose; and, secondly, it was too costly to put into competition with peroxide of manganese, which, though not so good, was cheap. It was the writer's fortune to discover how to make it cheap enough and solid enough to far outstrip manganese dioxide as a depolariser. It is made by adding to red lead, permanganate of potash in a powdered form and well mixing them. To this there is added any acid which will decompose the permanganate, such as sulphuric, or preferably hydrochloric acid. This will unite with the alkali and liberate the permanganic acid, which is the

most powerful oxidiser known to chemists. This will immediately unite with the red oxide of lead, Pb_2O_3, and produce PbO_2. The whole mass, if properly made, is in a semi-liquid form, and if poured into a mould containing a carbon, it will set in a few seconds. The mould can be opened, and the whole removed and dried, when it will be porous like a carbon and will be a conductor of electricity.

RECENT RESEARCHES ON FRICTION AND THE ACTION OF LUBRICANTS.—III.*

By PROF. HELE-SHAW.

OUR knowledge of the friction of dry surfaces at high speeds is chiefly derived from experiments on railway brakes, some of the most important being those of Poirée and Bochet in France, and Captain Douglas Galton and Mr. Westinghouse in this country. Both these sets of experiments show that at high velocities the friction of such surfaces is very much reduced. Captain Galton in his third paper (Proc. Inst. M. E., April, 1879, page 172) states that "the coefficient of friction between the brake blocks and wheels varied inversely, according to the speed of the train." This must not be taken to mean in inverse ratio, but simply that the friction increased as the velocity was diminishing. For instance, in one case with cast-iron brake blocks and steel tires, with velocities of 60, 40, 20, and 10 miles an hour, the corresponding coefficients of friction were ·074, ·140, ·192, and ·242. Another remarkable fact was made evident, which was that the coefficient of friction was affected by the duration of the time of application of the brakes. Thus, when the speed of the van from which experiments were made was kept constant by the engine, instead of allowing the resistance to bring it to rest, "the friction of the blocks *decreased*, and this occurred notwithstanding a continued increase of the brake-block pressure, showing that, through some cause not yet fully determined, the holding power of the brake blocks at all speeds is considerably less after some seconds of application than when first applied." The result of this is that "the decrease in the coefficient of friction arising from time to time, sometimes overcomes the increase in the coefficient of friction arising from a decrease in speed." This is especially so when the train takes some time in coming to rest, in which case a higher brake pressure is required. Prof. Kennedy, in his "Report on Friction at High Velocities" (Proc. Inst. M. E., Nov., 1883), has plotted Captain Galton's results in order to see if the difference between the frictional resistances at different speeds would still remain after those resistances had taken the lowest value to which they tend, and which they must certainly reach (although not, perhaps, in the limited time of 30 seconds, for which each experiment usually lasted), and the result of the plotting shows that, "so far as can be judged, the difference would remain." The effect of increase of velocity with lubricants seems in every case, after a certain point is reached, to produce a corresponding increase in friction. Thus from an examination of the seven tables of results obtained by Mr. Tower (Proc. Inst. M. E., Nov., 1883, page 643-650), it is seen that in all cases where a bath of lubricant was used the friction increased as the speed was increased from 100 revolutions (corresponding to 105ft. per minute) up to 450 revolutions (corresponding to 471ft. per minute). But though increasing as the velocity increases, it does not do so as rapidly as the square of the velocity, which would be the case, or nearly the case, if the laws of fluid friction maintained. Professor Thurston considers that for cool journals, lubricated with good sperm oil, and between the limits of 100ft. and 1,200ft. a minute, the friction may be represented approximately by the expression $f = a\sqrt[5]{V}$ where V = the velocity, and for a pressure of 200lb., a = ·0015. For cases where the lubrication was effected by an oil pad or by a siphon lubricator, Mr. Tower found that the friction decreased up to a certain point and then increased. For perfect lubrication, that is with an oil bath, the speed of minimum friction was found to be from 100ft. to 150ft. per minute; but this point tended to rise with increase of load and with less perfect lubrication. It is an interesting fact that all the plotted curves of Professor Thurston's latest results, representing a very large number of experiments, all show this preliminary decrease (often rapid) with velocity, and final increase after a certain velocity is reached. This being so, the above formula cannot hold, at any rate, below that point.

IV.—*The effect of change of temperature.*—Scarcely anything seems to be acccurately known with regard to the effect of different temperatures on the friction of solids. With regard to the effect in the case of lubricants, much recent experimental work, by different observers, has been published; but the results are so varied, not to say contradictory, as to make it extremely hard to generalise upon them. Mr. Tower found that, in his experiments with a bath of lard oil, as the temperature, rose from 60° to 120° F. the friction was in every case diminished. Thus for 105ft. per minute it was ·0059 at 60°, ·0048 at 70°, ·0040 at 80°, ·0034 at 90°, ·0029 at 100°, ·0026 at 110°, and ·0024 at 120°. Mr. Woodbury has quite recently published the result of more than 1,000 observations on a standard brand of mineral oil. The flash test of this oil gave 342° F., the fire test 410° F., evaporation at 140° F. for 12 hours was ·02, sp. gr. ·888. The velocity was maintained constant at 300ft. per minute. By increasing the pressures uniformly from 1lb. to 40lb. per square inch, it was found that the coefficient of friction decreased in a remarkably uniform manner as the temperature increased. Professor Thurston has made a large number of experiments on this subject. In one set of experiments in which sperm oil was used, at constant velocity of only 30ft. a minute, he found the friction *increased* with the temperature: at 200lb. per square inch the friction rose from ·0056 at 90° F. to ·05 at 150°, an increase of nearly ten times for a rise of 60°. At 100ft. per minute, and for pressure below 50lb. per square inch, he found that the friction did not vary between 90° and 150°, but that it rose nearly 300 per cent. at a pressure of 200lb., over 100 per cent. at 150lb., and 33 per cent. at 100lb. The latest experimental results by this observer, and others, show the laws which connect friction and temperature to be of a most complex nature. There have been various attempts to express them in a simple form, as, for instance, by Prof. Franke (quoted by Prof. Cotterill, "Applied Mechanics," page 258) in the formula $f = f_o e^{-av}$, where f_o = ·29; a (for velocities of one mètre per second) ranges from ·02 to ·04, v representing the velocity. But in view of the nature of a large number of results such attempts do not seem satisfactory.

The Friction of Higher Pairing or Rolling.

The laws of rolling friction, as given by Coulomb, have been already stated in a concise form, purposely placed in juxtaposition to the corresponding statement of the laws of sliding friction, in order to show their remarkable similarity. The only difference between them lies in the fact that in the former the resistance varies, as might be expected, inversely as the radius of the rolling body, so that comparing rolling bodies of the same radius, but otherwise under different conditions of material, pressure, and velocity, the laws are the same. Such a fact might have suggested that the retarding causes at work in the two cases were the same; but this does not appear to have been recognised, resort being had by Tredgold and others to the artificial idea of a couple with a length of arm depending on the nature of the surfaces. To Prof. Osborne Reynolds is due the first satisfactory explanation of resistance to rolling, in a paper in which it is conclusively proved to be the direct result of sliding friction. Professor Reynolds first investigates the deformation produced at the point of contact, and proves that this must result in a *sliding* of one surface over the other; that this takes place both in contraction—that is, both as the wheel or roller is approaching any particular point in the surface and leaving it; that consequently the amount of friction depends not merely on the roughness of the surfaces in contact, but also on their softness, or the extent to which they yield. These two effects tend to counteract each other, a greater frictional resistance allowing less extension of the surfaces, and a greater extension resulting from a small coefficient. Since, however, the work of friction is the product of the resisting force into the space passed through or rubbed over, it is evident that when the coefficient is zero, or there is *no resistance*, and when it is such that the surfaces are locked together and there is *no slipping*—that is, at the two extreme values of the coefficient of friction—there is no work at all done. Therefore there must be some intermediate value of the coefficient of friction for which the work done in overcoming friction is a maximum. Prof. Reynolds experimented on surfaces of various kinds, in several sets of observations. A very accurately prepared cast-iron roller was placed successively on surfaces of cast iron, brass, plate glass, boxwood, and indiarubber, which was tried, both clean, and oiled or blackleaded. The resistance was estimated by inclining the lower surface until the roller just started into motion, the amount of the inclination being obtained by means of a surveyor's level, placed upon the surface, and used to take initial and final observations from a staff placed 50ft. away. The results of these experiments showed that the resistance to motion on the metallic surfaces of cast-iron, brass, and glass was much the same, though rather less on the first of these in starting, and rather greater in rolling back. The boxwood surface caused about twice the resistance of the metals, indiarubber about six times in starting, and ten times in rolling back. The results of oiling or blackleading the surfaces were curious, and, to a certain extent, in accordance with what might have been expected, for on the harder surfaces, in starting from rest, the effect is to reduce the resistance, whilst on indiarubber the effect is to increase it. On rolling back, however, the result in the latter case is reversed, and the friction is less with the prepared surface than with the clean one, though greater in the case of glass and brass. Some other experiments were made upon the actual slipping on a hard cast-iron roller on an indiarubber surface, and of a soft indiarubber tire on a hard surface, which proved that a hard roller on a soft surface rolls short of its geometrical distance, but a soft roller on a hard surface rolls more than its geometrical distance, though to a less degree, and, finally, that a roller on an equally hard surface rolls less than its geometrical distance.

The above results quite accord with the views set forth in the paper in question, as to the nature of rolling friction, and the writer remarks that the surprising durability of steel rails is accounted for, not directly by reason of their greater hardness compared with iron, but by reason of the fact that the greater hardness reduces the slipping, and thus the rolling friction; the same reasoning goes to account for the fact that the harder rails wear at all, which could not be done on the mere hypothesis of a pure rolling motion.

An important case in which rolling and sliding friction can be directly compared occurs in the case of the brakes of railway trains, and the experiments of Captain Galton and Mr. Westinghouse, already referred to, led to the interesting discovery that the retarding effect of a wheel sliding upon a rail was much less than when braked with a force of just sufficient magnitude to allow it to continue to revolve. The calculations from these experiments showed that the friction between the wheel and the rail when the wheel is sliding on the rail is *less than one-third* of the friction between the wheel and brake blocks when the wheel just continues revolving. This result appears to be due to the simple fact that the rolling friction was greater than the sliding friction, and, in fact, in the case of a steel tire on a steel rail no less than three times as great. The comparison of sliding and rolling friction, and their relation to each other, is a subject of very great importance, and the author is at present engaged in making some experiments which promise to throw further light on the matter. The subject of rolling friction demands greater attention from engineers, for, notwithstanding its many important practical applications, it is as yet but little understood, and in one application alone—viz., that of friction-gearing—it may be that a more careful study of the conditions of the problem will, in the future, lead to its greatly extended use.

The author, in conclusion, must confess how imperfect he feels the foregoing sketch of our knowledge of friction to be. If, however, he has succeeded in calling attention to some of the main features of recent advance in the scientific treatment of the question, this paper will not have been written in vain.

* A paper read before the Liverpool Engineering Society.

IN the September number of the *Meteorologische Zeitschrift*, Prof. Hann gives the results of many years' observations on the temperatures of the various parts of the Vienna forest. The forest valleys have a considerably lower temperature than the open land outside. This difference is smallest in winter and greatest in summer. But there is no similar effect during the course of the day, for the afternoon difference is not the greatest. It is actually least in the warmest hours of the day, and greatest in the cooler part. In the early morning and evening the influence of the forest in lowering the temperature of the air is greatest.

A PAPER on comparative study of the actions of walking and running, together with the mechanism of the transition between these two movements, was recently read before the Paris Academy of Sciences, by MM. Marey and Demeny. In this paper, which complements the author's previous communications on animal kinematics, numerous differences are shown to exist between slow and rapid pace, the latter being characterised by moments of complete detachment from the ground and by other equally important features scarcely visible to the naked eye; but which are now clearly revealed by the chronophotographic and dynamographic processes. The paper was furnished with six diagrams illustrating the contrasts between both motions and the transitions from one to the other.

THE statue of Liberty on Bedloe's Island, New York Bay, when completed, will be illuminated at night in a novel manner. The torch held by the statue will contain eight electric lamps, of 6,000 candle-power each, the light from which will be thrown directly upwards, making a powerful beam and cloud illumination. Four or eight lamps, of 6,000 candle-power each, will reflect their light upon the statue, illuminating it and causing it to shine forth in bright relief.

SCIENTIFIC NEWS.

MANY old students will hear with great regret of the death of Frederick Guthrie, Ph.D., F.R.S., Professor of Physics, Normal School of Science and Royal School of Mines. Prof. Guthrie died on the 21st inst. at the comparatively early age of 53 years.

Dr. Alexander Dyce-Davidson, Professor of Materia Medica in Aberdeen University, died suddenly in his class-room in Marischall College one day last week. The bursting of a blood-vessel in the head was the cause of death. The deceased, who was a native of Aberdeen, was 41 years of age. He graduated M.A. at Aberdeen University in 1863, and M.D. three years later. He was appointed Professor of Materia Medica in 1878.

Dr. J. von Hepperger, of Vienna, has published "Elements of Comet Barnard" (1886*f*.), which differ from those given on p. 170, calculated by Mr. Ritchie, jr. Dr. Hepperger makes the time of perihelion passage Dec. 24·3064 Berlin M.T.; $\pi - \Omega$ 78° 56′ 20″; Ω 140° 17′ 55″; i 93° 33′ 52″—mean equinox 1886; log. q 9·61236. About the time this will reach the majority of our readers, the comet will be near Nu Virginis.

In a communication to the Paris Academy of Sciences M. Cruls, director of the observatory of Rio de Janeiro, says that the transference is about to be commenced, the new site being on the same parallel, but two minutes further west. The Brazilian Observatory has an advantage over all others, as for forty days in the year the sun's zenith distance does not exceed one degree. M. Cruls will endeavour in the new building to make regular observations of terrestrial magnetism and atmospheric electricity.

Some experiments lately brought before the Paris Academy of Sciences by M. Luvini, combine with those of other observers, he considers, in warranting the conclusion that "gases and vapours, under any pressure, and at all temperatures, are perfect insulators, and cannot be electrified through friction, either with one another, or with solid or liquid substances."

Mr. Jarman has fitted up in the garden of 443, Brixton-road, S.W., a tram-road, on which he runs a model self-contained electric tram-car driven by his patented electromotor. This motor is of the Pacinotti type; but its most novel feature is that the axle carries two armatures, one of which is used for driving in one direction, and the other for propelling the car in the opposite direction. The current being cut out of the field on one side, that armature, rotating in the air, has time to cool down if it should have become heated, and it is considered that the extra cost of the, so to speak, spare armature and fields is amply compensated for by the fact that the arrangement avoids all risk of damage from excessive heating. The full-sized car, which Mr. Jarman intends shortly to build, will carry E.P.S. cells under the seats, and each car will have two or more sets, so that on its arrival at the terminus or at the charging station the cells can be drawn out on to a trolly, and be replaced by a set which has been undergoing the operation of charging. The time occupied in effecting that change certainly need not be longer than is now necessary with the horse-traction. The weight of the mechanism, including sixty storage cells, will be only two and a half tons for a 46-seat car. The model exhibited weighs about 168lb., and readily turned three curves of 6ft. radius, one at least on a rising gradient. The motor is reversed by a simple lever, and the car is always under complete control.

A method of making fine filaments for incandescent lamps is somewhat analogous to wire-drawing. Mr. R. Dick, of Glasgow, prepares the fibre of the *Caryota urens*, known as Kitool fibre, and imported from Ceylon for brush-making, by drawing it to a uniform size through sharp dies. The fibres are then placed in fine copper tubes, much shorter than the Kitool, and the whole passed through a draw-plate, which has the effect of squeezing the metal round the fibre, and compressing the latter. The tubes and filaments are then cut into lengths, and placed in a crucible, where the filaments are carbonised, and the copper is subsequently dissolved off by means of acid, portions being left to form connections.

It is stated in a French paper that Prof. Place, of the Cavalry School of Saumur, has recently applied electricity with great success to horses which prove refractory while being shod. A vicious beast will often give much trouble in shoeing. M. Place's method renders it at once tractable, and permanently cures its aversion to the forge. An electric shock is given through a bridle of special form.

A new alloy of nickel, which is said to possess a specific electrical resistance much higher than that of German silver, is reported to have been discovered at the Munich Electrical Laboratory.

It is proposed to hold a Tercentary Potato Exhibition at the beginning of December in St. Stephen's Hall, Westminster. It will not be merely an exhibition of potatoes, but will consist of four sections, containing: (1) an historic and scientific collection, including early botanical works in which the potato is figured, and papers, &c., in which attempts have been made to define the different species; (2) illustrations of the potato disease; (3) methods of storing, preserving, and utilising partly diseased potatoes; and (4) a display of all the varieties of potato now grown, with labels giving date of planting, locality, nature of soil, &c.

M. Rucktchell, a Russian engineer, has invented a new explosive, which he calls "silotvaar," with which experiments have been recently carried out at the camp of Krasnoie Selo, near St. Petersburg. As compared with ordinary gunpowder, the penetrative power of the new explosive, when used for cartridges, is stated to be ten times greater. The explosive emits neither smoke nor heat, and the discharge is unaccompanied by any report. Since these experiments the Russian war and naval authorities have had the new explosive examined and tested by experts, who are stated to have reported favourably upon it. It is further stated that a motive force may be generated with the explosive by means of an engine constructed by the inventor, for which he claims superiority over steam and gas-engines. The inventor has patented both the explosive and the engine in several countries.

M. A. Verneuil brought before the Academy of Sciences of Paris at a late meeting a paper "On the Preparation of the Sulphuret of Calcium with Violet Posphorescence," on the principle laid down by M. E. Becquerel in his researches on phosphorescence. M. Verneuil has succeeded in effecting the synthesis of this substance, which has long been known in commerce, but the preparation of which has remained a secret.

USEFUL AND SCIENTIFIC NOTES.

A SUCCESSFUL and interesting narrow-gauge railway has been constructed by W. G. Bagnall, Castle Engine Works, Stafford, at Spezia, to ascend the Monte Cappuccini. The distance from the quay to the summit is about three kilomètres. The railway winds to the top with a succession of heavy gradients, several being 7·1 per cent., and sharp curves from 34ft. radius upwards. The gauge is 80cm. (31½in.). The engines, which have 10in. cylinders, make twenty journeys a day, and take six wagons containing 2½ tons of stone each. Mr. Bagnall says the idea was ridiculed by the engineers there, but the saving had proved to be fully 60 per cent.

THE Guarantee Committee of the Universal Exhibition of 1889 was formally installed in Paris last week. M. Lockroy, Minister of Commerce, who was present at the inaugural meeting, thanked members for subscribing to the Guarantee Fund, and said that their patriotism had succeeded in surmounting the difficulties of furnishing the necessary capital, which has now exceeded twenty-two million francs. The Minister called upon the Committee to hasten its labours, as the various factories were awaiting orders. "Throughout France," added M. Lockroy, "industry was preparing for the great struggle, and for a pacific victory which would restore to France her position in the world."

A REPORT just published by Dr. Eck shows that the average death-rate in European Russia is 68 per cent. higher than in England. This means that, roughly speaking, three Englishmen live as long as five Russians.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of he* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

ABNORMAL TELESCOPIC DEFINITION.

[26413.]—MR. FRANKS'S "Notes on Telescopic Definition as affected by the Direction of the Wind" (ENG. MECH. Vol. XLIV. p. 61) are of great interest. The *locus classicus* on the triangularity of the star discs is, of course, Dawes's preface to his observations in Vol. XXXV. of the *Memoirs* of the R.A.S. Mr. Franks seems to imply that the phenomenon was noticed by Sir W. Herschel, and I have no doubt he is right; but I must confess that I have not myself been able to find any passage in Sir William's printed observations or MSS. relating to the matter. I do not know whether it has been noticed in Asia; but it has been observed in all parts of Europe, from Dublin to Pulkova, and from Upsala to Naples. I think (but I speak from recollection merely) that on mentioning the matter to Mr. Burnham and Dr. Gould, the former said he had not seen anything of the kind at Chicago, nor had the latter at Cordoba. As Dawes remarks, its association with the east wind seems unaccountable. I have, however, seldom seen it with reflectors, when a refractor, at the same time, exhibited it in a very marked manner, and a somewhat analogous phenomenon has often been observed with the 26in. at Washington, though I am not aware that the discs have ever been noted to be triangular there. Prof. Hall writes: "I would be observing stars near the zenith, the images being tolerably good; on turning the telescope down towards the north to the star Σ 2034 [+ 83° 59′ north decl.], the images at first would be fair; but after a few minutes, and before an observation could be made, the images would become so bad that an observation was impossible, the stars being simply a confused mass of light. This condition was probably produced by the cool north wind blowing against the warm object-glass and disturbing its figure. Our large objective is very sensitive to change of temperature, and will not perform well so long as these changes are rapid." Dembowski, as might be expected from the enormous number of double-star observations made by that prince of observers (he made at least seven times more measures than our own Dawes, or as many as Struve's and O. Struve's combined) has many notes on the triangularity of star discs. I give the following observations of his:—

1862, July 29. 70 Ophiuchi = Σ 2272: "Osservato coll'oculare 670, vidi un singolare fenomeno ottico. Le due stelline apparivano triangolari, anzi erano due perfetti triangoli equilateri, colla base all' incirca parallela all' orizzonte, ed il vertice opposto alla stessa, rivolto verso lo Zenit. In quel momento l'aria era tranquillissima, ed il massimo ingrandimento 670 reggeva perfettamente. Gli annelli attorno ai due dischette, invece di essere circolari e continui, erano rotti in tre pezzi, rappresentati da tre piccole linee rette, decrescenti in lunghezza ed in intensità e parallele ai tre lati del triangolo. Sostituiti gli oculari 500 e 400 l'effetto rimase lo stesso. Dopo una quindicina di minuti circa le due stelline ripresero la loro forma rotonda. Non ho mai veduto nulla di simile. Questa è l'immagine in vertita dell' apparenza che presentavano." [Cf figure 1.]

1862, July 30. η Cassiopeiæ = Σ 60: "Oculare 500. A 22h. 40m. in un momento di tranquillitá perfetta, si reproduce il fenomeno di jeri, cioè delle stelle in forma di triangolo. *A* specialmente era un perfetto equilatero. Dopo un pajo di minuti l'apparenza svani et ridivennero del tutto rotonde."

1875, August 18. η Cassiopeiæ = Σ 60. "All' oriente 19h. 43m. aria buona. *A* va facendosi in triangolo confino a cinque pezzi d'anello [cf. figure 2] decrescenti in intensità e lunghezza, e paralleli ai tre lati del triangolo. La base è sensibilmente parallela all' orizzonte. *B* invece non presenta traccia alcuna di forma triangolare. Essa è, o *sembra*, perfettamante rotonda."

I have selected these observations of De's on

account of their very curious characters. The short duration of the phenomenon, and, in the case of the observation of August 18, 1875, the extraordinary fact that one star only of the pair was affected (the distance as measured by De that night was 5·64″), render these some of the most remarkable cases on record. Several other curious phenomena, not adverted to by Mr. Franks, have been noticed from time to time.

There is only space at present to say a few words about two of the most remarkable, viz., transient cases of spurious duplicity, and the absence of diffraction rays. My late regretted friend, the Rev. T. W. Webb, has given so excellent an account of the first that it will be advisable to quote it in full from the *Intellectual Observer*, Vol. IV. p. 194. "The evening of July 27, 1863, had been cloudless, but hazy, with flaring and fluttering definition. As night advanced, however, it improved, and towards 11h. the discs of the stars came out finely: about this time, in endeavouring to meet with the beautiful triple star ε Equulei . . . I came across a 6-mag. star with a close 8 or 8½ mag. companion, about 1·5″ and 330°, both discs being very nicely defined. Thinking that this might be an object of W. Struve's, which I believed to exist in that quarter, but had never seen, I looked carefully at it, and continued my search, turning to a similar star in the field of the finder, some 2° distant. To my great surprise this had the same appearance. I tried a third; they were all alike. I at once turned the eyepiece (an achromatic combination, by Powell and Lealand, giving a power of about 300) round its axis; but the images remained unchanged. I then turned the object-glass one-third round; the companion was still there—I fancied

FIG. 1

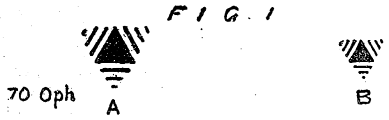


FIG. 2.

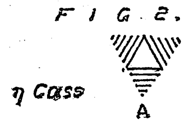
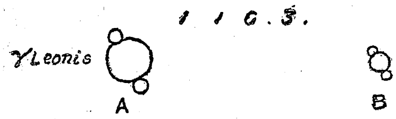


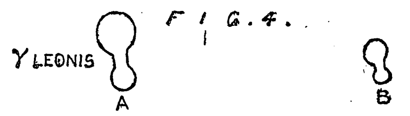
FIG. 3.



at first somewhat altered in angle, but further examination proved that I was mistaken; and a turn of another third made no difference. A star not far from Al Tair gave the same result, perhaps less distinct. I looked to the west towards Hercules; still something of the same kind came before me, though not so clearly. I returned to my first three stars; in each case the attendant was still perceptible, though much less obvious, and apparently fading away: while occupied among them I came unexpectedly across my intended object, ε Equulei; and here the beautiful and black division of the close pair at once satisfied me that neither the eye nor the instrument could be the cause of this singular deception. I regretted that its short continuance, and my own haste, prevented me from testing it more fully on other stars, and with other eyepieces, but as to what I did see, no doubt remained. During an experience of many years I cannot remember a similar illusion, excepting perhaps once, with a single star, and even that may be questionable. It may possibly be referred to some unusual condition of atmosphere, producing, apparently, for a short time, something like double refraction in a vertical plane. Similar effects, it is well known, are frequently perceptible in looking at distant shores or vessels across a considerable intervening surface of water—a species of *mirage*, of which I was a frequent spectator at Clevedon during the summer of 1846, especially in using a little hand-telescope." I have seen this singular phenomenon once very distinctly, and only once—viz., on February 19, 1874, in bright moonlight, with a 3in. refractor. Stars in the S.E. only were affected, 8 Monocerotis having a spurious *comes* at 140°: 2·5″, 8½ mag., ε Hydræ being triple, with a spurious disc at 165°: 3·5″; but γ Ceti was only seen double, and single stars in the north were unaffected. The illusion lasted about 20 minutes. I had the pleasure of seeing Mr. Hunt a few days ago, and I asked him, in the course of conversation, if he had ever noticed anything of the kind with his beautiful 8in. o.g., which formerly belonged to Dawes. I think he said that he had not; but he believed he had very distinctly on one occasion with a small transit instrument, but only in the case of one star.

Dembowski has several observations of this optical deception. He writes in his observing book on May 30, 1863, not two months previous to Webb's observation:—"Σ 1424 = γ Leonis. Oggi questa coppia mi ha presentato un aspetto singolarissimo. L'aria era tranquillisima, ma fosca. Vi era come una annebbiatura generale, che dava all' aria una tinta grigio—azzurra. Osservato prima e dopo il tramonte del sole, oculare 400. Nel principio le due stelle apparivano come due dischetti minuti, ma di luce intensa, e circondati da un annello completissimo e di luce perfettamente stabile. Lo spazio fra il dischetto e l'anello poteva dirsi *nero* ed era abbastanza ampio. Talvolta l'anello si sformava, e subentrava quest' altra configurazione [cf. figure 3] li due dischi fittizi rappresentanti le due stelle erano accompagnati ciascuno da altri due dischetti più piccoli, l'uno sopra, l'altro sotto, ma tangenti ai primi. Diametralmente opposti l'uno all'altro, la loro congiungente faceva all' orrizzonte un angolo di circa 60°. Tal altra volta offrivano questo altro aspetto [cf. figure 4], in luogo di quattro dis-

FIG. 4.



chetti secondarî tangenti, vi erano solamente due dischetti secondarî più piccoli dei principali, ed attacati ai medesimi mediante due tratti luminosi. In tutti i casi il fenomeno era stazionario per qualche tempo. Rammento d'aver osservato qualche cosa di simile a Napoli, se non erro sopra ζ Aquarii [Yes, on Dec. 10th, 1857]. Mano mano che si avanzava il crepuscolo le stelle crescevano in luce, le diverse configurazioni perdevano di precisione, e succedeva un rimescolamento. Poco dopo osservai ξ Ursæ Majoris. Continuano anche su questa copia le apparenze vedute in γ Leonis, ma sono molto rare le due seconde, e per lo più ha luogo la prima, cioè quella dell' anello completo. Provato dopo la misura di 35 Comæ, non posso farne nulla: la persistenza dell' anello che passa sulla compagna (distante 1·3″) toglie ogni possibilità di misura." And again on May 17, 1870, when observing Σ 1722, Comæ 179, a pair of 7·7 and 8·7 mags. 3·1″ apart, he writes:—"Talvolta si vedono altri due dischetti precedenti ai veri, alla distanza di circa 1″. Dopo pochi minuti scompajono del tutto, e restano solo le vere immagini."

The temporary absence of rings is mentioned by Webb on p. 3 of the fourth edition of "Celestial Objects," and is a rather inexplicable phenomenon. Sir J. Herschel writes of it thus:—"December 31, 1830, ξ Ursæ Majoris. Perfect measures. No appendages, and scarcely a trace of rings about the stars, which are like two pearls, and perfectly motionless; really, I never saw anything like it." "ξ Boötis. March 29, 1830. (The finest of the fine nights of last spring.) The observation says; 'In my life I never beheld anything so lovely. There is a sort of liquid light in it; a soft, quiet lambency in the discs such as I never before witnessed (and only once since—viz., on Dec. 31, 1830). *The rings are but traces of rings*—all their light being absorbed into the discs.' The very remarkable fact in this last sentence, corroborated by the observation of ξ Ursæ on the 31st December, and illustrated by a diagram made of it at the time, is so prominent a feature in the optical history of these rings and the general subject of the action of telescopes, that I could not but insert this remark at length." Sir John was using the 5in. equatorial. I have given a remarkable observation of De's of the absence of rings in the case of O Σ 159 on page 21 of the "Corrections," &c., to Gledhill, Crossley, and Wilson's "Handbook of Double Stars." He calls it "momento sublime!" as it must have been, the bright yellow disc of the larger star of the very close pair O Σ 159 appearing to cover about a quarter of that of the blue disc of the small star, there being not the slightest trace of a diffraction ring to either star. He saw it again in 1870 and 1876. Can "A Fellow of the R.A.S." or Mr. Knott (whom I thank for his kindness and trouble in observing the planetary nebula H IV. 37) give me any information as to where the investigation of the "eminent German astronomer," mentioned by Prof. Wheatstone to Dawes (*Memoirs* R.A.S., Vol. XXXV. p. 156), is to be found? I have searched for anything of the sort in vain. It is certainly not in anything published by Bessel; but there are a good many "eminent German astronomers."

October 16. **H. Sadler.**

DOUBLE STARS—α LYRÆ—θ AURIGÆ—δ CYGNI—41 ARIETIS.

[26414.]—On the night of Oct. 11, while observing various stars, I turned the glass (a 4in., by Cooke) upon α Lyræ, having a desire to see if the companion could be seen in full moonlight; the distance I had some recollection of being about 40″ to 50″, but the position angle had been entirely forgotten. Putting on a diagonal eyepiece, I ran my eye around the star for some time, and finally suspected a point at one position. A short watch nearly convinced me that it was the companion; but to satisfy myself more fully, I revolved the diagonal with my eyes shut, and then ran around the star again.

In a few moments the point was again seen, but in a different position in the diagonal. Keeping my eye upon the smaller star, I turned the diagonal back to its original position, and found the point of light came back to where I had first seen it.

The diagonal was then taken off, a direct eyepiece put on, and in a few moments the companion was again picked up, and its position angle estimated. Upon referring to Webb, I found it agreed pretty closely, so that I felt sure it was seen. While looking for the close companion another more distant one was seen almost pretty steadily after once noticing it. Its position was *n.f.*, and about three times as far distant as the close companion. Upon referring to the diagram of Mr. Sadler, on page 10, I find it was the star marked there as B, but it was easier than the close companion, and was first noticed without thinking of it. In Gore's "Catalogue of Suspected Variables" this star is spoken of as being a magnitude fainter than the well-known companion in Oct., 1870. It certainly seemed to me brighter than the close companion on Oct. 11, as it was noticed without even looking for it. On the same night at 11h. 40m. I used a p. 200 upon θ Aurigæ, and a small star estimated at about 10th magnitude was seen pretty steadily, at about 35″ *n.p.*, position about 300° The close companion mentioned in Webb I could not see, although carefully looked for; neither could I do anything with δ Cygni, although the moon was within a day of full. The star 41 Arietis is given by Mr. Sadler in his "Star Guide" as a space-penetrating test for a 4in. glass. On Sept. 2, while trying to remedy a slight tilt in the o.g., I turned it upon this star accidentally, without knowing its name, and after some little attention saw two faint companions. Not finding the star in Webb, I made a careful estimate of distance and position, and after coming down from my observatory referred to Mr. Sadler's work, where I found that my estimates agreed with his measures very well. Both companions, however, were picked up without knowing it was a double star, and while casually turning the glass upon various stars to see their discs and rings. **Ariel.**

THE BRANDENBURG LUCKY STAR.

[26415.]—The above, which only appears at intervals of three centuries, is expected within the next four years by Continental astronomers. The star was so called because it appeared the night the Elector Johann Sigismund of Brandenburg was born. It was first noticed, however, in 945, during the reign of Emperor Otto I., shining in the constellation Cassiopeia, and then vanished until 1254. Tycho de Brahe suddenly discovered the star in November, 1572, sparkling with greater brilliancy than any star of the first magnitude, and nearly rivalling Venus. It could be seen even in the daytime, and shone distinctly through the clouds at night when all other stars were invisible. The light soon began to fade, and the star finally disappeared in 1574, after being visible for seventeen months.

The time for its reappearance is thus now at hand. (Above is a copy of a paragraph from the *Graphic*, Oct. 16, and may interest.) **D. A.**

SUNSET PHENOMENA—EARTHSHINE.

[26416.]—The pink or salmon-coloured "streamers" of "E. E. M." (letter 26390, p. 171) are merely the sunlit intervals between wider cloud shadows, cast through the air by some clouds just out of sight beyond his west horizon. The appearance is common enough within the Tropics, and I once saw at sea, near Barbadoes, a double daily display, each morning and evening, for nearly a week. On one morning this had the comparatively rare feature that the beams were traceable all across the sky, so as to grow *convergent* to the west, and plainer there than overhead. It may seem a puzzle that perspective can make the sun's really diverging beams appear to *converge*; but we must remember that all of them visible to us, in our few score leagues of atmosphere, are practically quite as *parallel* as the lines of any building. Like the cornices of a gallery, they will converge whichever way we look, to the sun or from him. Brewster's "Optics" mentions these "converging beams," which I have once, too, seen in Europe.

"F.R.A.S.," on the same page (171), says "the earth-illumined part of the moon's disc is rather brighter before the new moon" (i.e., in the mornings) "than after it" (in the evenings), but does not point out how well this accords with theory. When we (in Western Europe) have the moon rising, the terrestrial hemisphere turned to her contains all the old continents; but when we have her setting, the earth turns chiefly oceans to her,

reflecting far less light than the lands. This inferiority of earthshine on the setting new moon, compared to the rising old one, must be true of all places in the Atlantic and both American continents. But the contrary should be observed over all Eastern Asia, Australia, and the Pacific Islands. Their setting moon must get more earthshine than their rising one. **E. L. G.**

EGYPTOLOGY.

[26417.]—MAY I contribute a little to the question of Israel's captivity in Egypt?

"Now the sojourning of the children of Israel, who dwelt in Egypt, was four hundred and thirty years." (Ex. xii. 40.)

"The Covenant, that was confirmed before of God in Christ, the Law, which was four hundred and thirty years after, cannot disannul." (Gal. iii. 17.)

This number is twice mentioned (Gen. xv. 13; Acts vii. 6) indefinitely, because definiteness was not required.

There is a difficulty connected with these Scriptures, for, notwithstanding the assertion that the Children of Israel were in Egypt 430 years, they were really there, in our reckoning, only 215 years, just one-half the time. Consider the following table:—

	Years.
Abraham, after the Covenant, to the birth of Isaac	25
Isaac, to the birth of Jacob	60
Jacob, when he went down into Egypt	130
	215

When was the Covenant made? When Abraham was 75, just before he went down into Egypt (See Genesis xii. 4). From this period God reckons the whole period of 480 years, which close with the exodus of the host of Israel. Israel were the seed of Abraham (Consult Heb. vii. 5—10). God made the covenant with Abraham by word at first (Gen. xii.); afterwards by oath (Gen. xv. 9, &c.; Heb. vi. 17).

Clifton. **W. Howell.**

[26418.]—"RAMASES" is mistaken (26323) in supposing I wish to exclude the testimony of the Bible. I admit its value, as I would that of any other ancient book, but do not look on its historic or scientific statements as final. We have only it to prove that the Israelites were in Egypt, which I do not deny, though I doubt the details of the story. As "Ramases" admits the records are "more or less imperfect," it seems to be the amount of error, not the general principle, on which we differ.

As to Gesenius, I have no library at command, and cannot refer to his works; but, knowing that he changed his earlier rationalistic views in later life, I do not attach much weight to his opinion (probably an early one) on the nature of a generation. Why does not "Ramases" give the facts on which Gesenius relied? We are not children—we want facts, not opinions, and Gesenius had no secret information. "Ramases" seems oblivious of the prevalence of Herbert Spencer's philosophy and of agnosticism when he says Strauss's influence is on its last legs. I consider it was never so widespread or so strong.

The "about" of Fairbairn's "Biblical Dictionary is not of much value, as the revisers omit it altogether.

The main defence offered by "Ramases" is that of traditions of the Apostolic age; though, in reality, these may only have had reference to some general statements of Moses, especially referring to the Commandments, and not to the form or verbal peculiarities of the old books.

The writers of the New Testament used words often in a poetic and non-scientific manner, as the passage Acts ii. 5 proves e.g.:—"And there were dwelling at Jerusalem Jews, devout men, out of every nation under Heaven." Will Ramases claim that Jews were there from Mexico or Peru? And if not, why not, if the writings are accurate?

Late traditions respecting ancient history or writings are not trustworthy, and are apt to be produced to suit circumstances, and the objections against the Mosaic authorship of the Pentateuch are so many and so weighty that tradition is worthless against them. I will state a very few objections.

1. Moses is said to have been learned in all the learning of the Egyptians, and therefore knew something of their history, so could not have placed the Deluge at the date we find it in the Hebrew Bible—according to that, it occurred B.C. 2288; but, as Menes, the first king of the first regular dynasty lived at least 1,000 years before that date, it seems as if no one versed in Egyptian lore could make any such statement. The Egyptians claimed an immense antiquity; but the labours of the learned have cleared the mystery up to a very great extent, and Mr. Sayce, in his "Ancient Empires of the East," says, at page 23:—"The date to which this event (the time of Menes) was assigned by Manetho has, for reasons already given, been variously computed. Boeckh makes it B.C. 5702; Unger, 5,613; Mariette, 5004; Brugsch, 4455; Lauth, 4157; Pessl, 3917; Lepsius, 3892, and Bunsen, 3623. We shall provisionally adopt the dates of Mariette, whose long-continued excavations in Egypt have given him an exceptional authority to speak on the matter."

According to the Septuagint (written in Egypt, and very late) the date of the Deluge is 3216 B.C.—not far from Bunsen's date for Menes; but as the oldest remains in Egypt give proof that the civilisation was old and very peculiar when they were made, it is idle to suppose that any of the dates of the Flood could have been written by one versed in Egyptian knowledge. This seems to me to prove that Moses did not write Genesis.

2. Moses must have known all about the immortality of the soul; yet no mention is made of it in the Law. In Egypt it was the main thought and hope of the people, and yet amongst the Hebrews no reference seems to be made to it; the point referred to by "Ramases" being very doubtful at best. The Hebrews appear to have been all Sadducees, and this could hardly be so if one brought up as an Egyptian had written the Law, and believed in immortality.

3. Three separate Pharaohs are mentioned in the Bible; but no special name is given to any of them. If Moses knew personally the two last, it seems wholly unlikely he would not specify them personally, especially as multitudes of details of other things are given. To use the word "Pharaoh" as a generic term would be natural to a late writer, but not to a contemporary, when three different persons are referred to.

4. It is not usual for a writer to record his own death and burial; but if Moses wrote the whole of the Pentateuch, he must have done so. That fact would not be taken by any court of law to be other than a proof that the person spoken of as dead and buried *did not* write the passage. But if the book is examined, it will be found that the style of the writer of the passage is that of a large part of the whole.

5. Numerous passages occur which prove late authorship, such as the following:—Gen. xxxviii. 31, "These are kings that reigned in the land of Edom, before there *reigned any king* over the Children of Israel." That passage was clearly written after some king or kings had reigned over Israel. I could easily multiply passages like this, but one is sufficient.

The main defence offered by "Ramases" is that of traditions of the Apostolic age; but these may well have only referred to a limited traditional memory of the general Law urged by Moses, and not to the form it now exhibits. As the writers of the New Testament used words in a non-scientific sense (as when saying the Gospel had then been preached to all the world), we must not attach undue importance to words which simply chimed in with the popular theory.

We find Josephus in one part of his works giving the ordinary Biblical account of the Israelites in Egypt, and later on we find him suggesting that the Shepherd kings were the Israelites, while, if so, the Biblical narrative must be wrong. We do not find critics in that age very well versed in ancient writings, though we do know they were very credulous.

Your readers must remark that "Ramases" is a practical writer, and has access to good information; he writes with the traditions of 1,000 years or more behind him; yet they must remark what a poor show of proofs he has brought up, and must see that my contention has been well borne out.

Memnon.

ANALYSIS OF SILVER ALLOYS.

[26419.]—I AM obliged to Mr. A. Allen for his notice of my query. The circumstances which led to a desire to analyse silver-plated articles, in addition to making a fire assay of the same, are as follows. Some few years since, my employers desired me to qualify myself for taking assays of their plated articles, and sent me to London to procure the necessary apparatus. The dealer advised me to adopt a method of quantitative analysis in preference to a fire assay, on the grounds that the first method was more speedy and accurate. He kindly wrote out for me the following instructions, and supplied me with graduated instruments. I will give the exact text of his instructions in separate paragraphs, and add to each my experience.

"Weigh, say, 100 grains of the alloy, and dissolve it entirely in pure nitric acid, diluted with half its bulk of distilled water."

It was not always convenient to take 100 grains.

"This solution may next be evaporated, either to dryness, or so nearly that the free nitric acid is either expelled or so little is left that it can be neutralised by the addition of a few drops of solution of carbonate of soda."

I found that when the solution of copper and silver nitrate was evaporated to dryness, a pale blue salt was formed which was insoluble in distilled water. This same pale blue salt was thrown down from the solution when a solution of sodium carbonate was added to neutralise the acid.

"In either case the residue, when redissolved in distilled water, must be neutral to litmus paper. This neutral solution is then ready for estimation."

From the causes mentioned above, I could not redissolve the residue in distilled water, nor could I get a solution, by this means, perfectly neutral to litmus paper. An element of doubt and possible error was therefore introduced.

"A standard salt solution is then made up and used in a burette. This solution is cautiously dropped into the silver solution, and this is best used in a beaker of good size, and kept hot by occasional heating. In order to determine the precise termination of the process, it is advisable to use chromate of potash. For this purpose make a very strong solution in water, and place a few individual drops upon a white plate. When it is desired to ascertain if any silver is left in solution, it is sufficient to take up a small drop upon the end of a stirring rod, and dip into one of the drops of chromate of potash solution on the plate. If any silver is present in solution, the colour will immediately change to a blood red; if none is left, no change whatever occurs."

I procured a burette graduated in grains, and had a decinormal solution of salt made up. I also used a 4oz. beaker, and followed the instructions closely; but I could never succeed in getting all the silver down, and always noted a tinge of red in the chromate test. Even when a decided blood-red spot was shown by the indicator, I found that a considerable excess of salt solution had been added to the solution of the alloy, and in making a calculation with test samples containing a known quantity of silver, the volume of salt solution used was greatly in excess of that required to throw down all the silver as a chloride. I therefore concluded that—1, the copper nitrate in solution greatly interfered with the precipitation of silver chloride, so much, in fact, as to prevent small particles of the silver chloride from being thrown down, and thus leaving them in the supernatent solution; and, 2, that those small particles of silver chloride were dissolved by the hot nitrate of soda solution. Mr. Allen has verified my second conclusion. Will he kindly say whether or not my first was also correct? If so, will not a similar thing happen in throwing down the silver as a chloride from the stripping solution, as recommended by him.

Not only myself, but many other readers will feel deeply obliged to Mr. Allen for his *exposé* of the way in which textbooks are made up. It is a pity such books are published and sold to students. Why cannot we have textbooks written by practical analysts and assayers? A statement in Sutton's "Handbook of Volumetric Analysis," to the effect that an analysis of a silver alloy could be correctly made in a quarter of an hour, led me to suppose that it was an easy and speedy process; but I find, on the contrary, that it is more tedious, takes longer, and is more liable to error than a fire assay. Mr. Grey advises me to throw down the silver as a chloride with hydrochloric acid, fuse the precipitate, weigh the residue, and estimate the weight of silver. May I ask him how I can be sure that all the silver has been thrown down? Is it not a fact that silver chloride is soluble in a slight excess of hydrochloric acid in the presence of cupric chloride in solution? Does silver chloride absorb oxygen when dried and fused in daylight? If so, what is the combining weight of such fused horn silver? Also, how should the silver chloride be collected, in what vessel should it be fused, and how got out when fused? **G. E.**

A NEW FORM OF HEADSTOCK.

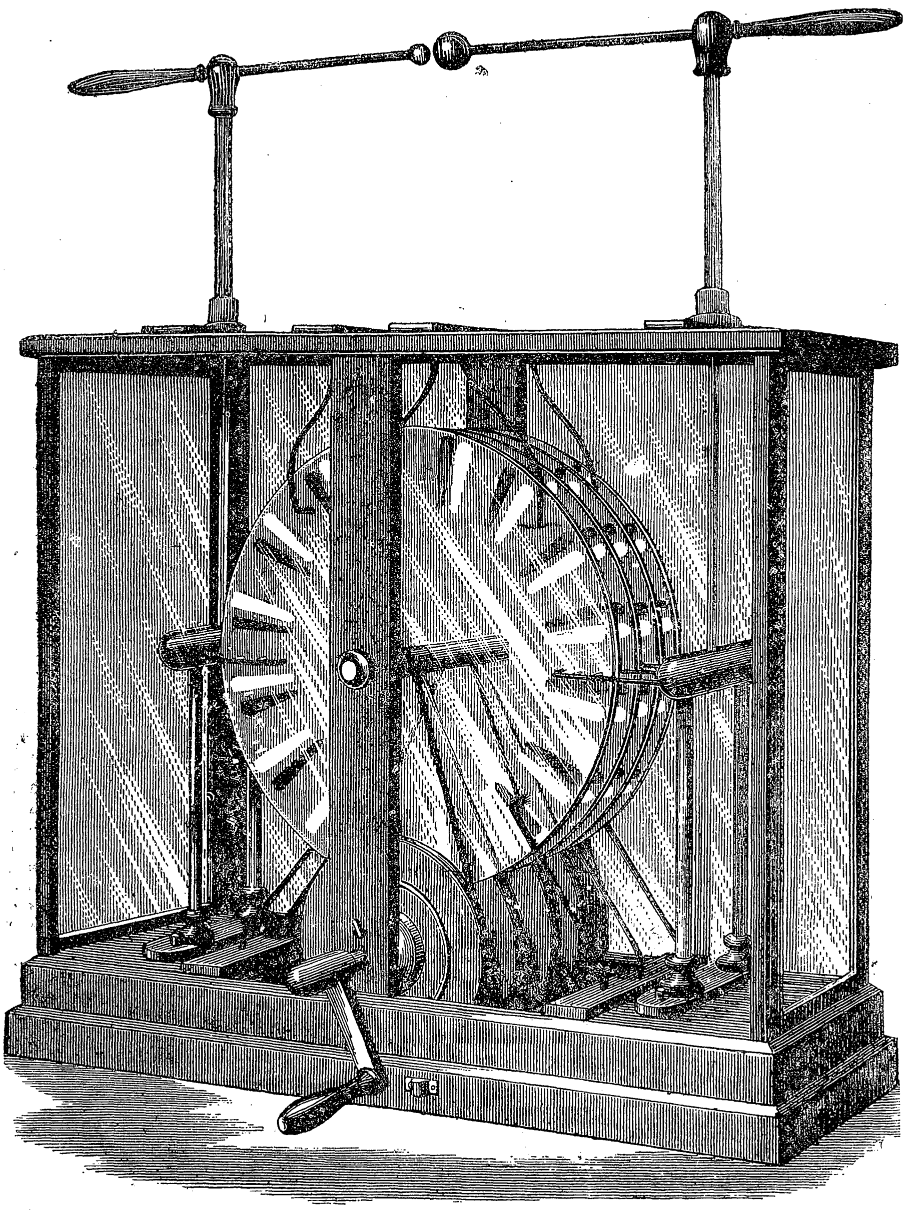
[26420.]—ON page 77 a pair of Hooke's joints are sketched at the left-hand bottom corner of the diagram.

I write to call attention to a point in connection with these.

In a single Hooke's joint, where two shafts are connected, and are not parallel, if one rotates at a uniform velocity, the other will vary in its rate of turning, so that if the complement of the angle between the shafts is a, and one makes r revolution per minute while running steadily, the other will vary its rate from ($r \times$ cosine of a) to $\left(\frac{r}{\text{cos. } a}\right)$

If the joints are placed as shown on page 77, and the shafts lie in the same plane, this variation will be doubled.

If the two jaws on the central shaft are placed parallel to one another—i.e., the right-hand coupling turned $\frac{1}{4}$ revolution before keying to the shaft, and the two outer shafts make equal angles with the central one: they will both revolve at the same rate, and the variation is got rid of. **Glatton.**



THE WIMSHURST INFLUENCE MACHINE.

By The Inventor.

[26421.]—Although in previous numbers of the English Mechanic accounts of several forms of this machine have been published, and the working details given (see 14th Nov., 1884; 16th Oct., 1885; 6th Nov., 1885) yet many of your readers will doubtless be glad to have the particulars of the working details for the more modern, or many-plated, form of the machine, similar in construction but not so large as the powerful instrument recently used by Prof. George Forbes in his lectures at the Society of Arts.

The leading characteristics of the new machines are that they have many plates, and that they are inclosed within a glass case, which to a great extent obviates the difficulties which the presence of dust offers to the student of statical electricity.

The following is a description of the working details of, perhaps, the simplest form of a machine with eight plates: a greater number of plates, or a less number of plates may, of course, be used; but then the number of parts of each kind must be proportionally increased or decreased.

The case, so far as external appearance and finish are concerned, may be left to the taste, the ability, or the pocket of the maker; but the form shown in the drawing above will probably give the greatest satisfaction. The dimensions given are measured *inside* the case—viz., $24\frac{1}{2}$in. length, $11\frac{5}{8}$in. breadth, $18\frac{1}{2}$in. height, top of base to the frame at top.

The fitting together of the various parts of the case must be left to the skill of each constructor; but care should be taken that the corners of the base, or bottom of the case, are strongly put together, so as to prevent any twisting when the machine is lifted.

The stanchions have narrow grooves cut into them, and are so arranged that each plate of the glass which forms the sides of the case is slipped into its place from the top; the grooves for the end glasses are so cut that those glasses can be lifted up at any time and taken away to enable any necessary adjustments to be made inside the case.

The driving-wheels and spindle are represented in Fig. 1. To make these procure a piece of straight bar iron, or steel, of soft quality, 15in. long by $\frac{1}{2}$in. in diameter, drill centres in its ends, then true up one end for $1\frac{1}{2}$in. in length, and on this end cut a screw-thread. On this thread screw tightly a stout washer in order to form a collar against which the driving handle can be seated. The next thing to do is to fit on to the spindle a length of wood; place the spindle with its wooden cover in the lathe, and and true up the wood, making it $11\frac{9}{16}$in. in length by $1\frac{1}{2}$in. in diameter; drill holes near each end through both the wood and the iron, and into these holes fit metal pins. This wooden portion of the spindle forms the base upon which the wheels are to be fitted and glued at the distances shown in Fig. 1. These wheels must be turned up with V grooves in their edges, and the sides slightly ornamented. After this, true up the uncovered portions of the iron spindle, so that it may run smoothly in the bearings, which are pieces of brass tube fixed into the stanchions of the case. The height for the centre of this spindle is $4\frac{1}{4}$in., measured up from the bench.

The spindle and the bosses for the glasses are represented in Fig. 2. For this spindle select a piece of bright steel wire 14in. long by $\frac{7}{16}$in. of an inch diameter, and a corresponding length of brass tube to fit the wire. Cut the tube into lengths slightly longer than those shown in the sketch, and on these lengths fit pieces of well seasoned yellow pine; turn these up to form the bosses, taking care that the projecting piece which supports the glass will just fit the holes in the centre of the glasses. Lastly, turn up the ends of the brass tube, leaving a sufficient length on each to project slightly beyond the vulcanised fibre-washer with which the glasses are held upon the bosses. The length of the projecting ends of the brass tubes regulates the distances between the plates, and care should be taken to see that no other part than the ends of the tubes touch each other when the glasses are revolving. The total lengths of the five tubes must just fill up the space between the stanchions of the case. The height for this spindle is $12\frac{3}{4}$in., measured up from the bench.

The prime conductors are represented in Fig. 3, and are made of brass tube $6\frac{1}{2}$in. long by 2in. diameter, the inside of which is filled with yellow pine; the ends are of mahogany, and are turned up to a hemispherical shape. The conductors are each supported by two glass rods, which fit into holes cut through the bottom of the brass tube and through the wood; the lower ends of the glass rods are firmly cemented into suitable stands, which can be removed from the case. The stand of each prime conductor is held in place by a steady pin at each end, and by a screw in the

FIG. 1.

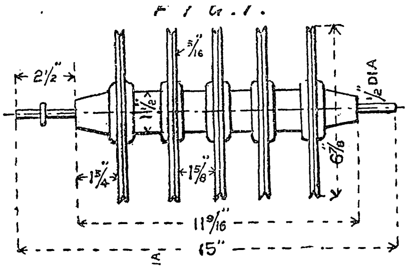
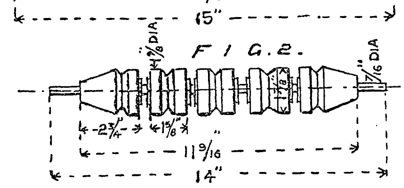


FIG. 2.



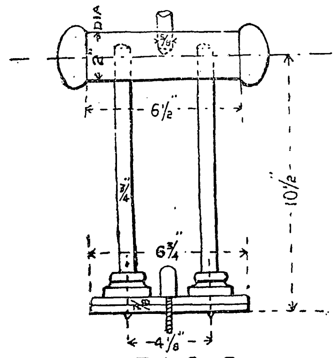


FIG. 3.

FIG. 4.

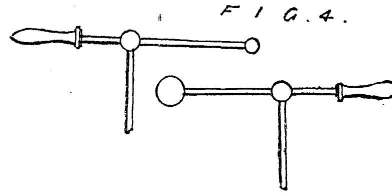
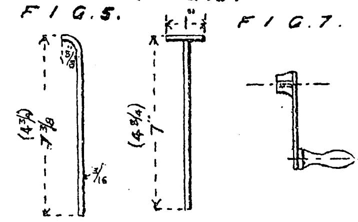


FIG. 5. FIG. 6. FIG. 7.



centre. It is advisable to fit a piece of vulcanite or wood over the head of these screws, as it will prevent its being a source of leakage for the electricity, and it will also make it easy to release and take away the prime conductor whenever it is required.

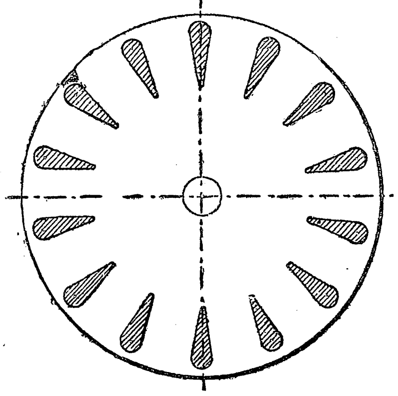
The carriers for the brushes are made of brass wire $\frac{3}{16}$in. in diam., and of a form shown in Figs. 5 and 6. Four of them simply have the ends bent to a right angle, and at the extremities small holes are drilled, into which the brushes are fixed; the remaining brush carriers are T-shaped, made up of pieces of straight wire, one end of each being filed hollow, and into this hollow a short length of small tube is soldered at a right angle to the wire: these tubes take a brush at each end. The new machine having eight plates, and, therefore, requiring sixteen brushes, four of these brushes will be held by the four carriers with the bent ends; they may, therefore, be called single carriers, while the remaining six carriers each hold two brushes, one brush being held by each end of the small tube; they may therefore be called

double carriers; the single carriers consequently together hold four brushes, while the double carriers together hold twelve brushes, thus making up the sixteen. To support the carriers, four pieces of wood are fitted, two being at the top, and two at the bottom of the case; these pieces should be so fitted that they can be removed at any time. Holes must be drilled in them at positions suitable for the brush carriers, and the ends of the carriers must be tightly fitted therein. The piece of wood at the bottom of the case upon the right-hand side of the driving handle, and the piece of wood at the top of the case to the left hand of the handle, will each support two single carriers, and also one double carrier; the brushes in these will neutralise the sectors upon the first, fourth, fifth, and eighth plates. The remaining two pieces of wood will each support two double carriers, the brushes of which will neutralise the second, third, sixth, and seventh plates. It must be borne in mind that all the carriers must be brought into metallic contact with one another: this is best done by cutting grooves in the woodwork of the case, &c., and placing copper wire in them, afterwards cementing up the grooves with shellac putty.

The collecting combs are made of guttapercha-covered copper wire, the only uncovered portions of which are the collecting points and the portion within the prime conductors; they are fastened by having one end tightly forced through holes drilled through the brass tube forming the conductor, the other end being bent to form a right angle to the glass. Sixteen of these wires in each conductor will be found sufficient.

The glass plates (Fig. 8) should be of thin, flat, and proper quality glass, 15in. in diameter. The hole in the centre should be $1\frac{1}{4}$in. in diameter. The glasses must be well coated on each side with pale shellac varnish. The sectors should be of

FIG. 8.



tinfoil, $2\frac{1}{2}$in. in length by nearly 1in. broad a the outer end, and 1·5in. broad at the inner end; they should be situated not more than $\frac{1}{4}$in. from the circumference of the plate; fourteen sectors on each plate will give about the best results.

To attach the glasses to the bosses, the best plan is to first test that the glass runs true when only lying upon the boss, then cement the vulcanised fibre washer to the free surface of the glass, then firmly screw the washer to the wood boss; but when using this arrangement, always be careful to see if one side of the glass is a little more concave or hollow than the other, and to see that the hollow side of the glass makes the surface upon which the washer is to be cemented: otherwise the plates will gape at the edges. Practice shows that the closer the glasses can be brought together the better is the result.

The handle drawn in Fig. 7 may be of any form, but the one shown answers very well, screwing it on to the spindle; the thread being cut in its boss is, perhaps, the best method of attachment. This plan, moreover, insures the machine being always driven in the proper direction, as the handle will unscrew if turned the wrong way.

The driving belts are best made of the round leather used for sewing-machines. The joint is made by scarphing the ends and stitching them together. The first, the third, and the fifth bands run straight, while the second and the fourth bands run crossed.

The terminals or discharging rods (Fig. 4) are simply straight wires $\frac{1}{4}$in. in diameter. On one end of each is a vulcanite handle, and on the other end a brass ball. The balls should differ in size, and be highly polished, the ball on the right-hand terminal should be nearly 2in. in diameter, and the ball on the left hand rather less than $\frac{1}{2}$in. in diameter. The electricity is brought from the prime conductor to the terminal by a stout wire encased all its length in a thick glass tube which extends from the conductor to the terminal. Care must be paid to see that there is metallic contact between the wire and the conductor, and between the wire and the horizontal terminal. The joint between the vertical glass tube and the terminal may be made by a wooden ball thickly polished, or by any more tasteful device.

Always remember that all glass used must be tested for insulation before labour is added to it: frequently glass is of such a character as to be useless. Avoid all sharp edges and all points: one point wrongly exposed, or even a rough surface, will be fatal to good results.

Mr. Thomas Gray, C.B., lately edited a pamphlet, which contains a reprint from the ENGLISH MECHANIC, giving particulars of the construction of all the simple forms of these machines, and how to make them. He has given a great deal of time to the subject, and was, I believe, the first to construct a machine with many plates. The pamphlet will be useful to those about to construct either of the simple forms of the machine: it may be obtained from Messrs. Pewtress and Co., Little Queen-street, Holborn, the publishers.

CHAMBER ORGANS.

[26422.]—IN common with many others, I have perused Mr. Audsley's remarks on chamber organ building with the greatest interest, and trust that it will be long before the subject is allowed to drop. It seems to me that most of our organ-building firms are utterly at sea in the matter of organs suited to small buildings, the general idea being that the *number* of stops must be in proportion to the size of the building, instead of reduced power and greater delicacy in voicing. A short time ago, wanting a three-manual organ with about 20 stops for a very small church, I found my ideas received with scorn by two of our largest firms. I was fortunate enough, however, at that time to become acquainted with the builder referred to by "Organist," who has erected for me, in a small building utterly destitute of any good acoustic properties, one of the most charming organs I know, with endless variety, and capable of effectively interpreting every style of music. I think before Mr. Landel decides on a builder, he would do well to try some of Mr. Gern's instruments, and give his work a thorough inspection, both as regards quality of tone and workmanship.

I am sure Mr. Audsley will pardon my combating his condemnation of voix céleste stops. The objection that anything systematically out of tune is inadmissible applies equally to mixture stops, the fifths in which are never in tune with the corresponding sounds on other stops. The beauty of the voix céleste does not consist in the fact of its being out of tune nor in its wavy character, but in the peculiar liquid fulness which the sharpening of one rank imparts—an effect unobtainable by any other means. I think myself that a perfect organ should have two voix célestes, one of the Gamba type, as usually inserted by Mr. Gern, and one of the extremely soft type, such as Messrs. Forster and Andrews frequently insert.

I wish some of our acoustic friends would give us their opinion in the matter of swell boxes. I fancy the grand effect of some swells is due to the acoustic properties of the box as much as to the pipes contained in it.

Another Amateur Organist.

[26423.]—I HAVE seen Mr. "G. S.'s" scales of pipes for the chamber organ Mr. G. Landel intends to build. It seems to me that Mr. "G. S." made a mistake, for I do not believe Mr. G. Landel will get a good "Gamba" out of a 4in. pipe (diameter at C C). If the Open Diapason has $5\frac{1}{2}$in., the Gamba should never have more than 3in.; and if Mr. G. Landel is able to voice narrow-scaled pipes, I should advise him to make it only $2\frac{3}{4}$in.

The Voix Celeste should not be more than $2\frac{1}{2}$in. (diameter at C C), or, referring to the Gamba, $2\frac{5}{8}$in. **W. Drechsler.**

[26424.]—I HASTEN to thank Mr. Audsley for his kind answers to my queries, but am a little disconcerted at his remark, "If Mr. Landel *seriously* intends to have all his manual stops of metal, &c." I am quite aware that most organ builders put in about one-third wood pipes; but I fail to see why this should be, except to save expense. True, some of the wood stops are extremely beautiful, but I have yet to learn they cannot be imitated, or even surpassed, by those of metal. I believe there are several French builders who now only use metal stops. In designing a chamber organ, the space it is to occupy is a most important item, and by adopting all metal stops the space is reduced fully one-third in an organ of, say, 15 stops, although the cost is thereby increased in proportion.

I shall be very much obliged if Mr. Audsley will kindly give me his opinion on this subject at an early date, as I now feel reluctant to go on with my organ until I hear from him.

I am exceedingly sorry to learn that his organ is not so perfect that he would care to publish the specification; but perhaps he will have the kindness to give us what he would consider a perfect specification for an organ of, say, 10 stops, and another of, say, 15 stops, both with two manuals. By so doing he would confer a great boon on your readers and myself, and add greatly to the value of his admirable and thoroughly practical papers upon this interesting and important subject.

I find I omitted to mention that my pedals would have an 8ft. "stopped flute" in addition to the 16ft. Bourdon, the 8ft. tone being obtained by carrying the Bourdon twelve notes higher (42 pipes in all), and fitting the pedals with octave coupler, so arranged that the 16 or 8ft. tone can be produced separately, or both together.

George Landel.

RAILWAY SIGNALS.

[26425.]—MY views on signalling have been clearly set forth in previous letters, and I have no reason to add to, nor detract from, the opinions already expressed, and I would not again occupy your space on this subject if it were not that G. L. Watkinson, page 172, has made statements, relating to myself, which are directly untrue, and therefore, require a reply.

This correspondent says that I "avoid giving a reply, direct, to 'Libra.'" This is not the fact. I have always, during the past seventeen years, given, and been pleased to give, a "direct reply" to any mechanical question that has been addressed to me in your columns.

Your correspondent publishes a letter from an engine-driver with reference to a very slight accident near Leicester, and he says that the letter is a reply to "a report by Mr. Stretton." Now, the fact is, *I made no report whatever upon the subject.* I was engaged at the Society's London Office at the time, and did not know of the account until I saw it mentioned in the newspapers. So much for the statements contained in the first part of the letter. Now to refer to the second portion. G. L. Watkinson says that I was "fully aware of his address" before I asked for it in your columns. *An* address was certainly forwarded to my solicitors, and to the editor of the *Railway Review*; but as I mentioned in my letter, page 134, it was proved to be not the *true address*, and it was further proved that the name of the writer was not "G. L. Watkinson."

The following Editorial note appears in the *Railway Review*:—

To G. L. Watkinson.—"We addressed a very important communication to you, which has been returned to us. Since then we have endeavoured to find you at the address you gave, but found you were not known there. We are therefore driven to the conclusion that you have been hoaxing us.—Ed. *R. R.*"

I do not object in the least to writers upon scientific matters adopting assumed names; but there is a limit to everything, and when *one* person under, at least, five names and false addresses, continues to write with apparently no other object than to damage the reputation of another correspondent; the limit has, I think, been reached, if not actually passed.

Clement E. Stretton.
Consulting Engineer Amalgamated Society of Railway Servants.
306, City-road, London, E.C., Oct. 22.

BELLADONNA AND SCARLET FEVER

[26426.]—"XAVIER" writes no doubt with good intention, but I trust no one will be induced to rely upon the drug named if placed in similar circumstances. Is it quite certain that the child has had scarlet fever, or even that the others have not got it also? Some children have the disease so mildly that it is not recognised.

Kensingtonian.

[26427.]—"XAVIER" makes an assertion about scarlet fever and its prevention by belladonna which practice does not confirm. If he will consult any book on medicine or therapeutics, he will there find evidence that it has been tried and found not to prevent it. "Xavier" makes the same mistake as many persons do, that because they did not take scarlet fever, therefore it was in consequence of the belladonna. He no doubt forgets the fact that all children are not bound to take scarlet fever because one in the house has it. Belladonna no more prevents scarlet fever than vaccination prevents smallpox. Vaccination does not prevent smallpox, as anyone may see who will go statistically into the subject.

If parents of families want to prevent scarlet fever or other fevers, they must allow as much pure air as possible in their rooms and keep their children apart from those who have it.

The cure of measles and scarlet fever is very simple. These are the rules I treat all my cases on, and my death-rate is almost *nil*, and no ill results afterwards. I first insist on pure air; the bedroom window must be open an inch or two. In autumn or winter a fire should be kept alight. The window must be kept open night and day.

Next allow your little patients as much cold water as they like, and do not force them to drink milk or other fluids if they do not ask for them. For food they may have thin soup, gruel, milk, puddings, bread and milk, and fruit. But the most important part of the treatment is two warm baths a day—one night and one morning—at a temperature of 90° to 95° Fahr. No drugs or medicinal treatment is required. I need not remark that the use of carbolic acid, chloride of lime, &c., is injurious and useless. Condy exposed in saucers is the simplest and best. I rely on disinfection from the air that enters at the window. To destroy any germs or infection in the excreta, bed and body linen, they should be exposed to heat. Hot water is the simplest. If the linen be put in boiling water there is very little fear of infection afterwards. If parents will cut these lines out, and carry out the treatment when their children have either of these complaints, they will never rue it. I have tried drug and hygienic treatment in a great number of cases, and my experience tells me never to use drugs any more.

T. R. Allinson, L.R.C.P.,
Author of a "System of Hygienic Medicine," &c.
29, Charlotte-street, Portland-place, W.

HORSE-POWER AND MEAN-PRESSURE DIAGRAM.

[26428.]—You are to be congratulated on the excellent way in which my diagram on p. 175 has been reproduced. There is only one error that I have detected, which was in the original drawing. Please call attention to the fact that the 200lb. line is very slightly too high. The sloping lines should cut the line of ·9 cut-off at equal intervals: it will be found that the interval between 190lb. and 200lb. is nearly 1lb. longer than the others. I would suggest that your readers may rule a red line for themselves just below the 200lb. one, which would put this right.

If they also rule a vertical one to the right of the diagram, and at a distance equal to one of the small divisions on the pressure scale from the ·9 cut-off line, it will give the H.P. and pressure if steam is carried throughout the stroke. It will just *touch* the 2's in the 20 and 200 respectively. Of course the sloping lines must be carried up to it, and if correctly drawn they will cut it into lengths *exactly equal* to those on the scale of pressures. The length of the H.P. scale is a little too great. The distance from 0 to 6 H.P. on this scale measures 199lb. on the pressure scale—it should measure 198lb. **C. H. Wingfield.**

[26429.]—In your issue of the 22nd inst. you illustrate a diagram with description by Mr. C. H. Wingfield, A.M.I.C.E., of which he says he reserves all rights.

What does this reserving of rights mean, as I have had a similar diagram for the same purpose in my possession since 1884, and I do not see how Mr. W. can claim the right to reserve that which is not his property?

I may say that I have many other similar diagrams for various purposes, and in the one I use for mean pressure I do not require a loose scale to read off the results; it is combined with the same.

A Twelve Years' Subscriber.

SIMPLE SCREW-CUTTING APPARATUS.

[26430.]—Amateurs generally experience great difficulty in chasing screws in wood or ivory with the ordinary tools.

The following easy plan is suggested as applicable to all lathes, and to every kind of material. The apparatus consists of two parts only:—

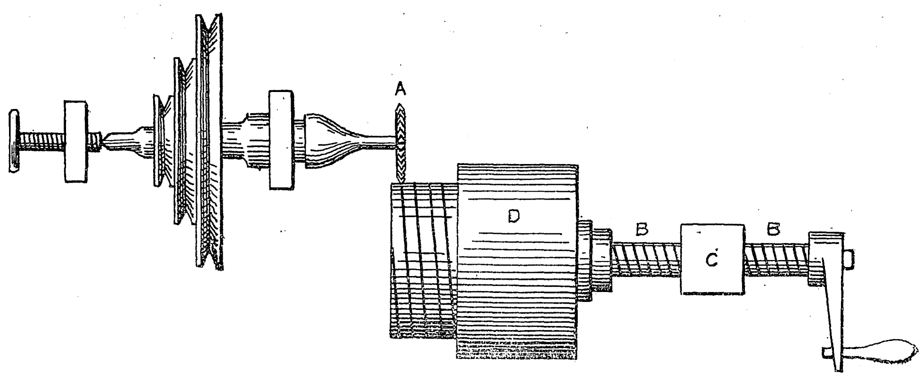
1. A circular cutter, shaped to form a V-groove, and carried on a short arm or spindle, having a socket or chuck to fit the nose of the mandrel.

2. A guide-screw, 3in. or 4in. in length, working in a nut or head held either in the tool-holder of a slide-rest, or in the socket of the hand-rest, or by an arm of its own fitted to the lathe-bed. But, in any case it must be adjustable so as to be truly level, and truly parallel to the axis of the lathe-centres.

This guide-screw has on one of its ends (to the left of the operator) a shoulder, with a screwed nose similar to that of the mandrel, so that any chuck which fits the one may fit the other. The other end is squared to carry a milled head or small winch-handle like those of the slide-rest.

The apparatus will act thus:—After turning up the object (say, a box), transfer it from the mandrel to the guide-screw. Screw the circular cutter to the mandrel. Adjust the slide-rest, or the hand-rest socket, or the arm carrying the guide-screw (as the case may be), so that the revolving cutter may make a notch on the wood or other material of the box. Then, on turning the guide-screw by its milled head or handle; this notch will be prolonged or continued as a spiral groove forming a true screw-thread around the work, of the same pitch as that of the guide-screw.

The internal screw of the lid will be similarly formed by the same cutter with equal facility.



A. The circular cutter on the lathe mandrel. B. The guide-screw, working in the nut C, carried in the slide-rest or some other tool-holder. D. The box or other work on which a screw-thread is to be cut.

The box and lid may afterwards be replaced on the mandrel, and the screws re-touched, if necessary, with the chasing tools, or otherwise finished and adapted.

There will be as many guide-screws as may be required; few amateurs will find more than three necessary. A very small cutter or two may also be requisite.

The following advantages are claimed for the above:—

1. Since the cutter may revolve with any degree of rapidity, while the motion of the work may be extremely slow, screw-threads may be wrought in materials of the most varied kind, from soft wood even to glass or porcelain.

2. By using suitable cutters, square threads, and other forms of screws, hitherto very difficult of execution in wood or soft material, may be produced.

3. As the mandrel carries the tool, while the work is independently supported, a screw may be cut upon work much larger than the lathe itself will admit.

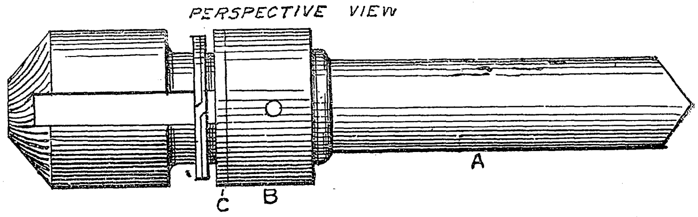
4. The whole apparatus may be constructed as a separate machine or "tool," quite independent of the lathe, with a hand-wheel to drive the cutter, and held in a bench-vice like the little lathe of the clock-maker.

5. Workmen may contrive it even for cheap wooden lathes. **W. E. D.**

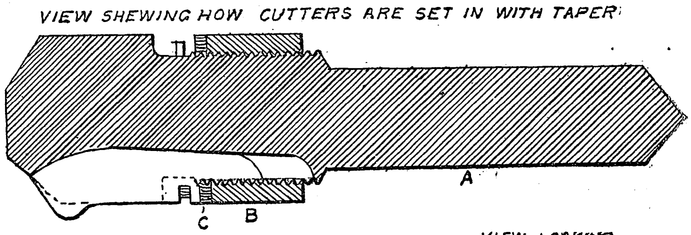
GILLIE'S EXPANDING DRILL OR WIDENER.

[26431.]—I send you drawing of my "Patent Expanding Drill," or "Rose Bit" or "Widener," which consists of a main screw spindle, A, which may be flat, round, or otherwise, with two or more wedge-shaped slots or grooves at the point, into which tools or cutters, D, may be inserted. The tools or cutters to be wedge-shaped so as to fit the

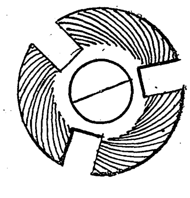
PERSPECTIVE VIEW

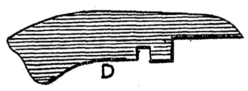


VIEW SHEWING HOW CUTTERS ARE SET IN WITH TAPER



VIEW LOOKING FROM POINT





VIEW OF CUTTER

grooves in point of main spindle A, and can be adjusted with a nut, or nut and washer, B and C, said nut, or nut and washer, to fit or come in contact with shoulders at the back of the cutting edge of tools or cutters, D, where, by screwing the nut backwards or forwards, you can adjust the cutters inserted in the grooves to make a large or small hole as may be required. E is a split spring ring so fitted into notch of cutters as to keep them from falling out of their places in main spindle.

David Gillies.

Bonnybridge, Stirlingshire.

BODIES FALLING FROM A TRAIN IN MOTION.

[26432.]—Many, treating this question, deal with it as though the body falling were of a nature to remain exactly where it fell; but an irregular-shaped object, such as a pistol, could scarcely be dropped even in a room from three or four feet high, and made to occupy the same position twice over.

I took up a key and allowed it to fall several times on the floor, but although I tried to drop it each time in a similar position, its movements were very different, sometimes remaining nearly where it fell, and again making very erratic movements, though allowed to fall each time as perpendicularly as possible, with the ring end down. When dropped at an angle the movement is different; and I advise anyone writing on this subject to try this simple experiment.

D. A.

[26433.]—A number of letters have appeared in your columns with reference to the falling of a pistol; but I fear, so far, nothing has been brought forward to clear up the railway mystery.

Your correspondents refer to "bodies let fall *in vacuo*"; but I must point out that the question before us is a pistol let fall from the window of a carriage in a train running at perhaps full speed upon a rough night.

I maintain that the moment any article is thrown from a train it ceases to be acted upon by the engine; consequently its velocity decreases, and as the train moves forward the pistol would fall on the footboard *behind* the window from which it fell. The sole question is reduced to this: When anything is thrown from a train, does it continue to travel at the same speed as the train, or does its speed decrease? Now, if its speed does not de-

crease, why does it not travel by the side of the train to its destination?

I am obliged to "Glatton" (page 173) for his reference to some "elementary book on mechanics"; but it is hardly necessary, as the subject is one upon which I passed an examination when a premium pupil to a civil engineer twenty years ago.

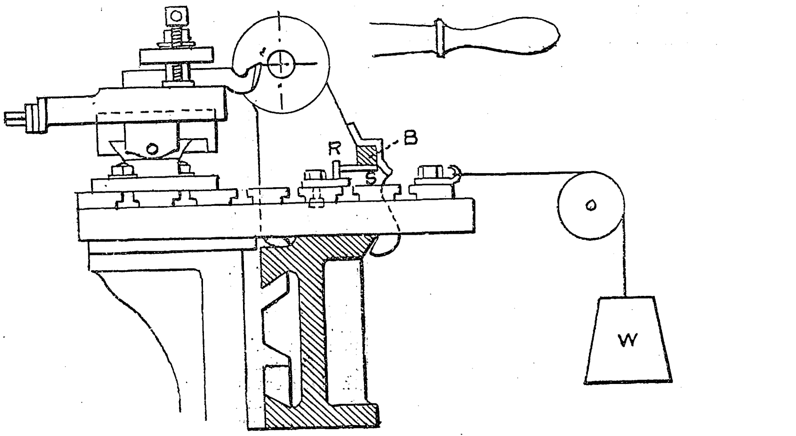
Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.

Leicester, Oct. 23.

TURNING WITH SHAPER-PLATES.

[26434.]—THE inclosed tracing of the end view of the vertical slide on page 121 shows another important advantage of the arrangement—namely, the ease with which shaper-plates can be used for turning irregular shapes, such as handles of levers (Fig. 2), and such like forms, which are required in duplicate. In Fig. 1 the long traverse screw is supposed to be removed; it is arranged so as to take out easily: a bar B is slipped into position, and firmly fixed to the headstocks, as shown: under this bar may be fixed shaper-plates, of which one

FIG. 1. FIG. 2.



is seen at S, and a small hard steel rubber R is screwed to the long slide and drawn up by the weight W. Now, as the lead-screw in the bed draws the saddle along, the rubber R, and therefore the rest and tool, will follow the curve of the shaper-plate. The two slides of the upper rest now become necessary, and the top slide is just the thing to give the feed. **F. A. M.**

HOW A BOY MAY RAISE A SOLID TON WEIGHT WITHOUT MACHINERY.

[26435.]—LET a cast-iron sinker, with a ring attached, altogether weighing a ton, be lying at the bottom of the hold of a large ship, say 20ft. deep.

Let a boy be provided with ropes 25ft. long, having an aggregate of 400 or 500 yarns. One end of the ropes to be made fast to the ring of the sinker, the other ends to be kept on deck. The ropes above the ring must be unlaid into yarns; a nail must be driven into the combings of the hold of the ship, or into the deck very near them.

One of the yarns to be pulled upwards with a strain say of 10lb., and made fast to the nail; another and another yarn to be treated in like manner, and made fast to other nails, then it will be found when 224 yarns have been so stretched, each taking a strain of 10lb., the weight will be suspended, so as to scarcely touch the bottom of the ship's hold. By continuing the process of pulling up a further number, say 224 yarns, the weight will be lifted probably an inch. The first and all other yarns in rotation, will now be partially released from their strain, and may therefore be shortened, by using the same force of 10lb., until the weight rises to the height desired.

The writer has demonstrated the above process upon a small scale. **B. R.**

THEORY OF SAILS.

[26436.]—I SHOULD like to draw the attention of those interested in the above subject to one or two points connected therewith, and that seem to have escaped Dixon Kemp and other writers.

The cause usually assigned for the increased weatherliness of a boat when heeled, and for its tendency to luff up when the heel is suddenly increased, is the superior ardency of the pressure on the lee bow. This is no doubt one factor, and in bluff-bowed or beamy boats a large one; but there are others equally, if not more, important.

The position of the centre of effort of sails appears to be uniformly found on the plan, and to be shown only in that view; no allowance is made by calculation—though actually made, as a rule, from the results of experience—for the couple, or lever, tending to turn the boat's head into the wind that is formed when the sheets are slacked, or the sails pressed over to the lee side. The horizontal plan should be taken into account, as well as the vertical one, in calculating the place for centre of lateral resistance, or of mast, &c. Also, some allowance should be made for, or an average should be taken of, the leewardness due to heeling. A vertical plan athwartships shows that at large angles of heel the centre of effort is away over the lee side, while the centre of forward resistance is very little to the lee of centre of boat.

Vulcan.

A NEW (?) METHOD OF DESCRIBING AN ELLIPSE.

[26437.]—THE day before reading your correspondent's letter in your last issue I chanced to turn over some old mathematical works of my father's, and in an Appendix to Mensuration published as a separate volume by the Commissioners of National Education in Ireland in 1857 I found the same method illustrated by a diagram essentially identical with that of your correspondent. We should be careful in receiving anything as new pertaining to mathematics of such an elementary character. **J. F. Wilkinson, B.A.**

SAFETY-LAMPS.

[26438.]—AT a meeting of the Chesterfield and Midland Counties Institution of Engineers, held at the University College, Nottingham, on Oct. 9, Mr. Clifford stated that he had seen the "Morgan" lamp exploded; it has no "shut off," which, in the opinion of many present, was a drawback to the "Morgan." Mr. Schanschieff has invented a miner's electric safety-lamp, to give 1½ candle-power for 14 hours; but it is heavier than the ordinary safety-lamp. He is working to reduce the weight. **G. E. Smith.**

PLATELAYERS.

[26439.]—AS your correspondent remarks—sufficient thought is not given by those who ride comfortably and smoothly over a mile of road in less than a minute, of the constant attention required to preserve the number of bolts, spikes, keys, trenails, &c., passed over in that short period of time in a condition to withstand the strains imposed upon them, to say nothing of the necessity of preserving the alignment, level, super-elevation of outer rails in curves, &c.

For the information of "E. M." and others, you will perhaps allow me to explain that no portion of the platelayer's work is done in the night except on some portions of the metropolitan lines, and if anyone looks at the beautiful line and level of a well-kept road, it will be apparent to them that daylight is required for this work.

The responsibility of supervising the repairs and renewals of permanent-way rest chiefly on an official who is termed the Permanent-way Inspector, and who requires years of special training to thoroughly fit him for that important position. The district for which he is held responsible will vary according to the opinions of the Engineer, the traffic, and assistance allowed him in the way of clerks, sub-inspectors, &c., and also as to how far his duties extend. On some lines he will have to take charge of not only the permanent way, which usually includes bridges, tunnels, platforms, &c., but also signals, station building, cranes, rental property, &c., while on other lines these matters are attended to by special inspectors. The districts, therefore, vary from 6 to 60 miles, but an average district will be about 25 miles, unless there are sub-inspectors, when it will generally be longer. Each inspector's district is divided into lengths, which vary according to circumstances, and on each of these lengths a foreman or ganger and a certain number of men are employed to keep the line in repair. The foreman or ganger is required by his rules to walk over his length twice each day and examine the fastenings, &c., marking and repairing as may be required.

The inspector or sub-inspector is also required to walk over every portion of his district at least once a week, and direct the ganger's operations, and also make a report to his engineer of the state of the line. Changing rails, as mentioned by your correspondent, is not a difficult or unusual operation, and in the days of iron rails on busy lines used to take up a deal of the repairer's time; but steel rails have done away with a deal of this kind of work.

Not only can rails be changed between the running of the trains, but the road is entirely relaid without working nights, as suggested, when there are as many as 80 or 100 trains passing over it during the twelve working hours.

Platelayer.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[59840.]—**Painting on Silk.**—I am sorry I did not notice this query until the other day. Dissolve white gum-arabic in water, about the thickness of the gum-water sold in shops; add an equal bulk of honey; mix well together, and paint over your subject with this; when dry, colour. Should the preparation crack off when dry, it requires more honey; should it be very long in drying, more gum water. It is easy to try if right on a bit of spare silk.—AN ARTIST.

[60255.]—**Hydrostatic Pressure.**—In reply to 'J. S. C.' I send a sketch of the working of this problem. It is an interesting application of the Integral Calculus. Retaining the same notation as at page 91 (Sept. 24th), the cylinder of known

FIG. 1.

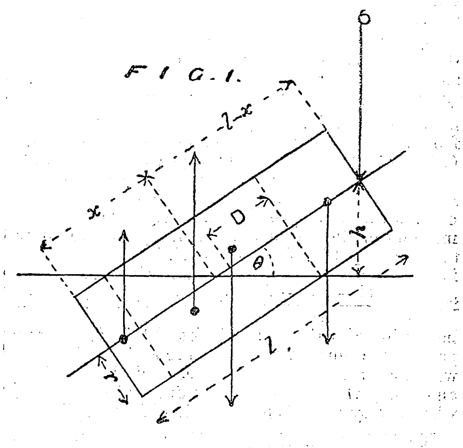
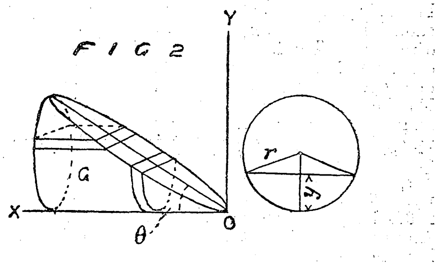


FIG. 2



length and radius, and of given specific gravity s is suspended by a string attached to the middle of its upper end, the lower end being submerged in water: required to find the length (measuring along axis) of submerged portion with given height h of upper end above the surface of the water. The result is more simply expressed by finding the length of the portion of axis above water, or $l - x$, it is $(l-x)^2 = \frac{4h^2 l^2 (1-s) - r^2 h^2}{4h^2 + r^2}$. If we require the length of $l - x$ when the cylinder begins to take a sloping position, $l - x$ will then be equal to h; hence, substituting in above expression, we get $h^2 = l^2 (1-s) - \frac{r^2}{2}$. If r be small compared to l, the last term may be omitted, and the result will agree with that on page 91. The working is as follows:—Divide the cylinder as shown by dotted lines at right angles to its axis; this gives two small cylinders, one at each end (the centres of

gravity of which will, of course, be in the middle points of their axes), and also two equal half cylinders of shape shown in perspective in Fig. 2, the water surface forming the dividing plane; we have therefore to find the position of the centre of gravity of a body of this shape. Referring to Fig. 2, let O be origin of co-ordinates, axes of x and y as shown (this x has nothing to do with the x in the main problem). Now suppose a thin vertical slice of thickness dx to be taken at any distance x along the axis. The shape of this will be a segment of the circle of radius r, and height of segment y, the area of which is—

$$r^2 \cos.^{-1} \frac{r-y}{r} - (r-y)\sqrt{2ry - y^2}.$$

If this is multiplied by its thickness dx, we get the solid contents of the segment, and in order to gets its moment round O, we must multiply by the arm x, now $x = y\ .\cot.\theta$, and $\frac{dx}{dy} = \cot.\theta$; therefore, $x\ .\ dx = y\cot.^2\theta\, dy$, which is to be multiplied by the expression for the area. Now, suppose y to vary from O to $2r$ (the full height), we get a succession of moments of all the vertical sections, and the sum of them all will be represented by

$$\cot.^2\theta \int_0^{2r} \left\{ r^2 y \cos.^{-1}\frac{r-y}{r} - y\,(r-y)\sqrt{2ry - y^2} \right\} dy$$

Now, suppose z to be the horizontal distance of centre of gravity from O, this multiplied by the contents of the whole figure must be equal to the above expression as the moment of the whole at the distance of the c.g. from O must be the same as the sum of the moments of its parts round the same point; therefore the above expression is to be equated to $\pi r^3 \theta z$, from which we have to find z. This looks very formidable, but these definite integrals generally come out very neat expressions. The expression can be divided into three terms, each of which is to be integrated separately. The first term, when integrated between the limits O and $2r$, is $\frac{5}{4}\pi r^4$; the second term is $\frac{1}{2}\pi r^4$; the third $\frac{5}{8}\pi r^4$. The integral, therefore, reduces to $\cot.^2\theta[\frac{5}{4} - (\frac{1}{2} - \frac{5}{8})]\ \pi r^4 = \frac{11}{8}\ \pi r^4 \cot.^2\theta$, which, equated to $\pi r^3 \cot.\theta\ .\ z$, gives

$$z = \tfrac{11}{8} r \cot.\theta.$$

Some help in integrating will be found in Todhunter's "Int. Cal." pp. 20 and 50. In the same way, by taking a horizontal slice of the same body, the vertical ordinate of the $c\ g$ will be found to be $\frac{3r}{4}$, showing that it is independent of θ. It will be more convenient to give the length of ordinate from the large end so as to get the length of D (Fig. 1). This will give $D = \frac{5}{8}r\cot.\theta + \frac{1}{4}r\tan.\theta$, the last term being the distance of c.g. from axis multiplied by the tangent of θ, which gives position on axis where the vertical from c.g. acts. The remainder of the problem is ordinary algebra, as in the case at p. 91. When the work is well advanced, it will be found necessary to substitute for $\cos.^2\theta$, its value $\frac{(l-x)^2 - h^2}{h^2}$, when the result near the beginning of this reply will be obtained. If any part of the lower flat end of the cylinder is above water, a more complicated process will be required, and hence the result now obtained will not apply when the cylinder is horizontal.—M.I.C.E., Bath.

[60275.]—**New Banjo.**—Many thanks to "Sam Koe" for taking up my query; but I had the two brass rings made before your answer came, or I should have been very proud to have gone by your directions. The inside ring is thick brass 11in. in diameter, 2in. deep, with a quarter of an inch of one edge turned up, with bits cut out for the bolts. The bolts and nuts will be inside of the outside ring. There are no brackets; the nuts will work up against the ½in. edge that is turned up on the outside ring. The outside ring is thin brass 3½in. deep, made to fit around the edge—that is, turned up. The staff goes through the outside ring and is 3ft. long. I hope these few lines will explain. Any further information will greatly oblige, as I have not got it made as yet.—J. S. S.

[60306.]—**Photographic Engraving.**—Am much obliged to Mr. Saml. Ray for his notice of my query. I here give full details of the above process:—To the copper plate is applied a coating (very thin) of the following preparation: Gelatine is dissolved in water, and a saturated solution of bichromate of potash in water added; when dry, the plate thus prepared is exposed in a printing frame, and beneath the transparency to be reproduced. The time of exposure is not stated; the plate is now ready for the etching bath. The etching mordant is thus prepared: Muriatic acid is saturated with peroxide of iron (dissolved by heat). This solution is strained, considerably evaporated, and finally bottled; it solidifies into a semi-crystalline mass. Its properties Mr. Talbot supposes to be the same as those of perchloride of iron. For etching, three bottles are required—1. A saturated solution in water of this supposed perchloride of iron. 2. Five or six parts of the saturated solution and one of water. 3. Equal parts both of water and solution. The greater the proportion of water, the more easily is the gelatine softened and the quicker the acid bites. The process was invented by Mr. Henry Fox Talbot, and is described at length, and two very beautiful specimen prints given in "A History and Handbook of Photography," from the French of Gaston Tissandier, edited by Mr. John Thomson, F.R.A.S., second edition, 1878 (Sampson Low and Co.). The book states further, as matter of surprise, that the process has been but little used. Can it be from any defect in the process itself? And, if so, may my failure be thus accounted for? Shall be glad to hear again from Mr. Ray.—C. B. Roper.

[60316.]—**Electric Time Ball.**—Get or make an electro-motor, e.g., the one of which I gave a diagram in "E.M.," Oct. 1st, only double all dimensions, and put two more layers of wire on the field-magnets. It will also be very much better if you get all the parts made of wrought iron. The armature must also be different, and should be a ring-armature, with, say, eight segments, or coils; but the more the better. There should be four layers of No. 16 in each coil, so you would have to get an iron ring for core of proportionate size. The four layers would be not much more than ¼in. thick. The battery-circuit must pass up the post of the time ball and be connected at top by a mercury-contact catch (See drawings) lifting freely on

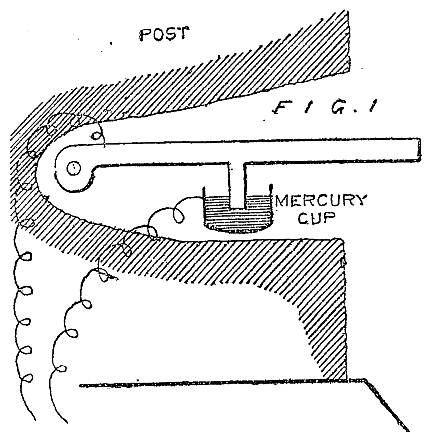


FIG. 1

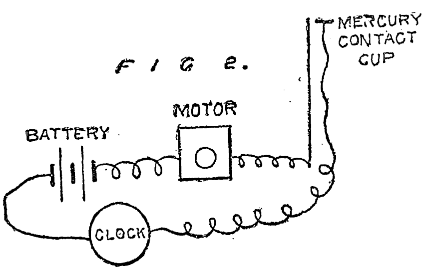


FIG. 2.

a pin, and at such a height that when the ball is at top of pole, and is caught by the brass catch I mentioned before, the top of the ball will just lift the mercury-contact out of the mercury, and so break the circuit. You must also have in the circuit a clock with a pin arranged so as to make contact with hour hand for an instant just before each hour, so that by this contact you can work a "relay" in the motor-circuit; that is a sort of electric-bell arrangement that will keep the motor-circuit open or broken, but will close it by the action of an electro-magnet worked by the clock contact. I will send you a more detailed drawing next week. Am sorry I could not write with what you wanted before; but have been very busy.—E. Conry.

[60334.]—**Falling Bodies.**—All that "E. L. G." says in current English Mechanic, p. 176, is quite right, except that he thinks that his last statement is inconsistent with something that I have said; which is not the case. Every ellipse, no matter what its ellipticity, from zero to infinity, and no matter what its magnitude, described by a body round a centre of force, the force varying directly as the distance, will be described in the same time. By the way, this is a very fortunate circumstance for the violinists. The middle point of a violin string is subject to a force having the above law; if it were not for this, Paganini himself would not have been able to play in tune.—Dubliniensis.

[60334.]—**Falling Bodies.**—The debaters of this problem have got considerably astray, I fear. I have been looking at Tait and Steele's "Dynamics"; but did not find the problem solved, as I hoped, and have not any work containing it by me. The path of a body through a non-resisting earth may approximate to an ellipse—a paraboloid is more probable, I think—but its orbit would certainly have no such minor axis as "Dubliniensis" and "E. L. G." suppose. The attracting force is directed to a centre and not to a plane, and in the latter case alone would the minor axis measure the same distance as the body would have gone if unattracted. Though the centripetal force at c.g. of earth would be 0, it would be 1 at initial end of orbit, and would never cease to pull centrewards and reduce length of axes. To calculate the orbit requires a knowledge of the calculi I do not possess; but I believe that, according to mathematics, the body would not reappear at opposite side of earth, nor would the minor axis pass through such centre. Will some one more advanced solve the problem mathematically, say "F.R.A.S."?—Vulcan.

[60334.]—**Falling Bodies.**—I did not say that it was of no use prolonging this discussion on account of the great discrepancies of the results, but that some of the assumptions made were not true. At the same time, I feel quite justified in expressing a perfectly natural surprise that one quantity (the length of the axis minor) should be variously estimated at 95ft. and 520 miles. It was assumed, I think, that the earth is of uniform density; but if this were the case, the force of gravity should decrease gradually towards the centre of the earth. As a matter of fact, however, the force of gravity at a depth of a mile is, far from being diminished, actually increased, so that a seconds pendulum at the mouth of a deep mine may gain several seconds a day on a similar pendulum at the bottom of the shaft. I may inform M. York that a body is certainly *not* retarded by that portion of the earth's crust behind it, for Newton has shown that the body is attracted equally in all directions by the spherical shell external to it, the influence of which may be, therefore, neglected. The body is then subject only to the pull of the internal sphere, exactly as though the extetnal shell did not exist. Now, as a pendulum at the bottom of a deep mine is acted on more forcibly than one at the surface, it follows that the earth is not homogeneous, and the motion of a body falling through the earth will be alternately accelerated and retarded as it passes through strata of greater and less densities respectively. In short, we know next to nothing about the interior of the earth, and that being the case, how can we presume to calculate the motion of a body, when we are absolutely ignorant as to the nature and magnitude of the forces acting upon it? Might I also suggest in a friendly spirit that some correspondents should make sure that their "corrections" are well founded before they venture to correct others?—R. E. F.

[60352.]—**Fire Engine.**—To Sam Koe.—The pattern I want is single vertical piston; two rods with cross-head, connecting rod and crank, working between flywheel close up to boiler pump down, by engineer's foot-plate. They all appear about the same size. I think the Holborn station had one of this description. I forgot in query to add diameter of hose unions. If you can oblige me I should be very thankful.—J. W.

[60369.]—**δ Cygni, &c.**—As Mr. Atkinson seems to query the accuracy of the data for this star given in the "Star Guide," perhaps I may be permitted to supplement the very full reply of "F.R.A.S.," on page 171, by stating that the position angle and distance of this star *were* roughly computed for 1886·5, as Mr. Atkinson supposes. He will have doubtless seen that there was a "screw loose" in the observation of the "practised double-star observer," whose results, by the way, as published in the *Observatory*, differ in the most remarkable manner from those communicated to the English Mechanic. I have not seen many of Dr. Copeland's measures; those few of Mr. Tarrant's which I have seen are very good indeed. I have a note on the orbit of 70 Ophiuchi in the English Mechanic for July 10th, 1885 (letter 24441, page 410). Perrotin's measures of this star last year were 26·02° : 2·077″ (4^n), 1885·502. Prof. Pritchard's (Mr. Plummer's?) elements give, for the same epoch, 44·6° : 2·64″; Herr Schur's gives 53·3° : 2·69″; M. Tisserand's, 49·0° : 2·50″. The data in the "Star Guide" (20·5° : 2·05″) were computed for 1886·5 by applying certain corrections to Schur's elements. It would seem that 17° and 2·00″ would have been more accurate; but none of the positions calculated from the above orbits for 1886·5 would have been less than 18° and 0·5″ in error. It may be as well to remark here that the large proper motions assigned by myself to a star near 70 Ophiuchi are erroneous. Prof. Asaph Hall has very kindly measured this star for me with the 26in. at Washington, and from three evenings' observations in last July he finds, for the star in question, 200·41° : 62·507″, measured from A of 70, so that there must be some very curious error in Secchi's result. For δ Herculis Engelmann gives 185·0° : 16·94″ ($6\text{-}5^n$) : 1883·29, and, therefore, the values on p. 15 of the little

FIG. 1.

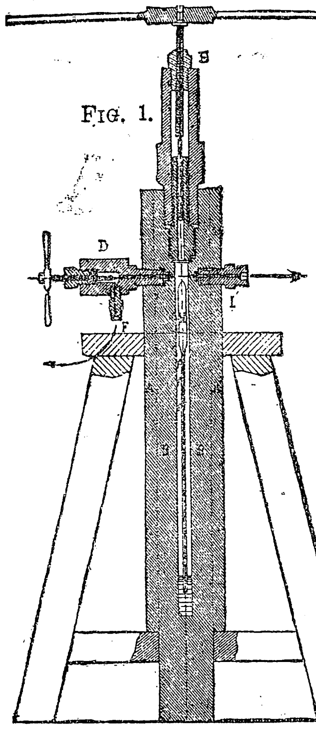
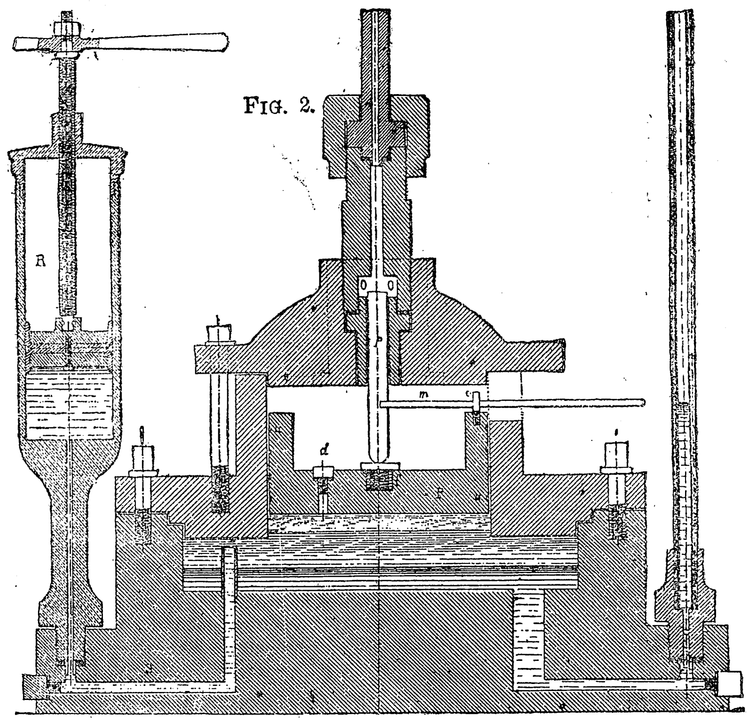


FIG. 2.



work published by Mr. Clark and myself would seem in this case to be correct enough, as also in that of ξ Scorpionis, for the close pair of which Perrotin found in 1884·53, 195·1° : 1·273″, C being at 66·8° : 7·35″ in 1883·52. The same observer could only see a very slight elongation in Σ 2525 (Cygni 22) in 1883, with a power of 1,000 on the 15in. refractor at Nice. Sir W. Herschel estimated the distance of 46 Draconis at 3½′ in 1780. The only measures I know of are those of Sir Robert Ball. The Astronomer Royal for Ireland found 160·5° for the angle, and 146·9″ for the distance of the wide, but pretty, pair in 1880. As "F.R.A.S." remarks, Secchi does not give the positions in Cygnus of the remarkable configurations he writes about in No. 975 of the *Astronomische Nachrichten* for 1855. Some of MM. Henry's photographs of the Milky Way in Cygnus, however, exhibit the wreathing and spiral structure Secchi speaks of in a very marked manner.—H. SADLER.

[60371.]—**High-Pressure Gauges (U.Q.)**—The following description of M. Amagat's apparatus for measuring the compressibility of gases at a high pressure will probably supply the information asked for:—The compressing apparatus consists of a cast-steel cylinder, B B, surrounded by a strong jacket, A A, which extends a little below the central bar of the cylinder. This central chamber contains a piezometer or a pressure gauge, inclosing the gas or liquid to be studied. In Fig. 1, a piezometer, H H, for liquids is shown. Pressure is exerted by means of a force pump, which injects glycerine through the tube, E, of a screw plug, D. When, according to circumstances, a pressure of 200, 300, or 600 atmospheres has been reached, the orifice of the screw plug is closed, and the pressure is continued by revolving the central screw, E, by means of a long lever. It is easy to see how this screw drives before it a steel cylinder adjusted with slight friction, which in turn, but without revolving, drives before it a leather capsule. The piezometer, H, containing the liquid to be tested, dips into mercury, which rises in the tube, since the volume of the liquid diminishes through the effect of the pressure. This tube is provided with several platinum wires, which are connected with each other by an insulated conductor, that establishes a resistance of 2 ohms between each of them. On a level with the screw plug D, the cylinder is provided with an insulating ring, through which the conductor makes its exit from the cylinder, to run to a properly arranged electric apparatus (two rheostats, a differential galvanometer, or other device), and then return and come into contact with the metal of the apparatus and the mercury. Owing to this arrangement, it is possible to ascertain the exact moment that the mercury touches each of the platinum wires, and to thus obtain the measurement of the volume of the liquid or gas. The pressure gauge shown in Fig. 2 is a changed and improved Desgoffe apparatus. It communicates with the compressing apparatus through a thimble, I, and a solid steel tube 10ft. in length. This pressure-gauge is provided with differential pistons, which are entirely free, and have no leather packing, and which are adjusted so as to move with slight friction. The smaller one, *p*, which supports high pressures, is rendered tight by an ingenious artifice—that is, by carefully lubricating it and pouring in molasses at *o*. In this way the piston, while preserving its mobility, is rendered absolutely tight. As for the large piston, P, which is provided with channels to facilitate lubrication, this is rendered tight without interfering with its mobility by causing it to rest upon a stratum of castor-oil floating upon a mixture of water and glycerine resting upon mercury. It should be remarked that this piston supports pressures of but a few atmospheres only—say, the height of the column of mercury in the tube, T. The rod, *m*, introduced between two pins, *c*, serves to give the two pistons a simultaneous rotary motion. Such a manœuvre is indispensable in order to give the pressure gauge perfect sensitiveness by annulling the feeble resistance that might be produced by imperfectly destroyed minimum frictions through a tangential motion. M. Amagat has found that the indications of this instrument leave nothing to be desired. To this effect he has verified it by comparison with a free column of mercury and with pressure gauges for nitrogen gas, the law of compressibility of which he has directly determined up to 430 atmospheres. It remains to be said that the pump R (seen at the left of Fig. 2) serves to regulate the quantity of liquid necessary to keep the large piston within the desired limits of its stroke. This latter should be short enough to prevent too great a lengthening of that of the small piston which supports all the stress. At *f* is seen a steel bolt, against the head of which abuts a plunger, *p*, and at *d* an orifice which is usually closed by a screw, and which is designed to allow the air to escape while the piston is rising. It is of interest to add that the piston, *p*, can be removed at will, and be replaced by duplicate pieces of various diameters. In the apparatus shown herewith the ratio of the surfaces is such that the mercury rises 6½ft. at T at a pressure of 1,500 atmospheres. As the column of mercury in M. Amagat's laboratory is not less that 16ft. in height, it has been found possible to exceed the enormous pressure of 3,000 atmospheres there, while no inequality could be detected in the operation of the apparatus.—E. R. J.

[60385.]—**Work on Carpentry and Joinery.**—"Nemo" apparently wants a work specially written for his benefit. If Tredgold's "Carpentry," Aveling's "Carpentry and Joinery," Holly's "Carpenter and Joiner's Handbook," "Carpentry and Joinery for Amateurs," and the many excellent articles published in your columns, will not satisfy his wants, he had better take some lessons from a professional. Any bookseller will supply the works above named, or "Nemo" can write to Lockwood and Co., Trübner, and Gill, for their catalogues, or procure Mr. Calvert's list from Gt. Jackson-street, Manchester.—SAML. RAY.

[60390.]—**Carving.**—Mr. T. Wood should really say what it is he wishes to know. There have been some excellent articles on wood-carving in back volumes, and if the information is "too meagre," perhaps if Mr. Wood asked a specific question he would obtain a suitable answer. Perhaps the "Instructions in Wood-Carving," published by Crosby Lockwood and Co. at 2s. 6d. would meet his wants.—NUN. DOR.

[60399.]—**Electrical Foot-Warmer.**—If M. Rabache has an invention so useful as he describes, why does he not patent it, or give it free to one of the railway companies?—SELIM.

[60407.]—**3in. Telescope.**—This querist will find all the instructions he needs in Vol. XXXIV., pp. 535, 607, 621, or in the previous volume.—NUN. DOR.

[60408.]—**Iron Workshop.**—There is no reason why an iron workshop and showroom should not do; but it must be well ventilated and kept warm.—O. L. P.

[60416.]—**Portable Forge.**—This query reminds me of the man who had a watch that would not go. He wanted to know what was the matter with it, but would not allow any one to look at it. Possibly if "Moorgate" gave some idea of his difficulty with the portable forge, he would get the instructions he requires.—SAML. RAY.

[60425.]—**Hard-Soldering Aluminium.**—Is not "W. S. F." asking for the impossible? At any rate, can aluminium be hard-soldered? However, see p. 156, No. 1074, and p. 523, No. 1091.—NUN. DOR.

[60426.]—**Nickel Polishing.**—"Polisher" seems to have left out the one material which is used successfully for polishing nickel—viz. Sheffield lime. The bob or buff—"dolly" it is called—is made up of many layers of unbleached calico, and the lime in powder is used with a little oil. N.B.—The lime is not thrown away. Like other polishers, it acts best when charged with fine particles of the metal. The query is headed "Nickel Polishing," but it may be nickel silver.—SAML. RAY.

[60428.]—**Silvering Glass.**—To "GLATTON."—Almost every back number contains some information truly, but not complete, considering that you quote eleven volumes since, which, I daresay, hundreds of us cannot get at. I don't think it too much for you to condescend to give us a résumé with your own experience, if any. I only require for small surfaces. Please give commercial name of chemicals.—ENQUIRER NO. 2.

[60429.]—**Electric Pen.**—I presume the querist knows that the electric pen is a patent. It is simply a small electro-motor which drives a steel point through paper, as the "pen" is traced over the sheet. The paper is then used as a stencil in the ordinary manner. Electric pens which I suppose are free from patent-rights were described in Nos. 742 and 746.—NUN. DOR.

[60431.]—**Lattice Work.**—I suppose that fine steel lattice work will answer; but it is impossible to fix the letters to nothing, and if something is employed it will surely be visible.—NUN. DOR.

[60432.]—**Architecture, &c.**—It is a principle that whenever adverse criticisms are made, any explanations on the other side should be heard in reply. In regard to the adverse criticisms referred to by "Delta," it should be mentioned that the late Mr. Street published a pamphlet giving a vigorous and warm reply to his critics, and in which he cited the *Architect*, the *Building News*, and the *Athenæum* as having published favourable notices of his designs for the New Law Courts. The editorial

articles, however, in the *Architect* were decidedly hostile to Mr. Street's design, as will be seen by perusing the number of Sept. 9th, 1871. In the list of journals mentioned by "Delta," which published criticisms in "torrents of execration" against Mr. Street's designs, there are two—the *Times* and the *Illustrated London News*—of which no account would be taken by the "professional" publications, because forsooth they are only "popular journals." It is indeed a fact that the technical journals in the building trade affect a contempt for the opinions of the public, and even for the opinions of artists other than architects to a degree that is really amusing. Pity such artists as myself, who cannot boast of having soiled our hands with brick and mortar! Are we to be frightened out of utterance at the attitude of a scarecrow labelled with the word "professional"? The aforesaid criticisms of the *Times* were reproduced in full in the next-published issue of the *Building News*. On this subject there is one matter which is deserving of notice here. We have the authority of an article in the *Architect* of Sept. 30th, 1871, for believing that "it was Mr. E. W. Pugin whose influence turned the scale in favour of Mr. Street." Those influential and favourable criticisms of Mr. Pugin (since deceased) were published in the *Times* of June 23rd, 1868, and also in previous numbers, but subsequent to that he changed his opinions in an extraordinary manner, and published in the same journal on Sept. 13th, 1871, and January 22nd, 1872, criticisms the very reverse of the former, and even calls on the representatives of the country to save themselves from "an unparalleled degradation." It would seem accordingly that the selection of Mr. Street's design was based on the indications of an *ignis fatuus*, so that the whole thing is really provocative of much laughter. With regard to the "battle of the styles," I would myself be in favour of Classic rather than Gothic for secular buildings. Whatever can be said, the Gothic always has a clerical and gloomy appearance, and I am not at all fond of clerical domination except in the proper cause. Classic architecture has a proud and manly expression of appearance as opposed to Gothic. The ultra-Gothicists go in for producing extremely moderate or "subdued" effects, and proceed to eliminate all manly features of expression from their designs until the whole has entirely an old-womanish aspect—what might be called the Mrs. Harris and Mrs. Gamp style. Mediæval Gothic architecture was entirely abandoned in practice just at the time of the Reformation, and, therefore, it can have no claim to Protestant nationality. My own idea of a grand style of architecture for large public buildings is the Classic, as distinguished from Renaissance, and this idea was advocated in the *Builder*, March 20, 1869, and in the *Times*, May 30th, 1868. As to the books to be recommended to "Upsilon," I would include "Sir William Chambers on Architecture," Viollet-le-Duc's "Dictionary of Architecture," and the works of Inigo Jones, published by Lord, Burlington, and Kent.—AN ARTIST.

[60433.]—**Manure.**—There is no work which answers to the requirements of "Severan"—probably for the simple reason that the sale to be expected for such a book would not cover the expenses of printing. He will find much useful information in the cyclopædias, and in works of analytical chemistry. There are Sibson and Voelcker's "Agricultural Chemistry," and Ville's "Artificial Manures"—the latter, 30s., I think—which may help the querist.—SAML. RAY.

[60439.]—**Petroleum Engine.**—This querist should procure the specifications of the patent. Spiel's was illustrated some time ago in one of the engineering papers.—SAML. RAY.

[60441.]—**Engraving Ivory Tablets.**—This process is just the same as engraving brass, and a set of tools can be obtained at almost any tool shop. Ebonite and celluloid are probably not engraved at all; but moulded up with the letters required. Any ivory cutter would sell suitable pieces at a comparatively cheap rate.—SAML. RAY.

[60443.]—**Japanning.**—Did "Harry" ever see a baked-potato oven in the streets of London? If so, he has an idea of a "stove" that will do for japanning. All that is wanted is a chamber which can be heated to from 250° to 300° Fahr., and, of course, the "stove" may be set in brickwork to prevent radiation of the heat. Care must be taken that the door shuts close to prevent the access of dust.—NUN. DOR.

[60484.]—**Twilight.**—The faintest stars are not reckoned of the "sixth magnitude," but at least the fourteenth; and there must be some interval between the first visibility of Ptolemy's faintest (called sixth magnitude) and that of the fourteenth in any telescope, which interval is part of the twilight. It will take a first-rate astronomer to assure me that either sixth or fourteenth ones were visible on October 17th within an hour of sunset. I have read Humboldt's South American travels, but found no mention of twilight ending before the sun must have been depressed 18°; and been in the same latitudes without finding any such. The zodiacal light always drowned the fainter stars between W.S.W. and W.N.W., up to 30° or 40° of altitude, for fully three hours after sunset; but this I do not confound with twilight. Of course, in typical English weather, that rarely allows stars to be seen, nobody can say when twilight ends. We have had London fogs that made noon darker than any night, because the public street lamps were not lit as they are by night.—E. L. G.

[60537.]—**Problem.**—The angle A D B being known, draw a circle through A B D, having its centre G. Join A G, B G, D G, and C G, then A B G will be an isosceles triangle, having angle A G B = 2 A D B. Assuming a value for A B, we may find the triangles A B G, A B C, and C B G, D C G = 180 + B C E − B C G. In triangle C D G we have C G, D G, and D C G, from which we may obtain D C, and thence A D C.—H. K.

[60540.]—**Tricycling Matters.**—I am obliged to G. Townsend for noticing my query about small *v.* large wheels, and automatic steering; but I must frankly say I do not find his suggested explanation satisfactory. It does not commend itself to my mind as at all sufficient to account for the superiority of the former, assuming it to be a fact. As to the discussion of this point in the cycling press, I regard it as absolutely valueless. Only a very small number of cyclists have any knowledge of mechanics, and of these a still smaller number possess more than a mere smattering. I find cycling literature, with very few exceptions, simply beneath contempt, especially upon mechanical details. I am glad to learn that the "stuffing-box" system for the steering wheel is superseding the so-called "automatic" system, which latter would be to me very trying indeed; the more so as it seems to involve the use of a cross-handle as a necessity. As far as my experience goes, "automatic" steering appears to be an absurdity; as you can very rarely proceed far in a straight line without encountering all the irregularities of the road, which can, by skilful and rapid deviation, be avoided—making all the difference to the comfort and enjoyment of the rider. Personally, a cross-handle steering bar I regard as an abomination, though I admit that is purely a matter of opinion. I can quite believe that one who has been used to riding a bicycle may prefer it; but I regard the spade handle as infinitely preferable, provided it can be arranged so as not to be turned aside by every trifle, and that I presume the "stuffing-box" should effect. My ideal is an arrangement with spade handles, so that either hand can be employed for steering, according to circumstances, and it would be a boon also for either hand to be effective with the brake.—GAMMA SIGMA.

[60562.]—**Current Quantity.**—Thanks for the many replies to my query. I did not expect to calibrate my instrument with any great accuracy; but if I could set up a battery, either the single-fluid bichromate or chromic-acid cell, or an accumulator, I thought I might calibrate very near. I might say that the resistance of my instrument is very little, being only a strip of copper 1in. wide and $\frac{1}{16}$in. thick. Perhaps some one might tell me about the current that is given with an accumulator of so many square inches surface exposed, with distance apart, fully charged.—C. R. W.

[60574.]—**Astronomical Photographs.**—The photographs of Mr. Common and MM. Henry cannot be obtained by purchase. The reproduction of the Pleiades by heliogravure is headed "Annales de l'Observatoire de Paris, Atlas," and possibly, therefore, "S. P. C." might be able to procure this, in the same way as Chacornac's Star Charts are sold. I believe that Browning, in the Strand, sells small copies of one of the Melbourne photographs of the moon for 2s. 6d. each. These and the lunar photographs of Mr. Rutherfurd, to which Mr. Franks refers, are, so far as I am aware, the only ones which can be obtained by purchase. Some small copies of Rutherfurd's are to be found in Proctor's "Moon."—H. SADLER.

[60600.]—**Musical Intervals.**—In my reply on p. 178, delete the word "tempered."—N. E. CHILD.

[60603.]—**Magneto-Electric Machine.**—This will form the subject of my next article on "Electrical Instrument Making for Amateurs." Will you forgive me if I ask you to wait till that appears?—S. BOTTONE.

[60604.]—**Resistance Coils.**—When the bridge is fitted up with coils, all that is needed is to place the unknown resistance in one of the gaps of the bridge, and remove the plugs which throw the different coils into circuit, until the galvanometer needle shows, by remaining motionless, that a balance has been attained.—S. BOTTONE.

[60610.]—**Fluorine.**—In reply to Mr. W. J. Grey's question, the statement that fluorine had been isolated was seen in the report of Mr. Crookes' Address at the British Association meeting, given at page 30 of the ENGLISH MECHANIC of the 10th ult. Many thanks to "F. J. C." for the information kindly supplied.—L.

[60622.]—**Astronomical.**—The aperture in these toys has to be oval, because the map is on a projection that makes any circle except the equator and its parallels a distorted oval. Therefore the horizon has to be so represented, and, what is far worse, the east and west points of it cannot be opposite. Nor would they be any better placed were the horizon made circular by using the kind of map (stereographic) that makes every circle appear a circle. The southern constellations would be greatly more expanded than the northern; as, indeed, the southern points of the compass are in any case. A planisphere made for St. Petersburg would not be quite so distorted; but for London, or still more any lower latitude, the contrivance is hardly more than a toy. A set of twelve, or even only eight, stereographic projections of the visible hemisphere, each extended E. and W., to show the stars about to rise or only lately set, would be far better.—E. L. G.

[60623.]—**Dynamo.**—When a dynamo maker states that a machine gives 200 ampères and 100 volts, he means, of course, through a resistance of 0·5 ohm. The output of a shunt machine can be varied to a very great extent, but not in the manner you suggest; for instance, take a machine giving 50 ampères at 100 volts, the machine would give 50, 60, or 100 volts, and currents of 75, 50, 25 ampères, or, in fact, any combination between 75 ampères and 25 volts, or 25 ampères and 100 volts; but it certainly would not be safe to take 100 ampères and 25 volts. Taking the machines of good makers, they will give a current 50 per cent. in excess of their normal amount without injury; but it would not do to try this experiment with the cheap machines, as most of them will barely give the output they are advertised at. If a large shunt-wound dynamo were short-circuited, it would certainly pull up the engine or slip the strap off; but if the engine was powerful enough to keep it going, it would probably injure it; of course, directly it was short-circuited all current would be cut off from the F.M.'s, so that the strain on the machine would only last a few seconds. If a series machine was short-circuited while being driven by a powerful engine, it would certainly be destroyed, as would also a compound-wound dynamo; this catastrophe is avoided in practice by the employment of fusible cut-outs. The hot resistance of an incandescent lamp is found by dividing the E.M.F. in volts by the current in ampères.—S. AND E., Coventry.

[60625.]—**Astronomical.**—Oh that "Vortex Atom" had only exercised a little of that common sense which, no doubt, he is in the habit of using in sublunary matters, instead of asking such a ridiculous question in "our" pages! I fear his knowledge of the phenomena of the phases of the moon is very crude, and should recommend him to expend sixpence in the purchase of some elementary primer on astronomy. "Why is it that we are not always able to see the whole disc more or less brilliantly illuminated?" Simply because the "earth-shine," or, as the French call it, "la lumiére cendrée," is too feeble in comparison with either the splendour of the sun's rays, when the moon is near to him, or with the reflection of the same from her surface as she brings more and more of the illuminated portion of it to our view. Let "Vortex" face the sun when shining brightly, holding a roughened white ball in his hand on the same level with the sun, but about 45° to the left of him. This represents the moon's position with regard to the sun when nearly four days old, he will then see that besides the crescent of light on the right of the ball, he is able to see the whole of the disc. This is due to the reflection of the sun's light from his own shining face, which aptly takes the earth's place. As he now carries the ball more to the left, turning round with it, he will find that as the crescent increases to "full," the "earth-shine" decreases. This arises from two causes: the one is that the crescent of sunlight reflected from his own face is diminishing, regarded from the ball; the other is, her brightness is increasing. Having carried the ball round to within 45° of the sun on the right, the earth-shine is again plainly visible; but as the ball is carried past the sun, it becomes totally black on the side nearest him. Does he not know that even the electric arc appears black against the sun? The inclination of the moon's orbit to the plane of the ecliptic (the earth's path round the sun) is little more than 5°—about five times the sun's own apparent diameter—therefore she can never pass further than this from his centre when in conjunction with him. I cannot help here remarking on the gross ignorance so frequently displayed on the simplest matters connected with the science of astronomy by otherwise "well-informed" persons, and, further, on their total want of shame in manifesting the same. A man may say, "I know nothing of chemistry or mechanics," without the slightest cause for our depreciation of him personally—these studies may not have come in his way; but for a civilised man never

to take the trouble to acquaint himself with the sublime, yet free, reiterated phenomena of the system of the universe, forced as it were on his notice, seems to me to be a wicked, as well as shameful neglect. It is not long since a man I know, holding a responsible position under Government, said to me and the company in a public place—"Oh! what you call the mountains in the moon are simply the reflection of our own mountains—that's all." Nobody contradicted him; I regarded him with mingled disgust and pity. When I was a boy of eight, I knew every named star (besides many lettered ones) visible in our heavens, and was never tired of "spotting" them out, and I remember a servant girl of ours once saying, "Oh, Master George! you should not have anything to do with star-gazing—it's wicked!" This shows what injury astrology has done to the popular study of astronomy. The cause of the apparently greater size of the bright portion of the disc is the optical delusion called irradiation, which causes all brilliant objects to appear larger than they are. This has been designated as "the old man in the new moon's arms."—GEO. BELL.

[60634.]—**Miners' Safety-Lamps.**—In giving my opinion as to the superiority of the Morgan safety-lamps over all others, I did so as one of the public anxious to find out the best and safest lamp for underground work, and as engineer to the Universal Electric Light Company I made some very severe tests, as previously stated, with the sole object of finding out the best oil lamp I could procure, and recommend my Company to take up, to work in combination with a new electric system about being introduced by them for colliery electric lighting. I am a thorough believer in lighting the main ways and various other parts of the mine by electricity, generated at the pit's mouth for safety's sake. Finding there was no practical portable electric lamp, or likely to be one, that could be placed in the hands of a miner to fulfil the necessary conditions, and also objections such as weight, cost of maintaining lamps, difficulty of charging, and many other matters known only to electricians—knowing these facts, I came to the conclusion that we must still rely on the best oil lamp obtainable to fulfil the requirements of the working collier, and after hundreds of tests I am convinced that the "Morgan Patent Safety-Lamp" of the newest type is the one best suited for this purpose. It is light in weight, simple in construction, gives a good light, and burns well in any atmosphere, and, above all, the lamp is very safe, and cannot be exploded, in my opinion, under any conditions likely to occur underground, and until I can find a better lamp I shall continue to use it, and recommend its adoption whenever I can. Price should be no object for a good lamp where life and property are at stake, and I have not the least doubt that many explosions have been brought about by the use of the cheap, so-called safety-lamps now in use. Mr. Palmer objects to wire gauze. Why? He would not do this if he knew the practical value of it when worked in combination with a double shield and air-space divider as used in the Morgan lamp. Mr. Rhodes is a well-known authority upon the subject under discussion, and it would be interesting to know from him if he has succeeded in exploding the "Morgan" lamp. If so, by what apparatus, and at what velocity? Like Mr. Clifford, I am not a betting man; but nothing would give me greater pleasure than to contribute, say, £20 with 49 others, to form a fund of £1,000 to defray the expenses of a public test of all miners' lamps now in use, the competition to be open to all inventors and makers of lamps. The experiments to be carried out in the presence of scientific experts, the Press, and the competitors themselves. After all expenses are paid, the balance in the hands of the treasurer to be divided between the inventors of the three best lamps, as 1st, 2nd, and 3rd prize. The public would then know whose lamp was worthy the name of "Safety Lamp." I am sorry I cannot give a full description of the Morgan testing apparatus used by me for the present, as published information might tend to invalidate Mr. Morgan's patent, as I understand the apparatus is not yet fully protected abroad by patent, but shall be happy to do so as soon as the specification is published. I think if Mr. Palmer will read my comments on this subject, he will see that I clearly stated I had not tested the McKinless lamp, but should be happy to do so, and publish the result of my experiments in the "E. M." for the benefit of its readers, this being a subject of national importance.—ARTHUR SHIPPEY.

[60638.]—**Photo Lenses.**—I regret to say that I am so fully occupied that I cannot find time to write such an article as I should like on the gelatine process. But as soon as I have cleared off my arrears of work I will endeavour to send the information "B." requires.—S. BOTTONE.

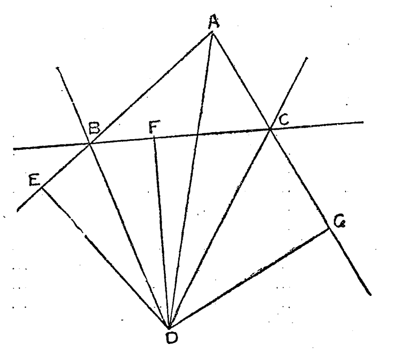
[60643.]—**Electrical.**— ERRATUM.— For relative resistance of shunt to armature in dynamos, for "$\frac{16}{20}$ to 1," read "160 to $\frac{1}{2}$."—E. CONRY.

[60645.]—**Faulty Watch.**—If the escapement is too deep, you can easily correct it. Take your screw-driver, and put point of it in space left between bottom cock and plate, and give it a slight tap with a hammer. This moves bottom cock back a little, and consequently shallows escapement. The banking pins might not act properly for another reason: The banking pin in balance might be short, or balance might be too high or low, and so miss banking pin in cock.—J. H. D.

[60646.]—**Cracked Gongs.**—The jarring noise is due to the two sides of the crack rubbing on one another; and if you separate them by running a fine saw down the crack, the tone will again become clear; but it will never be quite the same as before.—GLATTON.

[60646.]—**Cracked Gongs.**—Some years ago I had a 6in. bell-metal clock gong, which got cracked. I tried the method of cutting along the crack with a fret-saw, as I see recommended in the "E. M." this week by Mr. Ray, but found the metal so extremely hard that the saw made very little impression upon it. I then tried another plan, which succeeded very well indeed. Take the gong in a light pair of smith's tongs, and with a stick or a brush moisten the crack all along on the inside of the gong with ordinary soldering liquid (zinc dissolved in spirit of salt). Then heat the outside, but not to redness, in a powerful Bunsen flame (a clear fire would do as a substitute). Rub all along the crack with a stick of ordinary tinman's solder until it is filled in, then cool as slowly as possible; leaving in a fireside oven all night does very well. Next morning, with a fine file, remove all solder which may have run through the crack to the outside of the gong. Great care must be taken both in heating and cooling to do it as gradually as possible, to avoid unequal expansion and consequent extension of the crack.—A YOKEL.

[60650.]—**Geometry.**—Let A B C be a triangle and let the bisectors of the exterior angles at B and C meet at D. Join A D, then the angle A is bisected by the line A D. Produce the sides A B, A C, and draw from D the perpendiculars D E, D F, D G. Then in the triangles D B E, D B F, we have the angles at E and F right angles; the angle E B D = D B F (since E B F is bisected), and one side B F common; hence (Euc. I. 26) D E = E F. Similarly, it may be shown that D F = D G; hence D E = D G. Therefore, in the two triangles



E A D, G A D, we have the angles at E and G right angles, the side E D = D G, and A D common, and since $AD^2 = DE^2 + AE^2$, and also $AD^2 = DG^2 + AG^2$ (Euc. I. 47); hence $DE^2 + AE^2 = DG^2 + AG^2$, and since $DE^2 = DG^2$, therefore $AE^2 = AG^2$, and $\therefore$ AE = AG. Hence, in the two triangles E A D, G A D, we have the three sides in the one equal to the three sides in the other each to each. Hence (Euc. I. 7) the triangles are equal in every respect, and therefore the angle E A D = G A D, or the angle A is bisected by A D. (Q.E.D.)—J. E. GORE.

[60651.]—**Electric Signals in a Mine.**—Thanks to E. Conry and "C. D. R." for last week's, but would like some particulars as to battery, and I scarcely understand the former when he speaks about the different sorts of indicators, not being very conversant with electrical terms; but I can scarcely think that the gases of the mine had much effect on the wires, for it was in the shaft itself where we had the most to complain of, and being a downcast shaft there cannot be any gas more than at the surface. Our first wire was a single untinned copper, No. 15, coated with india-rubber, about $\frac{3}{16}$in. diameter, and in a short time after laying down wanted repairing every few days through "oxidation," the second was a 3-wired one stranded together, which insulated separately, each wire No. 20, untinned, covered with gutta-percha and one lay of cotton, in all about $\frac{1}{4}$in. diameter; this was much the best of the two, but in about three months after putting down failed as the one first put in. They were not cased, but sheltered under some wood pipes; it was in the driest part of the shaft where the mischief lay, as the wettest kept good.—A. O. H.

[60662.]—**Solution of High Specific Gravity.**—A solution of high specific gravity may be made by dissolving mercuric iodide in a strong solution of mercuric chloride.—A. E. F., Manchester.

[60669.]—**Gut Driving Bands.**—The gut is tapered slightly at the extreme end with a sharp knife, so that it will just enter the screw-hole in the hook; it is then screwed in until it projects from the other end into the hook or eye, as the case may be, and the projecting end is burnt with a red hot wire, which causes it to swell and prevents it from drawing out of the screw.—G. J. M.

[60673.] — **Mechanics.** — Assuming that there are 12 joists, each will sustain a load = (1cwt. × 12ft. × 12) = 1344lb., which will produce the same bending moment as a weight $= \frac{1344}{2} = 672$lb. at the centre of the joist, assuming that the ends are not fixed rigidly into the wall. The width of a beam, as compared with that of another of the same material, will vary as $\frac{w\,l}{d^2}$ where w = load at centre to break beam, l = length of beam in any units, and d = depth of beam. In your case, the breadth will have to be such as to allow the beam to break with (672 = a factor of 6) = 4032lb.; hence—

$$\text{Width} = 2\text{in.} = \frac{4032}{1000}\text{lb.} \times \frac{144}{50}\text{in.} \times \left(\frac{2}{10}\right)^2 = \cdot 927\text{in.}$$

—GLATTON.

[60674.]—**Strawberries.**—Has it never struck "Lady Gardener" that using "the contents of the slop-pail to water the plants" might be the cause of the failure pure and simple?—HENDON.

[60674.]—**Strawberries.**—There is no reason why our "Lady Gardener" should seek new ground for her strawberry plants; for, if properly top-dressed, a bed will last six or seven years, and anyhow all that is necessary is to trench the ground—that is, bring up the "spit" underneath the top to the surface, and put the surface spit in its place. This, however, is best done in the autumn, so that the winter's frost can have full effect on the soil brought to the surface, and it is well, too, to do only a portion of a large bed at a time. I do not know of a single plant which sends anything but tap roots into the subsoil; the tap roots draw water, the feeding roots are the slender fibres which are invariably near the surface—consequently, if ground is trenched, the surface is practically new ground. Our "Lady Gardener" will not want dissolved bones if she has bone dust: the former is, or should be, bones dissolved in sulphuric acid and mixed with some dry powder; it does not contain more than is in the bone dust, but is in a condition to be more readily assimilated by the plants. The bone-dust lasts longer, but is not so powerful—that is all. The sulphate of ammonia, nitrate of soda, &c., can be obtained readily enough of the dealers in artificial manures if ordered in quantities; but they are goods that require a lot of care in keeping, and I am obliged to pay 4d. and 5d. a pound for the small quantities I require, which I generally obtain of drysalters or dealers in photographic chemicals. If a "Lady Gardener" lives in the country, she might be able to get a friendly farmer to let her have half a cwt. or so at the price he pays; but if that is impossible I would advise her to look in the columns of the *Gardeners' Chronicle* or the *Journal of Horticulture* for advertisements, or send to Mr. Smyth, of Goldsmith-street, Drury-lane, London, for his list of horticultural requisites. As to the green vitriol, that is sulphate of iron, and can be bought at most oilshops. If the soil is of a clayey character and a lump of it burnt in the fire is red in colour, I should think iron is not needed; but no harm can be done by dressing the ground with an ounce to the square yard. There is no reason why guano should not be used as a manure for strawberries, but great care must be taken that it does not touch the fruit, and great care must also be taken to get your value for your money when you buy guano. A few years ago I bought some, and tested it by calcining in an iron spoon in the fire: about 90 per cent. was dead, inert matter. So don't buy guano unless you know it is right. Sulphate of ammonia and dissolved bones will give all there can be in guano, and they are at least tolerably free from adulteration. As to runners, I think it the best plan to cut them all off and procure any new plants that may be required from another district. If soil is "far from light," it is sure to be benefited by the addition of cinder-ash, sand, or charcoal, and, in fact, anything that can be procured; but ground that refused to perfect carnations, and yet sent geraniums into too vigorous growth, is, I should think, lacking in phosphates, and they can be best supplied by bone meal or dissolved bones. Geraniums are rather capricious, I know—blooming profusely at times, while running to succulent stems and foliage at others; but with two-thirds good loam and one-third rotten manure from an old hotbed, with just a sprinkle of sand, they ought to do well. Without an analysis of the soil it is

not easy to suggest a remedy; but I will venture an opinion that "Lady Gardener" would do well to give her garden a dressing of plaster of Paris or gypsum, and if it is sulphate of lime from the gas-works, it will probably do better than either. So far as the soil is concerned, agriculture and horticulture are reduced to the condition of a science, which is nothing more than systematised knowledge. The soil must contain certain ingredients, and the "proof of the pudding" rests in the skill of the gardener. This "reply" is so long, that I think I ought to apologise; but I hope the subject is one that interests your readers, for there is, to my mind, no pleasure in life equal to a good garden.—SAML. RAY.

[60680.]—**Field Magnets.**—All makers of dynamos endeavour to run the armature in the most intense part of the field. What we suppose you mean is why makers do not design dynamos with salient in preference to consequent poles. The reason is that there is really very little difference between them, and the question becomes a matter of mechanical convenience. The ordinary horseshoe magnet is very efficient, and on account of its shorter magnetic circuit would certainly be superior to one with true salient poles. If you cannot understand the diagrams of drum armature winding, get some wire and wind a small model with a few coils, and you will soon get into the more complicated forms.—S. AND E., Coventry.

[60687.] — **Screw-Cutting.** — CORRECTION.— Please accept apologies for a stupid error in former reply to this query, by which the trains of wheels are given wrong way about.—NEPHESH.

[60690.]—**Wood Carving.**—What do you mean by common ornaments? A knife, with joiner's gouges and chisels, will serve for many purposes if you sharpen them well. The best amateur carver of my acquaintance uses none else. Get a common Swiss bracket and copy it. They are cheap and nasty enough, but will do for a first lesson; but above all things, your tools must be sharp. As a trade, the carving of common ornaments is one of the worst paid, but that a joiner or a cabinet-maker should be able to add a final grace to his work by carving is highly desirable, while few pleasures are equal to that of cutting a kindly piece of wood with a keen tool.—W. A. S. T.

[60693.]—**Trigonometry.**—

$$\text{Tan. } 2\,\phi = \frac{2 \text{ tan. } \phi}{1 - \text{tan.}^2 \phi} = 0{\cdot}1723$$

Hence $2 \text{ tan. } \phi = 0{\cdot}1723 - 0{\cdot}1723 \text{ tan.}^2 \phi$
and— $0{\cdot}1723 \text{ tan.}^2 \phi + 2 \text{ tan. } \phi = 0{\cdot}1723$

Dividing both sides by 0·1723, we obtain—

$$\text{tan.}^2 \phi + 11{\cdot}60766 \text{ tan. } \phi = 1$$

Solving this quadratic equation, we find—

$$\text{tan. } \phi = 0{\cdot}08552$$

With reference to the second part of the query, since— $1 + \text{tan.}^2 \text{A} = \text{sec.}^2 \text{A}$

we have— $$\frac{2 \text{ tan. A}}{1 + \text{tan.}^2 \text{A}} = \frac{2 \text{ tan. A}}{\text{sec.}^2 \text{A}}$$

$$\therefore \log.\left(\frac{2 \text{ tan. A}}{1 + \text{tan.}^2 \text{A}}\right) = \log.\ 2 + \log.\ \text{tan. A} + 10 - 2 \log.\ \text{sec. A}$$

or since—

$$\frac{2 \text{ tan. A}}{\text{sec.}^2 \text{A}} = 2 \text{ tan. A.} \times \cos.^2 \text{A} = \frac{2 \sin. \text{A}}{\cos. \text{A}} \times \cos.^2 \text{A} = 2 \sin. \text{A} \cos. \text{A} = \sin. 2 \text{A}$$

we have—

$$\log.\left(\frac{2 \text{ tan. A}}{1 + \text{tan.}^2 \text{A}}\right) = \log. \sin. 2 \text{A} - 10$$

—J. E. GORE.

[60700.]—**To Draughtsmen, &c.**—Having to divide a straight line must imply that you have an equally long edge regarded as sufficiently straight; and so it seems the well-known method, Fig. 1, can hardly be improved. It needs only two compass-openings, one to strike the two arcs C and D of equal radius, and another to mark off along the lines from A towards D, and B towards C, one less than the number of parts you require. For dividing circular arcs, it is plain that whatever divides an angle will do. The taper lazy-tongs, Fig. 2, will do this, if their pivots at the large ends and crossings be perforated. There is no necessity for the bars to taper, but it makes them shut up neater. They should be of horn, to be used comfortably. Eight bars like this will enable you to divide any arc or angle into 3, 5, or 7, and so into any multiples of these numbers by one another, their powers, or the powers of 2. The compasses can only bisect arcs or angles; and hence it was held for 2,000 years, from Euclid's time to that of our contemporary Gauss, that the only divisions they could make of a circle were into the powers of 2, and the product of each of these into 3, 5, or 15. But Gauss proved algebraically that we can divide it into 17 or 257, or 17 times or 257 times any of those numbers. Seven is impossible, and every square or cube of other numbers than 2 and its powers. After all, the old-fashioned "sector" would seem the most royal road to division of either straight lines or circles, especially as it has, or used to have, a scale of polygon sides, from 6 up to perhaps 20. But the following are the only divisions of the circle possible by compasses; and the number of openings necessary for each, with or without a straight ruler (r). Where I put no r

FIG. 1.

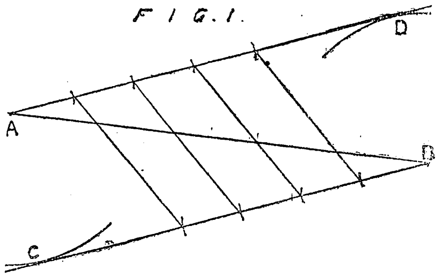
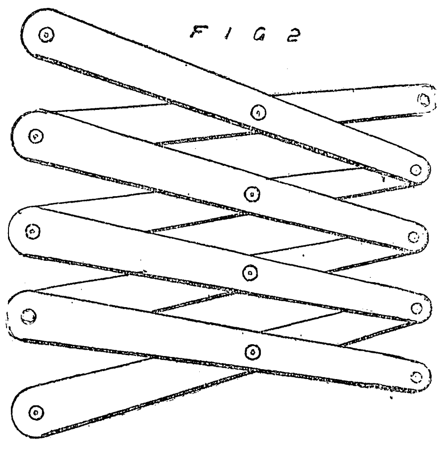


FIG. 2



the use of the ruler will not save a single opening, and in all cases it is best avoided, as a source of error to which circles are never liable. In the new divisions discovered by Gauss, I cannot be sure that 9 are the fewest openings needed, only that 9 suffice.

3	1	... 32	r2	... 128	r2	... 384	r2
4	2	... 34	9 ?	... 136	— ?	... 408	—
5	4	... 40	4	... 160	4	... 480	r4
6	1	... 48	3 (r2)	... 170	—	... 510	—
8	2	... 51	9 ?	... 192	r2	... 512	r2
10	4	... 60	4	... 204	—	... 514	—
12	2	... 64	r2	... 240	5 (r4)	... 544	—
15	4	... 68	9 ?	... 255	—	... 640	r4
16	3 (r2)	... 80	4	... 256	r2	... 680	—
17	9 ?	... 85	— ?	... 257	—	... 768	r2
20	4	... 96	r2	... 272	—	... 771	—
24	2	... 102	9 ?	... 320	r4	... 816	—
30	4	... 120	4	... 340	—	... 960	r4

Mascheroni, in his very useful "Geometria del Compasso" (which ought to be Englished), sometimes used unnecessary openings; three, for instance, to divide the circle into 24, which only requires two. The lazy-tongs (Fig. 2), which I believe are patented for this purpose, are the only means I can see for dividing any random angle or arc, not commensurable with the circle. But "Workman" speaks of dividing a circle, a much commoner problem; and for this, especially when the number, like his, would require an instrument of as many as 20 bars, I think I can suggest something better. Suppose a deep beam-compass, the beam at least 1in. deep, crossed by certain notches, to one or other of which the movable leg can alone be applied and screwed, instead of sliding. The whole length, from the fixed leg to the circle-marker being called 1, or radius, or cho. 60°, the notches are to be at the lengths of chords, like these—

Cho (180° ÷ 7)	Cho 7(180° ÷ 23)	Cho 5(180° ÷ 37)
180° ÷ 9	7(180° ÷ 25)	9(180° ÷ 41)
3(180° ÷ 11)	5(180° ÷ 27)	11(180° ÷ 43)
3(180° ÷ 13)	3(180° ÷ 29)	15(180° ÷ 47)
3(180° ÷ 19)	(180° ÷ 31)	15(180° + 49)

The divisors are either a prime number, or the square or cube of a prime; and each multiplier the number by which the divisor differs from the nearest power of 2. Now, to divide a circle (even into an odd number), first bisect it; then set off one of the above chords, and your circumference will be in two unequal parts, one of which will give the required points by mere bisection. Thus, for 9 parts, your chord cuts off 20°, which reduces one semicircle to 160°, or 4 of the parts required; for 13 your chord cuts off $1\frac{1}{2}$, making with the other semicircle 8 parts. A notch for any divisor composed of unequal factors, as 21, would be useless, as dividing the circle into 3 and 7 gives all the points. In bisecting, by the way, the use of the ruler does save one compass-opening of every two.—E. L. G.

[60700.]—**To Draughtsmen, &c.**—I am obliged to the correspondent who replied to my query last week; but his reply scarcely covers the ground of the query, which was not so much for information how to divide—as I can myself divide entirely to my own satisfaction—but, for a certain purpose, I wish the instruments and methods employed by others described with as much detail as possible. "Nephesh" says step it out with dividers; but how would the draughtsman who knows all about arithmetic and trigonometry proceed in setting dividers to proper distance? And how the illiterate mechanic on the two problems I set in my query, always provided the draughtsman and mechanic are provided with the modern and improved instruments?—WORKMAN.

[60704.]—**β 63 and P. XX. 177 Delphini.**— The principal measures of 1 Delphini, β 63, are—

De. 343·4 : 0·84″ : (4n). 1874·92. 6·0, 8·1mags.
β. 345·4° : 0·88″ : (3n). 1880·19. 6·4, 7·9mags.

It is a difficult object to see with a reflector. Some of the later measures of P. XX. 177 are—

Hall. 211·6° : 0·49 : (2n). 1879·73.
β. 211·5° : 0·51″ : (1n). 1880·61.
Eng. 211·9° : 0·40 : (6n). 1883·47.
Pe. 208·4° : 0·58 : (5n). 1883·63.

Both 1 and P. XX. 177 Delphini are probably fixed. Under the best circumstances Dawes was able to see a notched elongation in P. XX. 177 with a power of 600 on Mr. Bishop's 7in. Dollond, but he never divided it. Perrotin gives the distance of Σ 2491 as 1·277″ in 1883; the angle has increased a few degrees since 1828. The distance of 2 Vulpeculæ is 1·857″ according to six nights' observations by De. from 1874 to 1878; the magnitudes are unequal. β says of it: "The companion is a minute point, and lost in the rays of the larger star [with 6in. refractor] unless the definition is very good. De's mags. are 5·7 and 9·7; colours white and ashy olive or ashy blue. I suppose that "the triple 6968 Lyræ" in "Bramley's" query is a misprint for B.A.C. 6468 Lyræ.—H. SADLER.

[60705.]—**Dutch Language.**—I don't know any English-Dutch books; but perhaps the books used in the schools in Holland for learning English would do. If you like I will get you some titles of those books. If you want any further help I shall be glad to assist you.—HOLLAND.

[60705.]—**Dutch Language.**—If private study, try systems of "Thimms," 24, Brook-street; "Prendergast's Mastery," Longmans and Co.; "Monteith's," Cassells; and "Hossfield's" (at one time, if not now, at 96, Charlotte-street, Fitzroy-square, W., with branches). I believe they have all written for the above language. If classes, try those at the Birkbeck, City of London College, &c. See lists at some of the foreign booksellers (see Kelly's Directory), such as David Nutt, Strand; Williams and Norgate, Henrietta-street, W.C.; and A. Siegle, 110, Leadenhall-street. — BREAM'S BUILDINGS.

[60706.]—**American Medical Law.**—I am afraid all the American States are now following the English example, and recognising no qualification to practise medicine but those granted by themselves. The bogus universities are now blown up, and a genuine examination called for. Three years is the usual curriculum for medicals; but in many (as in France) an M.R.C.S. could get off with one year. As to the opening for a histologist or pathologist, I cannot give the querist any encouragement, for the simple reason that lately, when I spent some years in the great histological schools of Vienna, Strasburg, and Berlin, I found ten Americans for every Englishman at work there. —B.Sc., Plymouth.

[60707.]—**Dynamo.**—TO MR. BOTTONE.— Unless the resistance of the field-maget coils is enormously greater than that of the armature, the machine should work better with the wires coupled up in one continuous length than in parallel arc. The best proportion between outer circuit, armature, and field-magnets is: circuit, 1; armature, $\frac{1}{20}$; field-magnet, 20; or, what amounts to the same thing, the resistance of the armature must be $\frac{1}{20}$th that of the outer circuit, while the field-magnet coils should be 400 times that of the armature. But I am afraid you have joined up the wrong ends of the field-magnet coils.—S. BOTTONE.

[60708.]—**The Wimshurst Machine.**—As I have been engaged during the last twelve months trying various arrangements of electric machines, you, as well as others, may profit by a little advice upon the making of such a machine, so as to combine economy with efficiency — and nothing beyond the skill of an amateur. The method described by Mr. Bottone on p. 100, No. 1123, would certainly result in wobbling discs, and these anything but parallel to each other. If it be desired to make the machine after this pattern, the bosses

"must" be first bored completely through, then fitted with brass tube, and then turned up truly upon said tube. As to how the holes in the standards could be made and kept accurate enough to insure any reasonable amount of parallelism, must be left to the ingenuity of the operator. No, sir; if the object be to avoid boring a hole in the glass, mount each disc upon a separate axle. I find the following a very handy arrangement. The discs are of ordinary window glass, picked as flat as possible. I have previously described in these pages how to test it; but out of some dozens I only came across one bad plate, so that this is scarcely necessary; these are 19in. diameter, the mahogany bosses being $2\frac{1}{2} \times \frac{7}{8}$, affixed as already described by me, and which leaves nothing better to be desired. If when mounted the sharp edges be ground off by means of an old setstone, whilst the plates are revolving ("slowly," or you may break them) so much the better. The frame is of deal, having two coats of shellac varnish. The base measures $30 \times 17 \times 1$in., and has at each end, underneath, to prevent warping, a piece glued and screwed measuring 2×1in. Two standards, each $18 \times 4 \times 1$ are mortised into base at $3\frac{1}{2}$in. from the edge of one of the longest sides of the base and central. On top these are dovetailed to take a piece of inch stuff 8×4 for the bearings to rest upon. For the sake of ornament these standards may have, say, $\frac{1}{2}$in. cut out of edges next to the glass, so as to show the appearance of a column, and all edges chamfered off; at the back, we must let in a piece to carry the driving wheel. This is glued and screwed to the base-board, and is $8 \times 8 \times 1$, which also stiffens the standards. To finish these off we can glue around their bases little pieces of any ornamental moulding. The main spindle is made of a piece of iron gaspipe, say $6 \times \frac{5}{8}$ when turned truly, and upon one end of this is tightly fitted and soldered a brass face-plate, say $2\frac{1}{4}$ diam. by $\frac{1}{8}$ at outer edge running down to a neck of say $\frac{1}{2}$in., having four screw-holes to fasten it to the brass on disc, and enable same to be adjusted so as to run as truly as possible. Before turning up this piece of tube it is advisable to make a tool, in order to rymer out the inside of it. Take a piece of round steel, or say an old file, upset one end so as to turn up slightly larger than will fit into the tube; turn $\frac{1}{4}$in. taper and $\frac{1}{2}$in. parallel, and file, say, eight flats upon it. Note: four won't answer, as they will stick in a groove where the pipe is closed together. Harden as hard as it will go when heated to a dull red, now get the pipe in a vice, and work this round by means of a tap-handle, and use plenty of grease, and all the tarry stuff will be removed, and a tolerably smooth surface be left. After the outside is turned, I carefully redden the tube, sprinkle it all over with prussiate of potash, and seeing that it is red, dip perpendicularly into cold water; then on with the faceplate, and turn it up. The bearings are of brass, $\frac{5}{8}$in. in breadth, and I have not yet split them in order to tighten up, although often used for several months past. The spindle turned to fit inside of this one is a piece of brass tube, with the least possible amount turned off it. It has a similar faceplate, but fastened upon it in the reverse way, and in cutting it to lengths we must allow for thickness of brass, faceplate, and glass, so as to let, say, 1in. project beyond the end of the iron spindle. Now, we must cut out two discs of mahogany to turn up to $3\frac{1}{4}$in. diameter by $\frac{5}{8}$in. Into one side of each we let a square plate of stiffish brass, say, full $\frac{1}{16}$in. thick; drill a little hole in each corner, and bore with a small sprig bit, so as to gently drive in four round brass tacks, and rivet them nicely, so as to keep the pulleys from splitting or twisting; bore them to fit as tightly as possible upon the ends of the two spindles; then stick upon a mandrel, and turn them up, and with a V-groove of, say, $\frac{3}{8}$in. so that they will take an ordinary piece of sash-line. Although mine are only fitted thus, I have had them on and off scores of times, and now only require to slip a single piece of waxed carpet thread in. When putting them on of course there will require to be a washer or two of cardboard between the glass discs to prevent them from touching. The driving-wheel is made of two pieces of deal with the grain reversed, each 1in thick, and turned, say, 9in. diameter; these are first glued and screwed firmly together, then a piece of brass tube is driven nicely into the centre, measuring 2in. long by, say, $\frac{3}{8}$ bore. We then place upon a mandrel, and turn it up with two V grooves the same distance apart as are the two others. Now we require a stud-pin to fit this tube, having a washer at front with a small sunk screw into the end of the stud to keep the wheel on, and at the other a small collar, washer, and nut, by means of which we can screw it firm to the piece of stuff which is let into the lower sides of the standards. We have previously fitted a suitable handle to this driving-wheel by means of a small spindle of iron, say, about $\frac{1}{2}$in. diameter, having a small washer or collar fitted on to a part turned a little smaller and then soldered, so as to prevent it from settling out of the perpendicular. If we drive this into a hole at 3in. from the centre within about $\frac{1}{2}$in. from the opposite side of the wheel, it will be quite firm enough. Now if we take a suitable length of sash line, make fast one end, and give it a good pulling to stretch it, then pass it under the driving, then over one of the small pulleys above, down again, and up to the outside one, with a twist in it this last time; mark the right length, open an inch of each end, shove these ends after dipping them into the paste-pot and dividing each into four parts, then wrap around with waxed carpet-thread, we will have one endless belt, which has not required to be re-tightened after the first slackening up which will probably take place, for many months, and although I originally attached a means for tightening it with a movable arm, I have since removed same as unnecessary and spoiling the symmetry of the apparatus. The neutralisers for the plate nearest to the operator are made of two pieces of small brass tubing: that upon the left hand slides up and down in a hole bored perpendicularly in the piece of wood which forms the table for the axle bearings, and as near the inner ends of the sectors as convenient, in order to lessen the wear and tear of the same. About $1\frac{1}{2}$in. of the top end is bent to a round angle, a piece of the fine wire off an old bass string of a violin, about 2in. long, is pegged into its end, and this is all the brush that is necessary, and if nicely adjusted it will not injure the tinfoil sectors for a good while, and then they are easily repaired, being easily affixed to the glass or shellac with ordinary paste having a little pinch of borax in it. It is quite unnecessary to fumble with shellac upon the foil. The right-hand one is a straight piece moving in a little cleat upon the side of the standard, and there is not the slightest advantage to be gained by connecting them in any more direct manner either to one another or to the axles. The real circuit of the machine I maintain to be that the electricity is discharged from the plates to the air as well as to the nearest conductor to the sectors after they have passed away from the brushes; that it is given off most freely from the sectors which are midway between each pair of brushes upon the opposite discs, and that if the air be tolerably dry it seeks to regain its point of departure from the said brushes and sectors by ascending the framing and the driving band—not as Mr. Bottone, as well as Mr. Wimshurst, and, I believe, all others appear to think, viz., that it is from one brush to that upon the opposite diameter of the disc. As a proof of my position I am willing to describe an arrangement of my own, which will yield as much electricity of the same tension as does Mr. Wimshurst's, that is, if the disc or discs be driven at the same speeds, because I am of opinion that the peculiar advantage of the Wimshurst machine is to be attributed to the fact that as the discs are going in reverse directions, they are really going twice as fast as one single disc with a fixed rubber would be travelling past same. This letter is becoming of unwieldy proportions, so I must conclude by saying that the brushes upon the outside disc are similarly attached to a piece of the same tubing, having each end bent to a suitable curve and fastened by a small screw at centre to pillar of wood like, say, an umbrella shaft, with a suitable base glued on, to screw on to the baseboard.—A., Liverpool.

[60708.]—**Wimshurst Machine.**—The spindles in my machine are not insulated from one another, since the wooden uprights are not insulators. The thin brass does not hold on the glass nearly so well as the tinfoil. The mode recommended for attaching the bosses is far better than any I have yet tried, and I can strongly advocate its use. The simplest way of testing plates or jars is to warm them, so as to get them nice and dry, and then try whether they become fairly electrified when briskly rubbed with a piece of dry, warm silk.—S. BOTTONE.

[60710.]—**German Universities.**—To enter one of these, a German student must possess an equivalent to our degree of M.A. An Englishman, however, is admitted on his producing (1) any degree of any English university; (2) Evidence that he is a member or matriculated student of any English university. The idea that a student can benefit by joining a university where the teaching is done in a language he is unacquainted with, is so ridiculous that it needs no comment. After one year's hard work at the language in the country, a student may be able to follow the lectures with profit to himself. The fees are very moderate, and living also for those who know the language and live as the Germans do. Lecture fees vary from 10s. to 60s. per semester, according to the hours lectured in a week. Any aufhörer or outsider can hear the lectures on payment of the fees; but this does not count for a degree.—B.SC., Plymouth.

[60713.]—**Fire Hose.**—Two inch hose should be large enough for $\frac{3}{4}$in. jet, and very little, if any, benefit would be derived from $2\frac{1}{2}$in. hose. Can you not increase the pressure in main? It is decidedly low.—T. C., Bristol.

[60715.]—**Motor for Canoe.**—If you are about to make the pump yourself, I would suggest your trying the form I sketched in No. 1102, May 7. This pump, modified to have inlet in front of canoe, outlet at back, would send your boat forwards or backwards, according as you turned handle one way or the other. No air-vessel would be required, as this pump throws and draws twice for each revolution of the handle.—SILKE.

[60717.]—**Hot Dynamo.**—TO MR. BOTTONE AND MR. EAVES.—This dynamo is radically wrong. There is either a short circuit somewhere, or else the brushes are in the wrong position. The addition of more lamps would cause less current to go round the field magnets (if it is wound as a shunt machine), and this would make matters better for the dynamo. But a properly wound, and especially properly commutated, machine should not feel the difference of the lamps so much as yours does.—S. BOTTONE.

[60717.]—**Hot Dynamo.**—TO MR. BOTTONE AND MR. EAVES.—The heating of the machine is caused by an excess of current in the F.M. coils. There are three ways of remedying this fault. First, by using lamps of less voltage; secondly, by winding more wire on F.M.'s; thirdly, by inserting a resistance in series with the field coils and increasing the speed of the machine. Putting more lamps in circuit will not improve matters, as the current in the magnets would have to be slightly increased to compensate for the drop in E.M.F. caused by the increase of current in the mains. The heating of the commutator is caused by the sparking; the commutator, perhaps, wants turning up. The brushes of these machines want adjusting with great nicety, as the neutral space is rather small.—S. AND E., Coventry.

[60718.]—**In Beat.**—I think if "Amateur" will place his watch on a small box of rather thin wood, it will increase the sound; and also, if placed on a sheet of glass, such as a looking-glass, it makes the beat more distinct.—E. C. F.

[60724.]—**Circular Saw Bench.**—Belt and suitable pulleys, say 3in. and 24in., with 4in. saw, would be the best and simplest plan; and you can't beat treadle, unless you have someone to turn for you.—T. C., Bristol.

[60724.]—**Circular Saw Bench.**—You do not say whether you are to use your saw for cross-cutting or ripping; if for cross-cutting or ripping very short lengths, you may do with a speed something like 1,000 revs. per minute; but if you are to rip more than 12in. lengths, you cannot keep up such a speed. What I advise you to do is to put a pulley 9in. diameter by 3in. broad on the saw spindle; fit up a countershaft and mount on it a flywheel, belt pulley 18in. diameter, and crank handle, the crank arm, say, 12in. long, put on a light 3in. belt, and you have a very good manual circular saw; I have tried quick speed and failed. With a slow speed and a well-trimmed saw one man can keep up a steady drive, cutting 3in. deep. A very simple method of testing the slow-speed principle is to put a flywheel and crank handle on the saw spindle and drive direct, same as turning a grinding-stone.—SANDY DUNN.

[60724.]—**Circular Saw Bench.**—The usua plan is by a heavy flywheel and cord or strap to a pulley on the saw spindle. Assuming the speed of the fly to be one revolution per second, which is about the rate at which we work a lathe, a 3in. pulley, with a 30in. flywheel, gives 600, and a 2in. pulley 900 revolutions, with which I think "J. C. D." would be wise to be content. Increase of speed is decrease of power; and in any case it is hard work, though certainly extremely convenient, as the pulley must not project above the table. A 5in. saw will give a 2in. cut, which is all that is here needed. As to gearing with cogwheels, I should like "J. C. D." to try one of those novel saws, patented by the Britannia Company, who have an agent in Liverpool. Theoretically the thing is all wrong, but practically no saw can touch it. The speed is tremendous, and the power is stored up by the heavy fly and gear-wheel, and is given out economically. It will continue to cut long after you cease to treadle, and that is what no other saw can or will do.—O. J. L.

[60725.]—**Insulation.**—1. All wires should be evenly and tightly covered with silk. 2. When wires are double-covered the second layer should be in the opposite direction to the first. 3. There should be some little difficulty in getting the covering off either with knife or file. 4. Silk is used as an insulator because it is much more reliable as an insulator than cotton; also we can get a greater number of turns in a given space with silk-covered wires.—VINCENT.

[60725.]—**Insulation.**—I should doubt whether any general rule could be laid down, as the amount of insulation required depends upon the intensity of the current employed, as the thickness of a water-pipe must be proportioned to the pressure it will have to resist. External circumstances must also be considered—e.g., a wire running along a stone wall would require much less insulation than

one traversing a metallic surface; as, in the latter case, the increased tendency of the "fluid" to escape would have to be counteracted. Silk is frequently substituted for flax because its vastly superior insulating power enables a less clumsy covering with equal effect to be used. In certain electrical apparatus (as in induction coils), it is requisite that not only the secondary wire should be well insulated, but that the numerous successive coils should be kept as close to the core as possible; a silk-covering instead of a flax one facilitates this. No. 16 cotton, as being the coarser, would naturally give a better insulation, though No. 50 might be amply sufficient for the purpose required.—B. HARCOURT.

[60725.]—**Insulation.**—The difference in degree of insulation is simply to fit the wires for different purposes, and depends upon the E.M.F. of the current the wires will have to carry, and the degree of conductivity of the air or other substance that is to surround the wire. Thus, if the wire is for electric bells in a house where they (the wires) will be out of the way, not exposed to wet and never touched, single cotton covering will do, because nothing is likely to disturb the wires, and the E.M.F. of the current they will have to carry is extremely low, being only that of one or two Leclanché cells, or about 3 volts. But if there are many wires, so that they cross each other, and two or more strands have to be put under one staple, then it becomes expedient to use a rather better covering, as indiarubber and double cotton covering. And if the wire is to be carried under the sea, where it will be surrounded by water, which is a partial conductor, and will be exposed to considerable rubbing and cutting from rough rocks, &c., while the E.M.F. of the current will be high, a very heavy insulation is used. Similarly with telegraph lines, dry air is the best of all insulators, and in dry weather the wires, though bare, being fastened on telegraph "insulators" specially made for the purpose, remain insulated from the earth and from all other wires, although the E.M.F. is sometimes pretty high, and even in wet weather, though some of the current is lost, enough is preserved to do the work, which requires a very little quantity of current. Silk is often used, especially for the finer wires, because it makes a very close and firm covering, one layer being as good as two of cotton, and takes up less than half the space. Hence it is much used for small magnets, where, owing to magnetic laws, it is desirable to get the desired quantity of wire into the smallest possible space—e.g., to lie as close as possible to the cores of an electro magnet. Cotton is sometimes used for small wires. It is a matter of cheapness principally; but where the gauge becomes very small, silk is used on account of its greater flexibility, enabling it to be laid on tightly, with less risk of breaking the wire. Large wire, as for dynamo-winding, is generally used cotton-covered, to save expense. The insulation of electric-light wires depends on the situation where they are to be placed. If in the floors of a dry, well-built house, where the E.M.F. will not exceed about 100 volts (which means, in other words, all incandescent lamp installations), and the linesmen who lay the wires are careful, experienced hands, who understand taking precautions where wires cross or touch, comparatively light insulation is safe, providing the wires are properly connected, as they always should be, through fusible plugs or cut-outs, without which the best insulation is not safe. Where the situation is damp, however, as under the roofs, or underground, or in the open air, proportionately better insulation should be used, the exact quality being a matter of experience, upon which every electrical engineer decides for himself. For E.M.F. up to 100 volts and heavy currents, as for electric lighting, tinned wire covered with a plaited or woven cotton covering soaked in G.P. does very well for most ordinary indoor work. Wire from which the insulation can be stripped with a dig of the thumb-nail is not really fit for any purpose, not even for electric bells. There is no exact rule for determining insulation. In large contracts there is sometimes a clause specifying that when completed the installation shall show an "insulation resistance" of so many megohms. In electric lighting, 80,000 ohms means a good installation.—E. CONRY.

[60728.]—**Steel or Iron Tubes.**—The following is a most reliable rule for ascertaining the thickness of tubes to stand internal pressure. Let D equal the diam. of tube in inches, P pressure in pounds per square inch. Thickness $= \frac{D \times P}{11{,}000} + \cdot 125$. In your case it will be $\frac{12 \times 90}{11{,}000} + \cdot 125 = \frac{27}{275} + \cdot 125 = \cdot 098 + \cdot 125 = \cdot 223$, or about $\frac{7}{32}$ thick. The divisor for steel is 13,700. In the second question we shall have $\frac{16 \times 30}{13{,}700} + \cdot 125 = \frac{24}{685} + \cdot 125 = \cdot 035 + \cdot 125 = \cdot 16$, or about $\frac{5}{2}$ thick.—ENGINEERING, MANCHESTER.

[60728.]—**Steel and Iron Tubes.**—If you allow 2 tons per sq. in. section for single riveted joints it will give a factor of safety of between 5 and 6 for iron. For 12in. tube strain = 20 × 12 × 1,080lb., say $\frac{1}{2}$ ton, which would give 4in. sectional area—that is, $\frac{1}{8}$in. plate. For the 16in. steel tube strain is only 16 × 30 = 480lb., and bare $\frac{1}{20}$in. is strong enough, But if weight is no object, have it stouter, as there is very little more labour.—T. C., Bristol.

[60726.]—**Cement.**—I should think indiarubber dissolved in spirits of wine would do.—E. CONRY.

[60729.]—**Driving Belts.**—We don't allow anything for belts slipping. We have a belt transmitting 250 horse, and if it slips we tighten it, or apply a good coating of castor-oil on the back of the belt.—B. HELME.

[60730.]—**Turning Small Cylinder.**—Why not fasten to face-plate with bolts, and bore it out at one cut with a flat drill, put through a steady, fastened in the hand-rest, and drill held with a wrench. The drill would bore better if a piece of hard wood were screwed on each side of the drill, a little larger than the hole, and then you would get a clean cut.—B. HELME.

[60730.]—**Turning Small Cylinders.**—Scarcely possible to do it true enough by hand tools alone. Your best plan will be to chuck it on the face-plate, and start the bore truly by hand tool, and then put a packed bit through by means of back poppit. A packed bit is one having pieces of wood screwed on each side of a flat bit, and all turned to size parallel, then part of wood cut away for room for cutting. Of course the wood must be removed for hardening the drill.—T. C., Bristol.

[60731.]—**Drill for Small Work.**—The cranked lever is forked; forked ends slotted; upright tube slotted; slots engage pins on loose collar in the tube. Loose collar is between a fixed collar (on the spindle) and the drill-holder. Thus, raising or depressing collar-pins (by means of lever) raises or depresses drill-spindle. A portion of my drawing did not "come out" in the engraving; hence it is not quite clear. Don't understand how you could have been about to make one before my drawing appeared. Any further particulars if you advertise your address.—SILKE.

[60732.]—**Whitworth's Millionth Machine.**—You will find a sketch and description of this in "Shelley's Workshop Appliances." Briefly, it is as follows:—A rigid bed, with ends carried up to form headstocks, in which slide square bars with ends at perfectly right angles. The bar at, say, the left is moved by a screw of 20 threads thick, having a large wheel on end divided into 250 parts, so that a movement of one division moves bar $\frac{1}{250}$ of $\frac{1}{20} = \frac{1}{5000}$ of an inch. The other end has also a screw of 20 to the inch; but the large wheel is a worm-wheel of 200 teeth driven by a worm also furnished with a large wheel, or index, divided into 250 parts, so that a movement of 1 division of this wheel advances the bar $\frac{1}{250}$ of $\frac{1}{200}$ of $\frac{1}{20} = \frac{1}{1000000}$ of an inch.—T. C., Bristol.

[60733.]—**Take a Post-Card.**—I wish this query had not been put. But the answer is evident—that there is nothing to prevent the fraud suggested, and the exact weight is immaterial, provided it ranges between the weight of ordinary penny coins.—T. C., Bristol.

[60736.]—**Small Light Magnets.**—To "A.G.G."—I don't know what you infer by "raise"; but a 6in. smooth flat file cut off to the length required, and the tang end used as the pole, after being magnetised, lifted, on contact, a ring $\frac{1}{4}$lb. iron weight. These I have used years ago for telephones. I should observe that the tang end was ground down until it was square—about $\frac{1}{8}$in.—VINCENT.

[60736.]—**Small Light Magnets.**—You do not say through what space you want the magnets to act, and that is all-important. If not more than $\frac{1}{4}$in., then little electro-magnets would do—say, cores $\frac{1}{2}$in. by 3in., insulated with paper or a very thin bone, or wooden reel, and wound with, say, eight layers of No. 30 to make sure, and worked by about 8 volts and $\frac{1}{4}$—$\frac{1}{2}$ an ampère; but I do not see how you can dispense with a battery, unless you use a magneto-machine, and wind your magnets with the finest wire you can get, which would mean a lot of trouble.—E. CONRY.

[60740.]—**Universal Chuck.**—The square jaws with triangular notches are prevented from travelling on their round centre pins by two screws, which pass through the jaws and screw into the casting that forms the base of the centre pin, which casting is moved in or out by the main screw with right and left-hand threads as described. The heads of these two screws are shown in the drawing referred to by "R."—DYNAMITE.

[60741.]—**Mensuration.**—Half-close the open mouth of your vessel by a flat half-moon. Place it with this vertical; pour in water up to the level of axis; then tilt it till the liquid ceases to touch the half-moon, and make a mark where its surface meets the slant side.—E. L. G.

[60742.]—**Propeller for Launch.**—It is a very difficult thing to give a rule for the diameter of a propeller, and the area of blades can only be determined by actual experiment. A small propeller totally immersed is much more efficient than a large one, the blade of which is above the surface of the water; in which case the rule holds good that the diameter of the propeller should be less than the draught of water. It must, however, be borne in mind that the diameter should bear some relation to the power of engine, for if made too small it will not absorb the power developed by the engine. In your case, you cannot very well do with one less than 10in. diam., having a pitch of 20in. Total area of blades, 50 square inches.—ENGINEERING, MANCHESTER.

[60743.]—**Cast-Iron Piston Rings.**—In using cast-iron rings, the piston is generally made in two pieces—viz., a block and a broad ring called the junk ring, which is fastened to the block by means of set screws, the packing ring being between.—ENGINEERING, MANCHESTER.

[60743.]—**C.I. Piston Rings.**—The piston has a "junk ring" fastened by set-screws, which can be removed for insertion of rings. You can draw them by light hammering the insides with ball of hammer, but if not experienced may break them. If there is room put a circular spring of steel behind the rings.—T. C., Bristol.

[60744.]—**Question in Dynamics.**—If his ascent was gentle and regular, though swift, there should not be any motion; but in practice, the jerking of the string would probably add to his weight a slight momentum sufficient to start the other mass, when slow motion would result, accelerating gradually through momentum.—E. CONRY.

[60745.]—**Lead Valley.**—Your best result will be to rip off the slating and put in all new lead; but if you wish to try other ways, you may cut out the old lead, leaving 2in. off it from edge of slate, and turn the same up as flashing to cover edge of new lead. I would recommend you to employ a good practical workman to lay the new lead, who will be the cheapest man in end of time.—SOMERSET LAD.

[60745.]—**Lead Valley.**—Cracks in sheet lead, whether in flats, gutters, or valleys, should never be repaired with solder. Hear ye this, oh ye plumbers! Solder only makes matters worse, by making tight and immovable the lead, which should be free to move—to expand in sunshine, to contract with frost. I always use bicycle cement. I had, some years ago, a most troublesome lead gutter, which was always going wrong. The bicycle cement was used, and I have heard nothing of it since. A new gutter, badly constructed in the country, with too shallow a drip, let the water in badly. This drip was solidly covered up with bicycle cement, and the job was a perfect one.—SOUTH KENSINGTON.

[60746.]—**Valves.**—We have one of Hopkinson's full-way valves 2in., and is working with a pressure of 100lb.; it has been working nine months, and there is not the least indication of leakage. I scarcely need mention it can be opened full and closed again in two seconds, with a handle 6in. long.—B. HELME.

[60750.]—**Glass for Fish-Tank.**—I made a fish-tank, and it held about nine gallons. I used 28oz., and it seemed quite strong enough.—B. HELME.

[60752.]—**Turning Balls.**—Rough them all out as near as possible to templates, but a little large. You must now have a piece of steel for each size, say $\frac{1}{8}$in. thick for large sizes, and $\frac{1}{16}$in. for small sizes; now drill the steel with, say, $\frac{3}{8}$in., $\frac{5}{8}$in., 1in., $1\frac{3}{8}$in., and 2in. holes. If you have only 25 to do, the same piece of steel may be drilled out in successive sizes; you must harden the steel, and keep the sides ground flat. If you chuck the balls and apply above tool, either above or below, and keep moving it in all directions, as well as the balls, it will act as a scraper and make them true.—T. C., Bristol.

[60758.]—**Small Launch.**—You could not do so without considerable alterations. You might be able to manage by half-filling firebox with asbestos wool, and arranging apparatus to continually inject petroleum in a fine spray. In one of the London illustrated papers about two months ago (I think the *Pictorial World*) there was an article about the method employed on the Russian steamers on the Caspian, which burn petroleum. You might pick up something useful from this.—E. CONRY.

[60759.]—**Aniline Dyes.**—To S. BOTTONE.—Rince the flannel alternately and repeatedly in rather strong ammonia water, and then in plain water. Repeat this rinsing until the colour does not reappear when a few drops of vinegar are allowed to fall on the flannel.—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

QUERIES.

[60761.]—"**Performance Guaranteed.**"—Will some of our astronomical correspondents or makers of specula inform me through the medium of "Ours" if the remark "performance guaranteed," used so often in advertisements, really means, and is intended as, a guarantee that the specula will give a moderate-sized star's image, in a focus with the highest power, as a very small disc, almost a point, accurately round, with one or two narrow rings of light?—ENQUIRER.

[60762.]—**Engine Flywheel.**—I have purchased a secondhand steam-engine, with a stand or frame in the shape of a letter A, the flywheel working on the top of the triangle. The size of the flywheel is 5ft. 5in. in diameter, 4in. wide on face. The rim or edge is also 4in. thick, with 6½in. cylinder and 18in. stroke, which makes the cylinder longer than they are in general. Would not that give extra power? What would be the power? Would the flywheel be too large to drive a pulley wheel 8in. diam. for a 30in. circular saw and smaller one? Only one saw would be worked at one time. What distance would be required between saw pulley and flywheel for belt?—STEAM ENGINE.

[60763.]—**Clarionet.**—What is the cause of the following weak note in my clarionet? F sharp with the top key open and the four top holes closed. E natural below and G natural above blow quite strong, but F sharp is almost dumb. I have carefully cleaned the instrument and passed a rag through every hole, but cannot cure it.—FLAVIUS.

[60764.]—**Pyrophorus.**—I endeavoured last winter to make this remarkable firework. I tried the two following recipes: (1) Take three parts of saltpetre and one of flour (or sugar), calcine first the saltpetre in a ladle to a black mass; triturate this and mix the flour or sugar with it; place the mixture in a hard bottle, and set it in a small but clear fire till a bluish flame appears at the neck; cork it up with a chalk stopper and let it cool gradually. (2) Dissolve 1½oz. acetate of lead in water; dissolve separately ½oz. of tartaric acid and water, mix; a white cloudy precipitate falls—tartrate of lead; collect this on a filter and dry. Put this in a bottle and proceed as in No. 1. With both methods I had only partial success, the fire coming up so slowly even in the open air, and after a few hours refusing to come at all. Will some chemical friend show me the cause of my non-success, and also, if there are any other methods, describe them? I want to put the pyrophorus in a powder flask with a cut nozzle, to use as a pipe lighter. Some years since I bought one which was too "wick," as it went off like a rocket. It resembled a "ladies' tormentor" in appearance.—GEORGE BELL.

[60765.]—**Area of Sewer.**—Would any reader kindly say how to get the following? Let it be granted that a sewer of 2ft. in diam. is sufficient to remove the sewage from a population of 5,500—what size of sewer would be required for a population of, say, 10,000 or 15,000?—STUDENT.

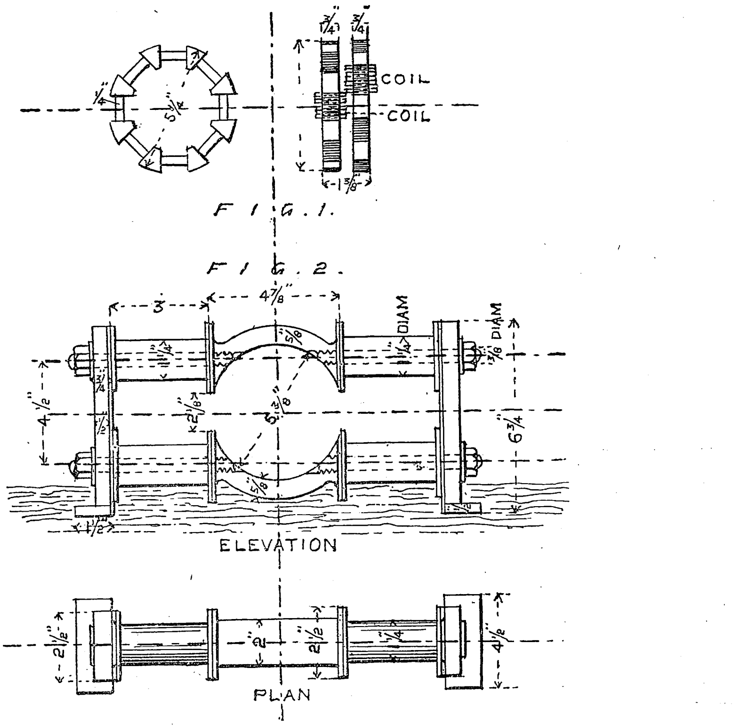
[60766.]—**Hooping Furnace.**—Would any of your readers oblige me with information, or a sketch, on this subject, as I am about to build one? It is for heating tires, 1⅝in. by ⅝in. and 2½in. by 1in.—A. L. K.

[60767.]—**Exploding Gas by Electricity.**—Will any of our correspondents kindly answer the three following questions? I want to explode gas in a cylinder by electric spark from an ordinary Bunsen cell. Will a Bunsen do for this purpose? What should I use to insulate the wires where they pass through side of cylinder? What should the terminals be made of?—VOLTA.

[60768.]—**Glass Taps.**—Would some glass-blower kindly say how glass taps (small ones) such as are used in chemical apparatus, are made? I mean a tap, say, in the middle of a tube of about ⅛ or ¼ dia. Could an amateur make them by aid of a good blowpipe and bellows, or are they all moulded?—G. W. A.

[60769.]—**Capell Fan.**—Will some of our readers give me a sketch of the Capell fan (double inlet), made by Heenan and Froude, Birmingham?—H. S. H.

[60770.]—**Field Magnet Winding.**—TO MR. BOTTONE.—Will you kindly help me in winding my dynamo? Some five or six years ago I designed a dynamo as per sketch before I was aware of the importance of using wrought iron. The armature is made up of two cast-iron rings with eight recesses in each for winding coils in (Fig. 1), placed side by side, with the coils of the one in advance of the other, as in a Burgin machine. These coils, sixteen in all, are connected up as in a Gramme ring, and their respective resistances are as follows: 0·18, ·15, ·16, ·15, ·14, ·16, ·16, ·16, ·17, ·20, ·17, ·18, ·17, ·15, ·16, ·19 of an ohm. The field



magnets are built up, as shewn (Fig. 2), of castings, all annealed. The bobbins, A, A, A, A, are cast separately for winding, and are fixed by a wrought-iron core running through them and bolting on the end pieces. This is as far as I have got. Now I should like to finish it. I don't care whether it is series or shunt wound; but I should like to get 12 volts and as many ampères as I can, say, at from 1,000 to 1,500 revs. Will you please tell me what quantity of wire to put on the bobbins and the B.W.G.? I think that on the armature is 20 or 22 B.W.G. I don't want to alter or make new field magnets if I can help it; but if you think it absolutely necessary, will you give me a sketch of what you would propose? I want to light as many 5-candle lamps as possible.—ANXIOUS.

[60771.]—**Ventilation.**—I am about to build a house at a cost of about £650, and am much perplexed as to ventilation, which I wish to be as perfect as may be. My architect, who is supposed to be a good one, suggests building shafts alongside chimney drafts, and putting Sherringhams in near ceiling for exhaust use, without providing for inlets. I think this is wrong altogether. I would not trouble you for your opinion, but I have read several works on subject which seem to treat the question in a very tentative manner, and all of which are rather opposed among themselves. Will you kindly advise me or indicate where I can find the knowledge I require? I estimate the ground floor will contain 10,000 cubic feet, the first floor 9,500, and the attics 5,000, and am inclined to ventilate as follows: (1) Have doors, windows, and fireplaces as near on one side of rooms as possible; (2) Have openings in wall opposite fireplaces, close to ceiling, connected with pipes, which shall lead from various rooms to chimney flue, and be conducted in cluster up same to outer air, the cluster of pipes being heated by pipes conveying hot water to bath room, if necessary, the hot-water pipe to be twisted or prolonged; (3) have an "Eagle" gill stove in hall to supply warm fresh air to house; (4) have ventilating stoves in living rooms. If above is a reasonable plan, I want to find out what size the pipes from living rooms and bedrooms should be—whether to supply Tobin tubes for use in summer instead of hall stove. In connection with this must be considered the probable consumption of gas, which would be in living rooms 24 cubic feet per hour.—ARTHUR ALABASTER.

[60772.]—**Running Lathe Backwards.**—When using the grindstone on the lathe, and turning it from me, as I have no guide, the driving chuck always loosens out and thus jams the stone. If this can be avoided, I shall be glad to hear.—BEGINNER.

[60773.]—**Legal Query.**—Will some legal correspondent kindly answer the following? I have been practising as an assistant to a surgeon for some years (though not qualified). Can I practise and call myself an oculist on my own account? Am fully conversant with the work and have all instruments.—OPTOTYPI.

[60774.]—**Heating Conservatory.**—"T. C., Bristol," described a boiler a few weeks back for heating small conservatory with hot-water pipes. Would he oblige by sending a sketch of same, as I have a small place I wish to heat by hot water; but I cannot understand how the boiler is made in the shape of the letter T.—C. W.

[60775.]—**French Wire or Sheet Gauge.**—There is a gauge called the French gauge, the numbers of which run as follows: 0000, 000, 00, 0, 1, 2, 3, 4, 5, 6, &c. I estimate Nos. 0, 3, 4, 5, 6 to be 75, 66, 63, 60, and 55 hundredths of a millimètre each respectively. Can anyone tell me further particulars of the gauge, and if it is based on any standard measure? A correct list of the numbers and their respective equivalents in French or English standard would oblige—B.

[60776.]—**Boiler.**—Would any practical reader kindly inform me whether a boiler 12ft. long by 3ft. wide would drive a 6 H.P. engine? It is an old-fashioned dish-ended boiler, with a straight flue underneath it. Would it be better if the flues were built round the boiler, and could I get extra power out of it by so doing?—WILLING TO LEARN.

[60777.]—**G.N.R. Locos.**—Will some railway correspondent please tell me how the G.N. manage to get such a powerful blast or exhaust on their suburban tank engines? Also whether they adopted any special arrangement of motion or valve-gear to get a pair of 19in. cylinders in between the frames of their large goods-engines that have cylinders of that dimension (19 by 28)? Are the valves underneath?—A REGULAR READER.

[60778.]—**To Mr. Bottone.**—I want to light a room 9ft. by 2ft. with electric light. I got a 2½c.p. lamp from Messrs. Shippey Bros., and made a Dale's granule battery of 4 cells, outer 8in. by 6in., and porous cells 7in. by 2in. Solution for outer, 2 parts of saturated bichromate of potash to 1 part of hydrochloric acid, and for porous, 1½oz. of salammonic and 1oz. of hydrochloric acid, and filled up with water. I cannot get the lamp up to its full power with that battery. If we substituted chromic acid for bichromate of potash, would that be any improvement? If not, what is the best battery for the purpose?—SCOTIA.

[60779.]—**Electric Gas Lighter.**—Clarke's patent Nos. 2,229 and 245. Will someone kindly inform me what kind of battery this lighter contains, and the best means of charging same?—F. G. B., Bristol.

[60780.]—**Wimshurst Electric Machine.**—I have constructed one of these machines, 16in. in diam., according to instructions in number 1123 of the "E.M." (the first number I commenced getting), and I cannot get it to work with good results—in fact, sometimes will not work at all. I shall thank any reader for instructions as to how I can work it so as to get a shock similar to that obtained from the medical or shocking coils, if such can be obtained. I see it stated in Messrs. Dale's price list, that the same results can be obtained from these machines as from the induction coil. Being a novice in electricity, I would like to know if there is a book obtainable on the application of these machines, with experiments, &c.? Any information will help me.—ELECTRIC.

[60781.]—**Corundum for Aluminium.**—We will be greatly obliged if any of your numerous readers will inform us if corundum of the following analysis would be suitable for the manufacture of aluminium:

Alumina (Al_2O_3)	68·90
Oxide of iron	4·62
Silica	25·65
Lime	·49
Magnesia	trace
Water of combination and undetermined	·34
	100·00

The analysis has been made by Bernard Dyer, F.C.S., F.I.C., of 17, Great Tower-street, London.—RICHARD BAKER AND CO., Mica and Mineralogical Brokers, 9, Mincing-lane, London.

[60782.]—**The Mustel Organ.**—Would "Country Solicitor" kindly say where the specification (French) and drawings of this referred to in one of his letters are to be obtained?—D. B. P.

[60783.]—**Battery Power.**—I wish to light by bichromate battery eight 10c.p. 12-volt glow lamps; size of cells, 12 by 8. Two carbon plates 12 by 6, and one zinc 12 by 6 to each cell. How many cells will it take, and whether lamps are in series or parallel arc?—LES DENTS.

[60784.]—**Locomotives.**—Having just returned from a visit to Scotland, I would ask one or two questions. What description of safety-valve is used on domes of North British engines in place of Mr. Drummond's Ramsbothams? What is the speciality of whistles on new Caledonian engines? The larger size has the sound of a horn. Is it a usual practice to employ bank engines on North British Railway going up to Galashiels and from Hawick, as I have seen done? So much for Scotland. Can any reader who remembers the 1851 London Exhibition give particulars of the "Liverpool" and "Folkestone" therein exhibited? I am reminded of these by the mention of "Cornwall" in last issue, which, if I remember rightly, was also shown. Besides these and

"Lord of the Isles" I forget what engines were there.—SETRACH.

[60785.]—**Induction Coil.**—What length of spark can be obtained with an induction coil as described in Mr. Dyer's book by using, say, a 6-cell Bunsen battery? I should like to ask some questions concerning induction coils; but as they will not be interesting to other readers, I should be glad if someone well acquainted with induction coils would give his address and allow me to do the questions direct to him.—HOLLAND.

[60786.]—**Colouring Photographs.**—To "B.Sc." OR OTHERS.—Would any reader kindly state clearly how photographs are tinted? What kind of colours—water or oil? What is the special preparation which renders the professionally-tinted photos. so clear and transparent? How is the colour applied to make it hold? Any wrinkles in the manipulation, &c., will oblige—BENSON.

[60787.]—**Earth Connection—Leakage.**—C M L is a battery circuit. At the point M a connection is made to earth. What is the result? Please explain by reference to potentials and resistances.—GAR.

[60788.]—**Botany and Geology.**—Will some fellow subscriber recommend me some books suitable to study for the Honours Examination in botany and geology of the Science and Art Department? I have obtained an advanced certificate in each. I believe that it is necessary to know the recent advances and discoveries in these subjects, and for this the ENGLISH MECHANIC is invaluable. Are there any other periodicals that would be useful? Any hints as to mode of study, &c., would be acceptable. Is Bournemouth a good locality for practically studying these subjects?—PYRAMID.

[60789.]—**Coil.**—I have constructed an induction coil of the following dimensions: Bundle of soft iron wire, ⅝in. by 7in., two layers of No. 16 double c.c. for primary, 1lb. of No. 36 silk-covered wire for secondary coil. Each layer is most carefully wound and varnished. Will anyone say how many square feet of tinfoil the condenser ought to contain, and what length of spark I ought to get with two bichromate cells, each containing two carbon 6in. by 3in. plates, zinc between.—WILLIAM WILD.

[60790.]—**Pressure on Model Boilers.**—Will some reader of practical experience kindly tell me what pressure an iron boiler 10in. long, 5½in. in diam., cylindrical in form, iron 1-12in. thick, will safely stand, the boiler being riveted and brazed; internal firebox with tubes screwed on? I don't understand how "Glatton" gets his 24lb. per sq. in. in No. 60548 Replies to Queries.—PUZZLED.

[60791.]—**Tangent Galvanometer.**—Will Mr. Bottone please tell me the correct way of calculating the strength of current in ampères with the above? Say in Birmingham you get 20° deflection with a coil 12in. diam. and magnet 1in. long, what is the current flowing? Only one coil of wire in ring.—CARNWORTH.

[60792.]—**Achro. Objective.**—I want to try my hand at a 4in. achro. objective, and would thank anyone for a little instruction. What are the best books to study? Where to get suitable glass (as I have no idea where to get it)? I have been practising with British plate. What focus best suited for the dia. and a (simple, as I am not far advanced in algebra) formula for finding the curves to produce achromatism? Dia. of cast-iron tool and polishing tools? What are best materials for grinding? I am using emery for coarse and fine grinding, then powdered pumice stone, and polishing with rouge. Can I do better with any other powder? An answer to 60611 would oblige—YOUNG MECHANIC.

[60793.]—**Wine Cellar.**—I wish to mature some whisky, brandy, and rum. Will some of your correspondents kindly say in what kind of casks this is best done for each respective case, and if I can do so by buying at maker's prices and placing in "bond"? Also, which whiskies make the best "blend"? I understand a good safe whisky is made up of not less than equal quantities of three distilleries. Which three are recommended?—EDINBURGH.

[60794.]—**Brazing.**—Having broken one of the teeth of one of the change-wheels of my lathe, I should be very thankful to some reader if he could instruct me. How could I get it put back again? Is there some method of brazing it together?—YOUNG TURNER.

[60795.]—**Studio.**—Will any reader inform me the best way to range the glass in my studio to get the best maximum of light for taking negatives? My studio is 14ft. by 8ft., walls 6ft. in a close back yard, ends running east and west. What sort of roof is the best?—A STUDENT.

[60796.]—**Spark from Wimshurst Machine.**—Would Mr. Wimshurst kindly let me know how to get the longest spark from one of his influence machines? I think he has mentioned "smallness of Leydens" for length of spark. The machine I refer to has 24in. discs and 20 segments. Also, would a condenser do instead of Leydens, and, if so, would not larger sheets of foil in condenser give denser sparks?—T. E. F.

[60797.]—**Bookbinding.**—Would some correspondent tell me the right way to prepare and use glair in bookbinding? I wish "Practical Bookbinder" would give us an article on plain finishing, as I believe it would prove very acceptable to a good many amateurs like myself.—A. ADAMS.

[60798.]—**Fixative for Drawings.**—Can anyone inform me how to make a varnish with methylated spirit to use with a spray-producing apparatus for fixing drawings? What kind of gum is soluble in methylated spirits?—D. S.

[60799.]—**Srew-Cutting.**—Suppose it be required to cut a screw 1¼ diam., and a nut to fit it, what size should the hole in the nut be before cutting thread in it? Any suggestions as to the sizes of other holes for other diams. will be thankfully received. The above is for a Whitworth thread.—POOR SCREW CUTTER.

[60800.]—**Ratepayers' Association.**—Will any reader be kind enough to tell how to start a ratepayers' association, and how to work the affair? What power will it have when established? Any information relative to the above will oblige—RATEPAYER.

[60801.]—**Mechanical.**—Will some of our electrical experts give the relative resistance between armature and field magnets for plating dynamos, series and shunt?—T. L. H.

[60802.]—**Spanish.**—Some of your corrrespondents recently recommended Foerster's "First Spanish Course on Ahn's system." This I got and studied. Could they now kindly oblige by saying what books they would recommend for further progress to one who has no facilities at present for attending classes or obtaining personal instruction?—PARALOS.

[60803.]—**Wheels and Axle.**—I should be glad if some kind reader would tell me, through the columns of this paper, how to make a good pair of cart wheels, and also how to put them to run well? I have heard of the axle fixed and the arms set by cross lines, but have no notion how it is done, being a young country wheelwright.—A NOVICE IN THE TRADE.

[60804.]—**Burgin Armatures.**—Can any reader of our valuable journal give me the probable cause and how to prevent the armature coils fusing in this dynamo, which have given me much trouble? The wires appear to get hot generally in the centre of the coil, and the heat increases until eventually the cotton covering burns, and insulation breaks down entirely. Is it possible to be brought about through opposing currents in the armature due to the collectors not set on the commutator in the proper position—i.e., one brush having too much lead, or both making contact with too many segments at the one time? The armature in question is used for arc lighting, and for some time I thought the fault was caused by excess current in the circuit through a lamp burning close-arc, or entirely out; but I have known it occur when the lamps were all steady and burning.—MILLER.

[60805.]—**Accumulators.**—I have a shunt-wound dynamo, giving 60 volts and 18 ampères, charging 26 E.P.S. Company's S type accumulators. I find that when starting to charge them (though I never allow them to get below 2 volts apiece), the engine goes at a certain pace; but when fully charged (that is, when the acid gets milky) the engine goes faster. How is that? Ought not the engine have more work to do when the accumulators are so full (the E.M.F. being more than 2 volts apiece while in that state)? A gas-engine is used with governors tied down, so that speed ought not to alter, unless load is taken off. Also, what is about the internal resistance of these cells?—P. LONDON.

[60806.]—**Storage Battery.**—Is it possible to make a storage battery capable of transportation after charging, say, from London to Edinburgh?—those that I have seen being accumulators only and not at all adapted for moving. It seems to me one might be constructed somewhat in the manner of a sawdust or paper-pulp cell, which might, with ordinary care, be moved from the place of charging to where it was required to be used. If this is practicable, will any of "ours" kindly give me details as to construction, &c., of a battery capable of lighting a 600c.p. arc lamp of the ordinary type for a period of two hours for once charging? Also, what would be the utmost limit of time between charging and using?—AMPERE-METER.

[60807.]—**The Mersey and Severn Tunnels.**—What are the respective depths below Ordnance datum at the level of the rails in the lowest points of these two tunnels? I have examined the accounts of them in several engineering papers, but in none is there any reference to Ordnance levels. From aneroid observations, I estimate the depth at the bottom of the former to be approximately 110ft.; but should be glad to know the exact figures; also the heights of the various stations on the Mersey Tunnel Railway.—PARALOS.

[60808.]—**Small Gas Engine.**—Would any of "our" "knowing ones" kindly give me the following information? I am thinking of making a small gas-engine during the winter. What are the best proportions of gas and air to explode? What length of stroke and size of cylinder most suitable for about ½-man power? How is the noise of explosion deadened as in the Otto? Shall be grateful for any suggestions and sketch of design. Prefer upright type.—S. S.

[60809.]—**Electricity Accumulator.**—Can I be informed through your columns if electricity can at present be stored so as to be commercially practicable—that is, what might be the size and cost of an accumulator or store to hold, say, sufficient to work an engine of, say, 10 horse-power, for, say, 100 hours, or for lighting purposes to light a railway station for, say, 100 hours, or, if the above is too large an amount, say the half or third of the above?—G. A., Glasgow.

[60810.]—"**Relief" Map of the Moon.**—I am anxious to make "Relief" representations of several of the principal lunar formations separately or in groups, and would much value practical help from "F.R.A.S.," Mr. Elger, or any of "our" many competent correspondents. Please say what material and scale would be best to employ? Also give typical example of how to reduce depth and extent of craters, &c., to scale adopted. I am sure the information would be of general as well as of special interest.—S. R. C.

[60811.]—**Solar Shadows.**—Would "F.R.A.S." be good enough to inform me whether and when any attempt has been made to ascertain the shape of the solar shadows at the equinoxes at the Equator? If the earth revolves on an axis, and the sun is in a direct line with the Equator in March and September, ought not the shadow from a perpendicular staff to be perfectly straight, first westward, then eastward, of such perpendicular, so—

(Sunset) W ——— . ——— E (Sunrise)

If it is not so, what shape is it, and why? And, indeed, I need not limit it to the equinoxes; but when a sphere revolves on an axis before a stationary light, all shadows from upright staves should be absolutely straight. Am I right or wrong?—JOHN HAMPDEN, Balham.

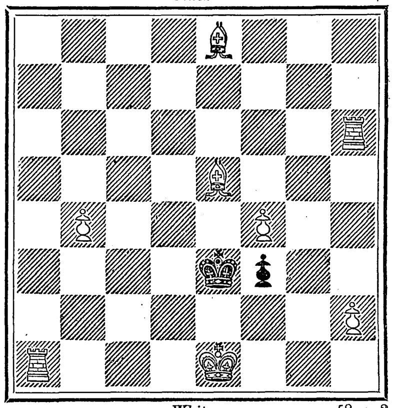
[60812.]—**Paper-Making.**—Can anyone assist me to a better understanding of following par.?—"A plan for rendering paper as tough as wood or leather has been recently introduced on the Continent. It consists in mixing chloride of zinc with the pulp in the course of manufacture. It has been found that the greater the degree of concentration of the zinc solution, the greater will be the toughness of the paper. It can be used for making boxes, combs, for roofing, and even for making boots." At what stage of paper-making is the chloride of zinc added, and in what proportions? And much oblige.—PAPYRUS.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXV.—BY A. BOLUS.

Black.



White. [8 + 2

White to play and mate in three moves.

SOLUTION TO 1,013.

White.	*Black.*
1. R-Q B 8.	1. Anything.
2. Q, R, B, or Kt mates.	

(Fourteen variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,013, by I. M. Brown (hackneyed), Black Pawn (easy; also a dual), J. Mackenzie, A Beginner, A. Bolus, Isca, and Avon; to 1,012, by A. Bolus, Thomas Quilliam, M. Blackmore (fine and difficult), G. A. A. Walker (exhibits beautiful chess), and I. M. Brown (fine specimen of the attacking style).

J. MACKENZIE.—In your attempt at 1,012, where is the mate if 2. $\frac{}{\text{P-Kt4}}$?

CAISSA.—Your solution to 1,006 is correct, but it was published some weeks ago.

G. A. A. W.—We congratulate you on having solved a very difficult problem under adverse circumstances.

I. M. B.—Many thanks for report, which we have found interesting. We are glad to find the Leeds Chess Club so flourishing.

WHITE PAWN.—You have failed again, but do not be discouraged. If 1. R-K 3, 1. R checks, and there is no mate. You must always give Black his best play.

A. DEAN.—You have put in your solution 1. Q-Q B 7; but it *is* there!

J. P. TAYLOR, J. Slater, C. J. Lambert, and W. H. S. Monck are thanked for problems and games. *The Wanderer* received with thanks.

THE result of Tourney B (solutions in two and three moves) is as follows: A. Bolus and the Hon. Sec. Leeds Chess Club bracketed, equal for first prize, Pierce's "Chess Problems," number of marks, 225; 3, M. Blackmore, 208, Miles's "Chess Problems and Poems"; 4, G. A. A. Walker, 201, J. P. Taylor's "Dot." The remaining competitors come in the following order: 5, G. T. Stringfellow, 166; 6, A Beginner, 150; 7, F. W. S., 120; 8, T. Quilliam, 110; 9, A. Dean and Link, 94.

THE problems which produced the greatest inequality were 1,005 and 1,009, which had more than two solutions; also 1,000, which had two solutions. It has been a pleasure to receive solutions from all these competitors, who have shown that no three-mover is too difficult to baffle them, and also that they fully appreciate the beauty of a problem when there is any there.

THE result of solution Tourney C will be given in our next. We hope to be able to start new Tourneys on similar lines in the course of two or three weeks.

A COLLEGE for the training of actors has just been founded in Berlin in imitation of similar institutions at Paris, St. Petersburg, and Vienna.

THE number of Freshmen who have been entered at Cambridge this October is 938, being the largest entry ever recorded. Trinity College heads the list with 197.

THE entire length of railroads of the world up to the end of 1884, as recently published by the Prussian Minister of Public Works, was 291,000 miles, an increase of 27 per cent., or over 60,000 miles, during the preceding five years. Of the entire length, very nearly one-half is that of the American Railroads, mainly in the United States.

AN amusing incident occurred last week at the Colonial and Indian Exhibition Aquarium, where a remarkable raven from the Isle of Mull is now on view. On being fed, it is the habit of this bird to hide the remnants of its repast in various parts of its habitat, and exhume them when prompted by hunger to renew the meal. One day a rat invaded the spot, and commenced to excavate for the hidden articles of consumption. Enraged at this proceeding, the raven fell upon the rodent, and gored it to death after a severe struggle on both sides.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 27, and unacknowledged elsewhere :—

JAS. MURRAY.—Medical Battery Co.—Leroy and Co.—W. Grimshaw.—F. A. Moilliet.—R. Hughes.—C. D.—W. Saunders.—T. E. Espin.—Taube.—Northern Counties.—Motion.—F. G. F.—J. Riley.—C. J. Tahourdin.—Geo. Hunt.—Engine Driver.—G. Bowron.—A Fellow of the Royal Astronomical Society.—A Socialist.—S. H. Smith.—J. C. W. Kershaw.—Hendon.—E. J. L.

W. J. JOHNSON. (The query has been inserted, and we must refer you to the replies, if any appear. The query omitted to mention the pressure and number of revolutions, and possibly may remain unanswered in consequence. You will not gain much by increasing the length of stroke, as such engines do best when running quickly under high pressures. We had no idea that you were working at such a pressure as 60lb.)—WALLACE NEWLAND. (In the surface condenser the steam is brought into contact with the surfaces of a number of tubes, through which cold water is drawn, and the steam, being condensed, can be returned to the boiler. The other form of condenser has a jet of water thrown into the steam, and the latter is thus mixed with the sea-water. It is usual to fit the surface condenser so that a jet can be used when advisable.)—DIVES. (See index to the last volne, under head "Fire-grenades.")—A READER, F.D. (A Bunsen cell consists of an outer jar, generally stoneware, containing a porous pot, which latter is occupied by a stick of carbon immersed in the strongest nitric acid. The porous pot is surrounded by a slit cylinder of zinc, immersed in dilute sulphuric acid. If you procure a list from Mr. Blackwell, 26, Chapel-street, Liverpool, you will find the various sizes of parts suitable for battery construction.) — ALKALI. (The sand-blast is used for many purposes, but mainly for abrading surfaces, such as glass, instead of grinding or clouding with acid fumes. It is also used for sharpening files. See Vol. XXVII. pp. 314, 437, or Vol. XVI. p. 235.)—READER, Weaver-street. (The query about the result of an irresistible body coming into contact with an immovable substance was inserted many years ago, and an apparently satisfactory answer is that the larger substance has a hole made in it. The question is, of course, nonsense.)—G. COLE. (The year 1900 will not be a leap year. Easter Sunday will fall on April 15, unless the modern system of arranging the movable feasts is altered by that time.)—VALENTINE. (There are several books about gasworks; but you do not specify what information you require. See "Common Sense for Gas Users," published by Crosby Lockwood and Co., Stationers' Hall-court, E.C. 2. It all depends on how much the burner can pass. A standard consumes five cubic feet an hour, but the majority of burners consume about three cubic feet.)—T. M. (Get the iron thoroughly clean by pickling in acid and rubbing with sand, and then immerse in a bath of molten zinc which is covered with a layer of salammoniac to prevent oxidation.)—C. (Barlow's "History and Principles of Weaving," Sampson Low and Co., may suit; Bischoff's "Woollen and Worsted Manufactures," Smith, Elder, and Co., is another. 2. For marine engineering, Sennett's work, published by Longmans, or Reed's "Engineer's Handbook," T. Reed and Co., Sunderland.)—W. G. M. (As you have been a subscriber for so many years, you will remember the explicit instructions given in the notes on plumbing. Lead-burning has, however, been frequently described; but see Nos. 912, 913, 915.)—A. B. (Nothing is better than air drying—that is, natural seasoning; but there are several processes nowadays with both dry air, steaming, &c.)—FLAVIUS. (The query must be more definite; but by searching the indices you will find references to devices of the kind.)—F. F. F. (What is it you mean—one of the screw copying presses, or one of the glue and gelatine "graphs," as they are termed? If the latter, answered many times; if the former, you must find out where to buy the castings, or the press will cost a great deal more than you could buy it for.)—E. P. B. (Neither well rounded or pointed; the essential thing is to have it set properly. Mitchell's F is a good pen for inking in.)—LECTURE. (Send the question to *Bicycling News.* We do not think such statistics have been published, and we cannot spare space for the insertion of such a query.)—E. S. MARRINER. (We have given details of the latest improvements in telephones, which you will find by reference to the indices.)—G. W. MOORE. (Perhaps you mean the mechanical telephone. If so, see No. 1061, p. 447.)—J. K. (If the plates and other parts are in good condition, it would be worth while having it "formed" if you have any use to put it to.)—MECHANIC. (The method of sharpening horse-clippers was described in No. 875, p. 410. They are usually taken apart and rubbed on a strong glass plate with fine emery and oil.)—S. H. (You will find many recipes for secret inks in back numbers, but possibly the best is a solution of chloride of cobalt, which appears when the paper is warmed and fades as it cools.—A NOVICE. (By fitting a layer of swansdown over the vent holes. The swansdown is usually glued to a bit of board, so that it can be readily removed when all the noise of the instrument is required.)—HENDON. (It is scarcely likely that any work of the kind has been published, as the sale would not pay for the printing; but you will find information in the back volumes, and in "Amateur Handicraft," published by Kent and Co., Paternoster-row, E.C.)—SHINY BOOTS. (If you refer to the "Answers" last week, p. 184, you will see that a correspondent is referred to Dircks's "Perpetuum Mobile," published by E. and F. N. Spon, 125, Strand. It gives illustrated descriptions of most of the schemes for producing perpetual motion.)—E. N. M. (The defects are probably in the medium used between the lenses, but you must get a practical man to examine them.)—J. W. BUTTERFIELD. (Diving is altogether peculiar work, which demands not only special but constitutional aptitude. If you can procure a medical certificate that you are capable of undertaking such work, Messrs. Barnett and Foster, 25U, Eagle Wharf-road, New North-road, London, might be able to put you into the way of finding employment.)—JOHN J. GILBERT. (We shall not be able to publish the lectures, nor do we suppose the lecturer would like them published. 2. We do not think any of our readers are offended by such remarks.)—SAN REMO, VAN EYS. (Yes, decidedly. An electro-plater who has any amount of work would find it advantageous to use a dynamo. If you look through the advertisement columns, you will see announcements of dynamos for sale suitable for plating purposes.)—AMBER. (Certainly it matters—the object is to get a length of wire on as closely as possible to the core; but there, rough winding would be altogether unworkmanlike.)—S. B. T. D. (The only book is "Back Numbers." Read an article in No. 1061, p. 447, and see if you grasp the principle.)—SOLAR RADIENCE. (You do not appear to see that a full answer would involve a gratuitous advertisement, and if we permit that in one case, we ought in fairness to allow others the same privilege. Procure the catalogue of published books issued by G. Philip and Son, 32, Fleet-street.)—WINDERMERE. (Just so; but then it is simply impossible for us to repeat what has been already given, merely because a reader has not the opportunity of referring to back numbers. If the information is worth having it is worth looking for, and it can be found in recent numbers. 2. We quite understand your question about asbestos cloth instead of porous cells, and refer you to previous answer, p. 184. 3. If the battery cells are required for a hot country, better have them properly lined with lead, or use glass or stoneware. 4. As to the ecclesiastical or legal opinions, as there is already so much difference, and they are really of no interest to a hundredth per cent. of our readers, why should we encumber our columns with queries which "five bishops" cannot agree to answer definitely? They are questions which only the highest courts of the realm can finally answer.)—L. (We gave the recipe for transparent cement on p. 182 as we found it; but we think with you that the proportion of chloroform to caoutchouc is much too small.)—15 YEARS' SUBSCRIBER. (If it makes you feel sick, it is decidedly injurious; but why heat petroleum spirit to 100° Fahr. and then breathe the vapour? If you are referring to a lamp, then that is not properly trimmed.)—D. BOOTH. (There is an article on "Japanning and Japans" in No. 860; and an article on "Blacking Optical Work" in No. 944.)—INQUIRER, G. J. J. (Mere guesswork without an opportunity of examining the walls. Try water-glass both outside and in, or cement or tar the outside.)—BOOTES. (Boiled oil 1 pint, bees-wax and yellow resin 2oz. each Melt together. That is liquid or semi-liquid. A dubbin is made by boiling 2lb. of black rosin and 1lb. of tallow in a gallon of cod, train, or whale oil.)—PHOTO. (Good glue or copal varnish will probably answer. 2. Depends on the nature of the recording instrument. Those having a continuously revolving drum produce a flowing curve. See Redier's barograph in No. 999.)—MOTOR. (You will find the information you require in back numbers. A gas-engine properly constructed and properly looked after, does not require to "be stopped and the cylinder cleaned often.")—B. (Boiled water is the best remedy for gout when distilled cannot be obtained; but a still can easily be arranged or an ordinary glass chemical retort be utilised for the purpose.)—W. G. MORGAN. (Australia or New Zealand, we should think. If you have had experience in the work, no doubt any of the agents for the Colonies would forward your application to the right quarter, or you could write direct to the locomotive superintendent of any of the lines. The Agent-General for —— (mentioning the colony), London, will be sufficient address.)—R. A. R. BENNETT. (No, we think not; but it could be managed by removing the tube and having a standard tube to take various kinds. Why not write and ask him direct?)—SOUTH COAST. (It could be done by carrying the flow-pipe up a sufficient height; but it would be troublesome and expensive. 2. Such a boiler is scarcely suited for the purpose. It should be a proper steam boiler to be safe.)—B., Dulwich. (Only in the Greenwich returns, we believe, for so many years; but try the library of the Royal Meteorological Society.)—W. F. P. (You do not say whether you mean waggon coupling, coach coupling, or brake-pipe coupling. If the first, no one can answer—not even the Americans, and they have made a good many trials. None has been adopted in this country. See index to last volume.)—INQUIRER. (Directions for polishing a ball-room floor were given in No. 1073, p. 148.)—TOM. (If you have not a lease, the landlord can compel you to leave by giving the proper notice, which appears to be a week, as you pay weekly. If the drain is in such a state that you talk of calling in the sanitary inspector, we should think you would do well to get out of the house and take one where the drains are in order.)—AN AMATEUR. (Sketches of model boilers in Vol. XLIII. pp. 63, 193; Vol. XLII. p. 346; Vol. XLI. p. 110; Vol. XL. p. 239; and so on through all the back volumes. Probably one illustrated in No. 1025 will suit you; but if you can see the back volumes you will have a large number to select from.)—S. (Mr. Wassell's papers on polishing glass specula commenced in No. 852, and Mr. Brashear's paper on making flats is in No. 883.)—A BEGINNER. (You will find it more economical to buy the porous pots.)—AN AMATEUR ELECTRICIAN. (You will find descriptions of most in back volumes; but there have been so many modifications, that it is impossible to say now without examination of a specimen. Surely those who sell them publish descriptions.)—BUILDER. (Better write the secretary, at 9, Conduit-street, W.)—VIBRATOR, F. L. STRIFFLER. (In type.)

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NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

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The English Mechanic

AND WORLD OF SCIENCE AND ART.

FRIDAY, NOVEMBER 5, 1886.

MICROSCOPICAL ADVANCES.—XIV.

By Dr. Royston-Pigott, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians, Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

Solar Spectra emitted by Small Lenses.

HERSCHEL'S solar shutter-beam, described in No. XIII., is extremely inconvenient; in fact, quite unmanageable for systematic observations.

I beg now to allude to some interesting results arrived at in bright daylight, and without any shutter-hole in a darkened room:—

The researches detailed in the present paper were commenced in May, 1871. The results arrived at were largely obtained by using the microscope. Similar, but less brilliant and more scanty appearances, can be obtained with the telescope; but the very high power and ready adaptability of the former confers some advantages not offered by the latter. In both, however, the same principles are illustrated.

A cone of rays of small angular aperture, having the object-glass for its base in each case, engages the eyepiece, and emerges parallel, and the eyepieces are similar in each.

Peculiar facilities for studying solar spectra and their indications of aberrations and mechanical errors are also afforded. The focal plane of vision may be employed to examine the effects of the interference of complex cones of light of large angular aperture, at least twenty times larger than those observable by the telescope.

The discovery by the writer of an unsuspected residuary aberration in the best microscopes, described in the "Philosophical Transactions" for 1870, renders it probable that some such a residuum still remains in telescopes.

Eyepieces, abounding generally with spherical aberration, require also particular attention. I have repeatedly observed a fine state of definition completely blurred merely by a change of eyepiece of the same power which no mere focussing ameliorated, and which could be only corrected by a change in the convergent pencil passing through the objective intrinsically affecting its aberrations.

Another branch of such an inquiry is the nature of the definition of an organic particle under high powers; as every such research, such as the detection of the characteristics of diseased and healthy cells may be resolved into the power of the microscope to define a single organic particle. Such particles are generally brilliant and refracting spherules, and the errors of observation are unfortunately at present of a numerous kind.

On the Circular Solar Spectrum.

Experiment.—If a lens be so placed that its axis is coincident with that of the microscope, and if its principal focus formed by the solar rays be examined by an instrument of the highest quality, we shall find that minute slices, as it were, of the solar cone, present phenomena of rare beauty and order, dependent on the quality of the examining instruments.

Experiment.—If two plano-convex lenses be placed with axes coincident, a good many coloured rings may be counted, *but no black ones*. As soon as their axes become oblique the solar spectrum takes an intricate form, whilst the centre shows a brilliant cross. Very difficult to describe or represent by portraiture, but worthy of the highest photographic art, are all the forms developed.

In my former research I had observed a flame-disc in a darkened room. This disc presented two or three diffraction rings similar to those of telescopic stars, but much broader. The same method was attempted with the sun. Various objectives were employed to obtain a solar miniature of the sun's disc.

Plane mirrors, of glass, silvered at the back, entirely failed.

In order to form a pure and brilliant solar spectrum, it occurred to me to take advantage of the principle of total internal reflection from a prism. I then constructed a prism-heliostat, which, acting in sunshine, presented an aërial miniature of the sun of great splendour (almost as dazzling as the sun itself) for half an hour, without further adjustment.

The heliostat was furnished with a double convex lens of crown, the prism being of flint glass. Extra lenses could be applied so as to reduce the solar miniature from 1-40th of an inch to any required diameter. In some cases object-glasses and eyepieces were also interposed to receive the minute solar beam. The whole apparatus was rendered as achromatic as possible.

Received by an inverted object-glass of fine quality attached to the substage at a distance of 200in. from the heliostat, the original miniature could be again reduced. A theoretical diameter of sixteen-millionths of an inch was found convenient.

(*Phil-Transact.* 1870, p. 595:—

"Diameter of disc at prism 3 × sin. 30′..................	= 0·026
Diameter of miniature at 200in. reduced by 1-8th objective 1,600 times (16 millionths)	= 0·000016
Observed diameter of solar disc, exclusive of its jet black diffraction ring...............	= 0·00061

As 0·000016 is to 0·000061, so is 1 to 4 nearly, or the observed miniature disc was enlarged just about four times greater than it ought to be.")

To moderate the overpowering brilliance of such a spectrum directly viewed, neutral-tinted slides were at first used, or smaller discs formed by deep heliostatic lenses.

When this minute spectrum is viewed with a power of 1,000, the phenomena attending residuary errors, whether of achromatism, or spherical aberration, or mechanical construction, are demonstrated with so keen a severity upon the handiwork of man as to throw all other methods into the shade. An extraordinary number of richly-coloured rings of dazzling brilliance was now exhibited in the plane of the focal vision of the solar disc.

The most striking figure amongst so much effulgence was an intensely black (*jet black*) diffraction ring encircling the central disc. The appearance of the rings changed every instant with the slightest change of focus, and their tints indicated the nature of the "secondary spectrum."

Upon closer inspection my curiosity was excited by observing the shape of the primary central black ring, somewhat squared off, as though not consisting of one true black ring. I then found, by changes of eyepieces, length of body, and collar corrections, that it was composed of several *eccentric rings*.

In some cases the movement of the Ross collar adjustment produced two false central discs. Another glass gave four false discs in a deeper focus. A 1-16th was fitted with a water-immersion front; this now displayed two, each disc displaying its own diffraction system of rings. It was now necessary, then, to insure only one axis by using a simple plano-convex lens to form the miniature sun.

An extraordinarily fine ⅛th immersion, at first used dry, produced from the miniaturing lens a crimson solar disc, edged with deep black. Deepening the focus, with exceeding lightness of touch, the central disc became pearly white, set off prettily in its black setting, and a number of pale lavender, pale rose colour, and then brilliant circles of bright green, with intervals of orange red, and more outwardly circles of red merging into ill-defined black.

Upon water being introduced between the objective and a small piece of glass cover 0·003in. thick, the central solar disc appeared single, and bounded by a clear, sharp, jet-black truly circular ring. By lengthening the body, and using different eyepieces and stage lenses, at last the whole field was perfectly filled with forty-eight magnificent rings, glowing with exquisite tints, which vividly reminded me of Sir John Herschel's eloquent language on telescopic diffraction phenomena. The field was apparently 4in. broad.

If the stage or miniaturing lenses be used smaller and smaller, many of these effects are suppressed. When we come to diatomic beading, some, however, are still preserved and exhibited.

Three general features were constantly observed: the rings were seen either wholly or chiefly on one side of the solar disc—i.e., either within or without the focus, or nearly similar except in colour on opposite sides of the focal point.

If the rings were on one side only, a nebulous brightness occupied the other side, into which the solar disc suddenly resolved itself on a slight change of focus; but frequently this nebulosity assumed a fine-grained "engine-turned pattern." Occasionally two primary discs, each with its own system of rings, struggled for the mastery; and, on changing the focus, a chromatrope effect was produced by the expanding rings and their eccentric intersections, presenting extraordinary loveliness of colours.

In these researches a very near approach to achromatism was signified by the whiteness of the central disc, the blackness of the fine rings contrasting finely with the intervening rings, which were then of a very pale and yet brilliant lavender.

Destruction of spherical aberration appeared imminent when the rings still coloured were tolerably symmetrical on different sides of the finest focal disc with contrasting colours of the residuary spectrum. Mechanical errors were revealed by irregularity of marking and complexity of form.

I shall now venture to detail some of the particulars attending the circular solar spectrum formed by a small plano-convex lens transmitting a minute beam of sunshine from the heliostatic system.

Description of the Rings of the Circular Solar Spectrum produced by a small convexo-plane lens observed in the focal plane of the solar disc.

Coloured Rings.	Intervals.
1. Central disc, white.	Primary ring, jet black.
2. Pale lavender	Secondary ring, black.
4. Lavender	Third ring, black.
6. Lavender	Fourth, black.
8. Lavender	Fifth, black.
10. Pale rose	Sixth, dark red.
12. Bright green	Seventh, dark red.
14. Bright green	Eighth, dark red.
16. Bright green	Ninth, dark red.
18. Bright green	Tenth, black.
20. Dark orange	Eleventh, black.
22. Deep orange	Twelfth, black.
48. No record	No record.

A high-quality water-immersion was used with a piece of glass 0·003in. thick, attached by water to the front lens of a 1-10th objective, giving a power of 1,000 diameters.

A remarkable fact appeared. Each of these 48 rings, under a power of 1,000, measured by a Browning recording micrometer, appeared exactly of the same breadth.* The thickness of the primary jet-black dif-

* The 1-16½ thousandth of an inch.

fraction-ring corresponded exactly to the wave-length of the line F in Fraunhöfer's Spectrum—viz., 0·000406 millimètres, or 52,256 waves per English inch.

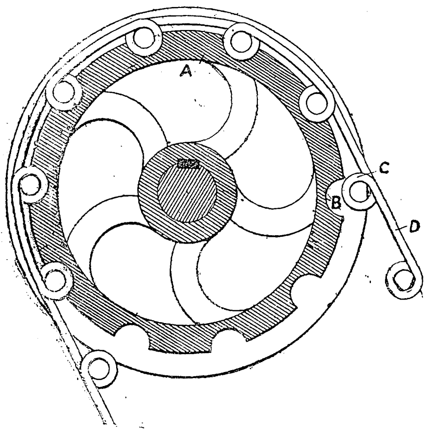
The precision of the construction of this fine glass was revealed by the use of a simple plano-convex lens, illuminated by a small pencil of solar rays. This speaks volumes for the use of diatomic lenses, such as have already been described in these articles. No one could have foreseen that an ordinary plano-convex lens of ¼in. focus supplies a most severely cruel test of the goodness of an objective; indeed, it seems doubtful to me whether any glasses in the world now extant can go through this ordeal without scathing its reputation. It is the action of the wavelets of light which here tests the glass.

In the next article I propose to deal with some of these exquisite revelations, giving drawings of results and the instrumentation.

(*To be continued.*)

STARLEY'S IMPROVED DRIVING GEAR.

UNDER the title of "Improved Means for Transmitting Motion between Pulleys or Drums," Mr. J. K. Starley, of Coventry, has recently obtained a patent for driving "bands" made of steel wire with coils. This invention



is designed to provide a substitute for the usual pitch chain (which, from the frictional parts contained therein, is liable to elongate in the pitch and so get out of truth with the wheel) or for the ordinary metallic bands, which are liable to break. The steel or other suitable wires or strips are coiled in one or more coils at intervals, and arranged to enter corresponding recesses in the pulleys or drums. The wire can be continuous or made in sections for the purpose of hardening the coils, such sections being coupled by suitable connections—such, for instance, as pieces of sheet metal gripping the ends of each opposite coil or pair of coils and riveted together. To assist in driving, pegs or studs may pass through the coils or through the couplings uniting them. Suitable recesses are made on the peripheries of the pulleys or drums for the coils and the wire to enter and where pegs or studs are used, transverse recesses may be made across or between the wire and coil recesses, according to the position of the pegs or studs. The coils are made for the purpose of allowing the wires or strips to twist or untwist without breaking as the pulleys or drums revolve, so that the wire may spring to the form of the pulleys or drums. By this arrangement the wire or strip can adapt itself when passing from the curve or form of the pulleys or drums to the straight again, and so relieve the strain. Such improved means of transmission is specially applicable for driving velocipedes or like machinery. In the figure, which represents one pattern of the new device, A is a pulley or drum, say, for driving a cycle, and B represents a simple shape of recess; C shows the spring coils formed at suitable intervals in the wire D. The ends of the wires can be coupled by, e.g., two solid pieces partaking of the shape of the coils, which are screwed on to the ends and connected together by a pin; but the device lends itself readily to many modifications, as will be understood.

LITHANODE: AN IMPROVED NEGATIVE ELEMENT FOR BATTERIES.

THOSE of our readers who have read the numerous notes on improvements in voltaic batteries which we have published from time to time will be aware that Mr. Desmond G. Fitzgerald has been making an elaborate search for more useful battery elements than those which are well known, and a reference to No. 1107, p. 316, will disclose the fact that some time ago Mr. Fitzgerald took out a patent for a method of utilising oxide of lead which has since been carried to something near perfection. The object the inventor had in view was to produce a dense and coherent mass mainly composed of oxide of lead, which could be reduced to porous metallic lead or converted into conductive peroxide of lead; and, further, to produce by chemical action a superficial coating of peroxide upon the surface of the dense masses, so that the latter could be used at once without preparation by way of charging. This method had been found so successful in the experimental stages that, some months after Mr. Fitzgerald had applied for a patent, a similar specification found its way to the Patent Office; but with that we have nothing to do. At the late meeting of the British Association, Mr. Fitzgerald read a paper in which he drew attention to the merits of Lithanode, a substance which he says is admirably adapted for the negative element of batteries, whether primary or secondary, and is also a perfect anode for the electrolytic separation of the most electro-negative elements—for instance, chlorine. The essential requirements in a negative element for use in a voltaic battery are inoxidisability in itself, and a capacity for retaining its electro-negative condition when constituting a cathode traversed by a strong current for a long time. If economy enters into the question, it is necessary that the cost of the energy developed by means of the voltaic combination should not exceed, say, a halfpenny per horse-power hour, while it is desirable that its cost should be reduced as much as possible, or to, say, one farthing per horse-power hour, which is believed to be within the bounds of practicability. An efficient negative element must also possess a high degree of conductivity, and as an anode it must be chemically unattacked by oxygen or chlorine in the nascent state, must not be disintegrated by the action of gases evolved from its surface, and, while possessing sufficient hardness to resist abrasion, must be capable of production in surfaces of any required area without increasing electrical resistance. A substance which fulfils these conditions was described in the last volume, p. 316, and is known as lithanode, though so far it has not been publicly introduced, except at the meeting of the British Association, where a few experiments were made with it. Planté, about a quarter of a century ago, obtained a peroxide of lead almost identical with lithanode, but it was in the form of very thin layers in contact with metallic lead, which, as will be surmised, involved much local action between the layer of peroxide and the metal beneath it. The thinness of the layers was another disadvantage in the Planté type of secondary battery, but that difficulty was overcome by Faure, whose device was heralded by such a flourish of trumpets a few years ago. Improvements have followed rapidly, as they generally do when the means of making experiments are freely supplied; but there is still a defect, for the local action, which has been considerably reduced, is a cause of continuous waste of energy and of the ultimate destruction of the plate supporting the peroxide. When this view of the facts became understood, it was seen that if an element could be produced of some coherent active material independent of any surface support, the problem would be solved theoretically, and we understand that after many failures a composition was at last formed which enabled the inventor to say that the problem was also practically solved. The question was how to obtain a dense coherent plate of peroxide of lead without the use of any cementing or agglutinating substance of which the effect would be to augment fatally the resistance of the electrode. If we mix oxide of lead with water, and mould the plastic mass thus obtained into the form of a plate, this, as might be expected, will be very friable when dry, and, when immersed in a fluid, will resolve itself into the original pasty form. In order to obtain a coherent solid without the use of an inert cementing body, it is necessary (says Mr. Fitzgerald) to produce a molecular change in the plastic mixture, so as to cause it to "set." Such a molecular change may most readily be brought about by a partial chemical change occurring in the moulded mass, provided such change be not too rapidly effected. If, for instance, we blend a certain proportion of finely-divided metallic lead with the oxide of lead and water, the rearrangement of molecules due to the gradual oxidation of the lead in presence of air will have the effect of greatly increasing the cohesion of the mass so as to allow of the immersion in a fluid without disintegration. The resulting plate, when electrolytically peroxidised, will possess a considerable degree of cohesion and hardness constituting the product known to some electricians under the somewhat barbarous term of petranode. If we mix our oxide of lead with a solution of a salt which will gradually be decomposed by the oxide—as, for instance, ammonic sulphate, from which ammonia is evolved whilst a certain proportion of the lead oxide is converted into plumbic sulphate—we may obtain a dense and coherent mass which, when electrolytically converted into peroxide of lead, constitutes lithanode.

The exact process adopted in preparing the plates has not, we believe, been made known, for experiments on a large scale are still being made, but an idea can be gained from the specification of the patent. Litharge is mixed with a solution of ammonic chloride, sulphate, carbonate, chromate, or phosphate; sodic or potassic chloride, sulphate, or chromate; or an alkaline hypochlorite or silicate, with a proportion of finely-divided metallic lead. The mixture prepared with one or other of these cementing bodies is compressed into plates, and there we have the lithanodes, when they are electrolytically converted into peroxide of lead. The improved plates are entirely composed of the peroxide, and are, consequently, free from local action, while they are not liable to deterioration, and are possessed of sufficient conductivity. When used in batteries, either primary or secondary, they offer a permanent element instead of one which contains the agents of its own destruction; they economise energy elsewhere expended in local action, and they enable the weight to be reduced. In the other patent above referred to the litharge and one of the salts are mixed in the dry state and steamed in moulds. The experiments made with plates of lithanode have been kept secret—probably because the owners of the patent wish to make all possible improvements themselves; but there is not much doubt that the invention represents an important advance, which will be made apparent when opportunity offers, as it may shortly, when capitalists make up their minds to support some of the schemes for working tramcars by storage batteries.

THE AMATEUR WORKSHOP.—XXVIII.

Self-acting Lathes.—(*Continued.*)

A FEW more words on screw-cutting in continuation of our last, p. 147, and we will pass on to other matters. And first as to the position of the saddle itself, which, being slid back after each cut, has to be brought into gear again with the screw at some definite position. When cutting screws in the lathe the position of the saddle at the commencement of a cut will depend upon the relative rates of the leading screw, and of the thread which is being cut. When the number of threads per inch which are being cut can be divided by the number per inch of the guide screw without a remainder, the saddle can be run back, and the clasp nut will fall into gear anywhere without exact setting. Thus with a screw of 12 threads, and leading screw of 4 threads,

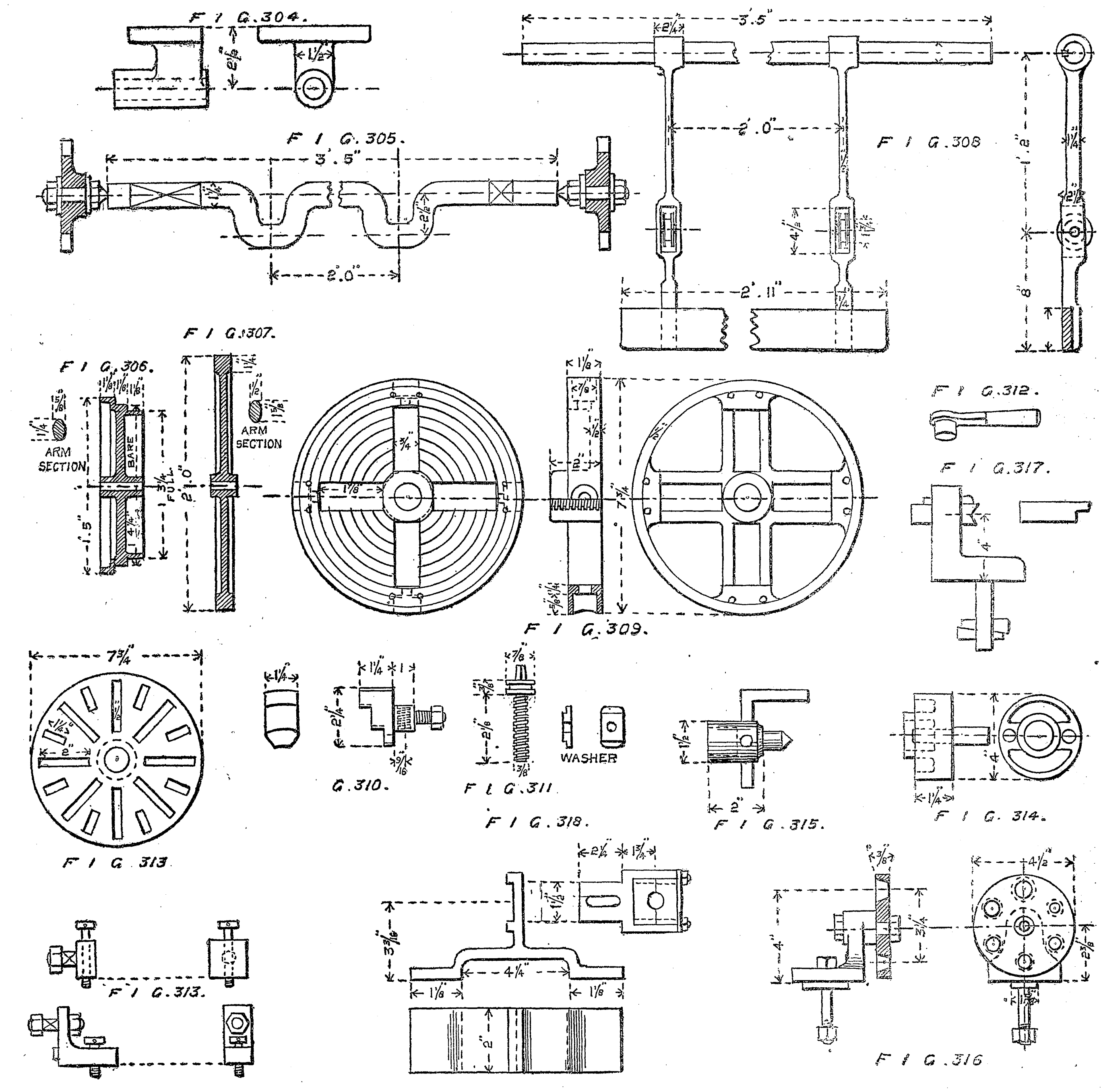


FIG. 304. FIG. 305. FIG. 306. FIG. 307. FIG. 308. FIG. 309. FIG. 310. FIG. 311. FIG. 312. FIG. 313. FIG. 314. FIG. 315. FIG. 316. FIG. 317. FIG. 318.

$\frac{12}{4} = 3$, there being no remainder, no precise setting of the saddle is required. But with an odd pitch which will not divide, we must put down the pitch in fractional form, and the numerator of the fraction will indicate the least number of inches which the saddle will travel to fall into gear again. Thus with a ⅜in. pitch 3 will be the least number of inches, there being 8 complete threads in 3 inches. Or $4\frac{1}{4}$ threads per inch $4\frac{1}{4} \times 4 = \frac{4}{17}$ and 4 is the least number of inches that the saddle will travel, and there will be 17 complete threads in 4 inches. Or multiples of these numbers will be used, as 3, 6, 9, 12, in the first instance, or 4, 8, 12, 16, &c., in the second, according to the length of screw to be cut, and a mark can be made on the lathe-bed as a guide for correct setting of the saddle. When cutting double or treble threads, one wheel of the train, that on the mandrel, must be so chosen that its teeth will divide into two or three equal parts as required, and these marks will be the guides for setting the work in relation to the tool for the second or third thread, as the case may be. Thus having a wheel of 30 teeth on the mandrel, and having, as we will suppose, cut one thread of a triple-threaded screw; stop the lathe, mark with chalk the tooth of the mandrel-wheel which is engaged with the tooth space of the stud-wheel, count round ten teeth on the mandrel-wheel, and mark again, and ten more and mark again. Throw out the clasp-nut, disengage the wheels by lowering the rocking-plate, and turn the mandrel and its wheel around until the second of the chalk marks comes opposite the chalk mark upon the stud wheel into which it gears, and there start the second thread. Afterwards repeat the process to obtain the starting point of the third thread, and the three threads will be of equal pitch and at equal distances behind each other.

Having given enough space to the elementary principles of screw-cutting, I will note how the saddle can be modified for a lathe having rack traverse only. The entire apron shown in Fig. 290, p. 103, is done away with, and in its place there is substituted the casting shown in Fig. 304. This consists simply of a bearing bolted to the underside of the saddle in place of the apron, and carrying the pinion spindle, whose dimensions remain unaltered. The lathe is simplified thereby, though much less efficient.

The driving apparatus is shown in detail in Figs. 305 to 308. The crank is of wrought iron faced with ends of hardened steel, running on hardened steel points. It is turned between centres similarly to the engine crank shown in Vol. XLII., p. 115. Upon it are keyed the driving and flywheels (Figs. 306, 307). The pattern of each wheel is built up in courses of segments in the usual fashion as already described. In the driving-wheel the segments should be thin, say, not more than ⅜in. or ½in. when finished, since thick segments in so slight a pattern would soon become disjointed. The flywheel should have three or four courses. The arms, oval in section in each case, are locked together as shown in Vol. XLI., p. 95, and those belonging to the flywheel are let into the rim segments between the rows during the process of building up. The driving-wheel arms can be let in similarly, but the rim is so slight—⅜in. thick—that I should prefer to make a good butt joint within the rim, and well glue and screw from the outside.

The castings are turned and bored upon the face chuck. When keyed upon their crank axle, the latter should be run round between the centres of a lathe in order to test their truth. If they wabble in a slight degree, as they are likely to do if they have not been turned and bored with great care, a very light cut can then be taken over them, and the file and emery cloth used to polish the belt faces. The diameters of the speeds on the driving pulley are given to suit the centres on Fig. 263, p. 546, of the last volume, or 1in., 2¾in. from the base of the standards. I have shown no balance weight on the flywheel; if desired, it can be cast as a thin plate between adjacent arms, and the wheel keyed on so that the weight shall come on the opposite side to the cranks.

I have shown flat link driving chains and wheels (Fig. 263, p. 546 of the last volume) as being lighter running than the ordinary connecting-rod. This necessitates a special construction of the treadle bearers (Fig. 308), being, therefore, light castings having a recess cored out to receive the wheel, the latter being simply a turned double-flanged roller revolving freely upon a central pin. The bearers are keyed on the treadle bar in the usual way, the bar is

pivoted on dead centres, like the crank axle, the treadle board is a plain piece of wood screwed to its bearers, and, if desired, faced with a strip of broad hoop iron where the foot rests.

The number of chucks which are employed with self-acting lathes is almost legion, being selected according to the convenience, taste, class of work pursued, or purse of the workman. Modern turners are not content without the possession of one or two at least of the many self-centring chucks of American manufacture in addition to the ordinary chucks in common use. Of the common chucks there are the point centre, the fork, the bell, the face, the three or four-jawed, besides drivers and steadies. Two or three of these I will briefly describe, showing how they may be made.

The details of a four-jawed chuck suitable for a 4in. lathe are given in figures 309 to 312. There is first the actual plate (Fig. 309). This consists of a disc $7\frac{3}{4}$in. in diameter by $\frac{1}{2}$in. thick, strengthened with a rib around the edge, provided with a boss screwed to fit the mandrel nose, pierced with four slots to take the jaws, and bossed up at the outer ends of the slots to receive the shoulders of the screws, and the holes for the box key used for setting the jaws. These slot holes should be cored, the core prints being put on the front side of the plate, and to facilitate the moulding, a good taper should be put on the inside of the stiffening ring, and also on the central boss. When the plate is cast, its boss should be screwed in the lathe, the plate then run on its own proper mandrel nose, and its face and edges and back face turned as true as possible. Then run a line round on the circumference to represent the centres of the jaw screws, and drill their holes as most convenient, enlarging those holes afterwards for the box key and shouldered collar, with a pin-drill. File the edges of the slots to templet for the sliding jaws.

The jaws (Fig. 310) in so small a plate would best be made of steel, notwithstanding that case-hardened jaws of wrought iron are used for plates of larger size. The sliding piece, or joggle, behind the actual jaw is properly welded on to the jaw to save the labour of shaping out of the solid. The joggles must be fitted to the slots, and the steps of the jaws turned with light cuts and circular ribbings or grooves turned on their outer and inner biting faces after the washers and nuts have been provided, and the jaws screwed up tightly. The screws are shown in Fig. 311, and the mode of their confinement in the plate is obvious from the figures, where it is seen that pins driven tightly into drilled holes through the plate fall into the turned groove in the shoulder of the bolt, just beneath the square head. Thus the bolt, though free to turn, cannot move endways. The thread may be cut either right or left-handed. The wrench is shown in Fig. 312.

A slotted face-plate suitable for the same lathe, with two clamps of different power, is shown also (Fig. 313).

Two driver chucks are shown in Figs. 314 315, the first being a face or catch-plate holding a pin, and used for work of large diameter, the second, a combined point centre and driver. The latter form is very convenient, because of the radial adjustment which is provided for in the slot hole and pinching screw, and is especially suitable for small lathes, the size of whose screwed mandrel is such that the boring of a hole for the dead centre takes away most of the metal in the nose. The chuck screws over the nose, similarly to the face chucks.

Cone plates and steadies are among the most indispensable adjuncts of a lathe. A cone plate is shown in Fig. 316, and backstays in the figures following. The first (Fig. 317) is simply a bracket or foot wedged to the lathe-bed, and carrying an arm notched out to steady a piece of wood while being turned, two arms being shown in the figure. The second (Fig. 318) is bolted to the back of the saddle of the slide-rest, and carries an adjustable arm A, with loosely-fitting blocks of wood, and since it follows, the work is termed a following steady.

With this I conclude the present subject, and in the next two articles propose to consider such forms of circular and band saws as are most suitable for amateur use.

MOULDING PULLEYS.*

THE drawing, Fig. 1, shows the moulding of a pulley 9in. diameter, 18in. face, rim $2\frac{1}{4}$in. thick, from a ring pattern with loose arm and lifting plate. This pulley was moulded in a foundry that had lately suffered from a fire in which a number of flasks had burned up and there was no flask on hand to make it in. It was an awkward job well done. The ring pattern was levelled up in the floor, rammed and drawn up, the arms bedded in, and the lifting plate shown by the dotted lines and dots A A, fitted in. A large flat, dry, sand core, shown in section at B, and in plan, Fig. 2, was struck up and the core print to be used on top of the hub was bedded in the core, as shown by the large hole in the centre. The two holes to the right of the core print were for the pouring gates, and the one at the left for the riser. This large core was well strengthened by good heavy rods, and made so that extra weight could be placed over the hub to help resist the strain at that point. A parting was made on a level with the top of the hub and the core put on over the top print and weighted down with pigs laid crosswise on it. The rest of the pulley was rammed up on a level with the floor. Broad planks were then laid on the floor lengthwise from the pulley with one edge near the outside of the rim. Other planks were laid across these for standing room when drawing the pulley and to keep from crushing in the edge. Before lifting out the core from over the arms air-slaked lime was shaken down on the inside of the mould and the joint marked with a "lifter" at the parting of the arms to serve as a guide in putting the core back on again. Before setting, the core back ropes were attached to the chains that supported it in the crane to steady it and to pull one way or the other, to guide it into its place. The long broad core plates C C were then placed across the mould a few inches apart all the way round. The runner-box D was built up with a dry sand core E, at the bottom of the basin, and the whole thing weighted down. F F are clamps to strengthen the runner-box, G is the vent from the centre core. The rim of this pulley was poured open and "the word" was given when the rim was full to stop pouring, so as not to run it over. H is an overflow basin. In moulding the pulley the rim was made 9in. deep below the centre of the arms, and 10in. above the centre. This left an inch ring to be cut off the top for whatever dirt might gather.

Casting pulleys in green sand with the rim open is practised in a very few shops, and will be a new feature to many. Although whether made with a lifting plate or with cores for the arms, the outside of the rim is usually made so that it can be checked off, and the inside of the pulley dressed up around the cores or joint. One well known firm that make a great many large pulleys, cast all of them with the rim open. Instead of having a ring 6in. or 8in. wide and drawing it up, which is usually the case, they have two band patterns of each diameter (heavy and light) 36in. deep, and two sets of arms (heavy and light) to suit. Figs. 3 and 4 are a section and plan view of the patterns. In the rim are rows of $\frac{1}{2}$in. holes, 1in. apart on a line from centre to centre, commencing 2in. from the bottom and running diagonally across the face of the rim as far as the centre, as seen in Fig 4. The arms are of cast-iron and have a hole in the end for set screws to hold them to their place until the lower half of the core is rammed up. Pulleys can be made on this plan in much shorter time than drawing up. For instance, to make a pulley 6ft. diameter 12in. face, set the ring on the floor, fasten the arms in with set screws 6in. from the bottom, ram up under the arms, and make the parting for the plate. The set screws can then be taken out and the outside rammed up. The upper half of the rim is left a little deeper to dress up clean in the machine shop; and wrought-iron straps are riveted in flush with the rim to draw it by.

* By ROBERT E. MASTERS, in *American Machinist.*

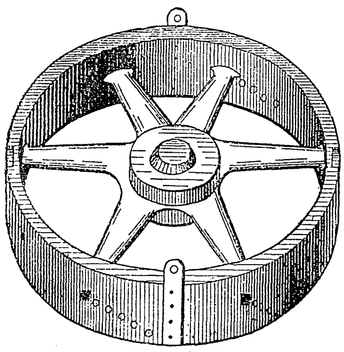


Fig. 4

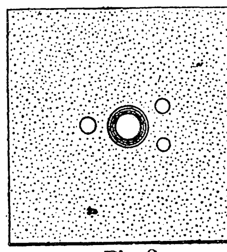


Fig. 2

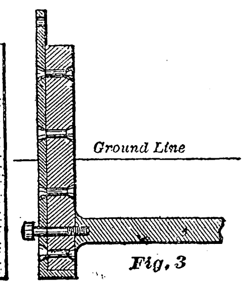


Fig. 3

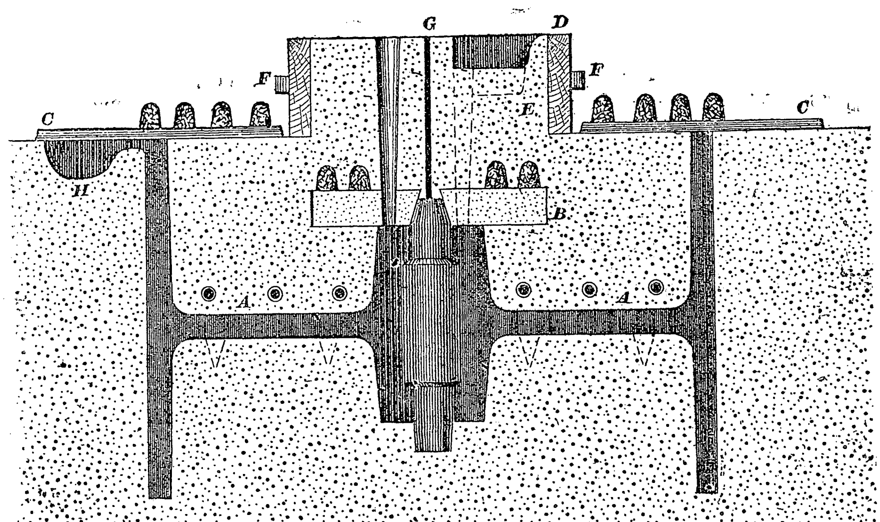


Fig. 1

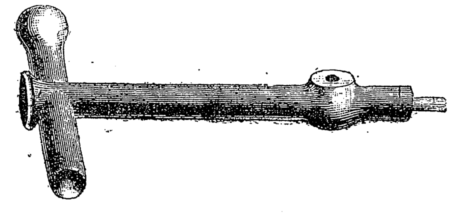
THE DREAMS OF THE BLIND.

A PAPER read before the biological section of the American Association for the Advancement of Science was on "The Dreams of the Blind," by Dr. Joseph Jastrow. The object of the paper was to determine the extreme age at which a child may become blind and yet lose all memory of the visible world, so that it no longer sees in its dreams. Almost all dreams of normal persons are sight-dreams, and a dream is often spoken of as a vision. The blind are deprived of this most important sense; but if they have not been born blind they may remember enough of what they have seen to enable them to imagine how things look and when the imagination has free play in sleep to picture themselves as in full possession of all their senses. Physiologists would explain this by saying that during the years in which they saw, a certain part of the brain has become educated to receive and interpret all these messages which the eye sends, and that when this part of the brain acts spontaneously in sleep the person dreams of seeing.

Such a portion of the brain would be called the sight centre. If now we find out the latest age at which blindness may set in and yet the person keep on dreaming of seeing, we will find out the time it takes for this sight centre to develop. For this purpose about 200 blind persons of both sexes were questioned at the institutions for the blind in Philadelphia and Baltimore, and it was found that those who became blind before their fifth year never dreamed of seeing; of those whose sight was lost between the fifth and the seventh year some did and some did not see in their dreams; while all whose eyesight was destroyed after the seventh year had quite as vivid dream-visions as seeing people. The fifth to the seventh year is thus shown to be the critical period. This period corresponds with the age which authorities assign as the limit at which a child becoming deaf will also become dumb; and also with the age of one's earliest continuous memory of oneself. It is interesting to note that blind persons dream quite as frequent as normal people, and that with those who do not see in their dreams, hearing plays the principal part. When dreaming of home, for instance, they will hear their father's voice or their sister singing, and perhaps will feel the familiar objects in the room, and thus know they are at home. We, in such a case, would see it all.

RIVETING TOOL.

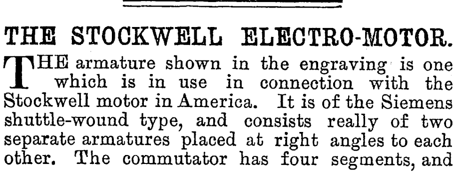
THE construction of this tool is very clearly shown in the figure herewith presented. On one end of the shank or body portion is a punch about the size of an ordinary copper rivet, and on the other end is a suitable boss to receive the blows of a hammer. One end of the head piece has a concavity shaped to give a proper form to the upset end of the rivet, and at the other end is a boss for striking upon. To use the tool, the parts to be united by rivets are first pierced by the punch,



when the rivet is inserted and the usual washer put on. The projecting end of the rivet is then placed in the hole in the shank of the tool, when the stroke of a hammer forces the washer down tightly to the work. The concavity is then placed over the end of the rivet, which is then upset and given a neat convex finish by blows delivered upon the opposite end of the head piece. The punch may be made removable, and the hole in the shank may be formed in a removable sleeve, to adapt the tool for use in setting rivets of various sizes. This handy riveting tool is the invention of Mr. James H. Stevens, of Grover, Col.—*Scientific American.*

THE STOCKWELL ELECTRO-MOTOR.

THE armature shown in the engraving is one which is in use in connection with the Stockwell motor in America. It is of the Siemens shuttle-wound type, and consists really of two separate armatures placed at right angles to each other. The commutator has four segments, and



the terminals of the wire on each part of the armature are connected to opposite segments. The latter are not made parallel with the spindle, but are helical in shape, so that there is no break in the circuit at that point, since the brush passes the current to one armature before leaving the other. By this arrangement only one armature is in action at one time. Taking the one to the right, for example, it yields its maximum effect during the quarter revolution when the polar faces of the armature are approaching the pole pieces, and until they come directly opposite each other. During the next quarter revolution the armature is cut out of the circuit entirely; in the third quarter it again comes into the circuit until occupying the same relative position as in the first quarter; and, finally, in the fourth quarter it is again cut out. But during each of these idle periods of the armature to the right, that to the left comes into circuit, and goes through relatively the same cycle of operations.—*Electrical Review* (Lond.)

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE first meeting of the session was held on the 13th ult. at King's College, Strand, W.C., the President, Dr. Dallinger, F.R.S., in the chair.

Letters were read from Prof. H. de Lacaze-Duthiers and Prof. W. A. Rogers, in acknowledgement of their election as Honorary Fellows of the Society.

The President said that it fell to him to take notice of the fact that Mr. George Busk, F.R.S., an Honorary Fellow of the Society, had died since the date of their last meeting. He had been intimately associated with their Society, having been its President in 1848 and 1849, and although he (Dr. Dallinger) never had the pleasure of a personal acquaintanceship with him, the name of Mr. Busk had been before him from the time of his very earliest studies. Everyone was familiar with his labours in connection with the Polyzoa, and he felt sure that all present would regret to receive the intimation of his decease. An excellent portrait in oils of Mr. Busk, painted by his daughter, had recently been presented to the Linnean Society, while an appreciative memoir had been published in *Nature* by his friend, Prof. Allman.

Mr. Curties exhibited several of the new apochromatic objectives (with a series of eyepieces) made of the new kinds of glass from the Jena manufactory, which were examined by the Fellows with great interest, the very high eyepiece which they carried without "breaking down," being a special subject of comment.

Prof. Abbe's paper, "On Improvements of the Microscope with the Aid of New Kinds of Optical Glass," was read.

The President said he had been greatly interested by the explanation given in Prof. Abbe's paper, and the Fellows would doubtless be glad to know that the 1-12in. objective was in the room that evening, and fitted to a microscope with a suitable eyepiece, so that its perfection could be seen by those present.

Mr. Cheshire inquired whether the new kinds of glass could be bought in this country, and if full particulars could be obtained as to their refractive indices, dispersive powers, &c., so as to make it possible for similar objectives to be made here in due course by English opticians? The objectives shown that evening gave results which he could only describe as most magnificent.

Mr. Crisp said that a very full and complete descriptive catalogue had been published in which all particulars were given as to the optical qualities of the glass. Indications were given as to the best kinds to be used in the construction of objectives for telescopes, &c.; but with regard to microscope objectives, the subject was dismissed with the remark that "it must be left to the skill of the practical optician to choose the most suitable from the above series. The new objectives show what can be attained in practice." It was, of course, quite fair to keep such a matter as a trade secret.

Mr. T. B. Rosseter's paper on "*Trichodina* as an Endoparasite" was read by Prof. Bell. The author described a very careful series of observations by which he had established that this infusorian, hitherto only known as an ectoparasite, infested the urino-seminiferous organs of newts. Apparently the animals were of a different species to that (*T. pediculus*) parasitic on the tentacles of *Hydra*, as, when placed in a watch glass together, the *Trichodina* took no notice of the *Hydra*, and if they struck against it they recoiled as it were from the contact and continued their course.

Dr. Crookshank said it would, perhaps, be remembered that during the last session he read before the Society a paper on "Photomicrography," in illustration of which he then showed a number of photographs of Bacteria. He had done some further work in that direction, and had brought with him a new negative which he was anxious the Fellows should examine, because it was one in which the flagella of a *Vibrio* were very distinctly shown. It would, no doubt, be known to most of the Fellows that some persons had doubted the existence of a flagellum; but, although it was a thing very difficult to be seen, this was not the first time that it had been photographed. Koch had been able to do this after a process of staining, for which he recommended the use of a watery solution of logwood and subsequent treatment with chromic acid; but he had rather given up the attempt to photograph specimens unless he could get them stained brown. This, however, he (Dr. Crookshank) had not found to be essential when using isochromatic plates; the specimen shown had been stained with gentian violet, and it would be found on examination that the flagella were very distinctly seen. He would also hand round for inspection another negative to show that it was possible to get very good results without staining brown; the specimen being *Spirochæta* from sewage contaminated water, for which he was indebted to Mr. Cheshire. He had also mentioned in the paper to which he referred that in reproducing the photographs the colour given to the prints was rather objectionable, and he had suggested to the Autotype company that they shouldtry to use some other colouring matter for the purpose. It had been found very difficult to carry out this idea at present; but what he desired to do was to be able to print in such a way as to reproduce the objects of the same colour as the stain with which they were originally prepared instead of in the ordinary photographic tint. The micro-organism exhibited had been enlarged 2,500 times.

The president said that to him it was of exceeding interest to examine the photographs which had been brought for their inspection by Dr. Crookshank, seeing that they depicted objects which for years he had been drawing and studying. Koch had for a long time failed to detect the flagella with his eye, but when he photographed the object the flagella appeared. Now that they were able to obtain photographs in the manner which Dr. Crookshank had so successfully adopted, they would be able to see for themselves all the minute details which had been described. He felt it was a great gain to have photo-micrography so readily and easily at disposal, and personally he felt very much obliged to Dr. Crookshank for bringing the matter before them.

Mr. Crisp inquired if Dr. Crookshank had tried to obtain photographs by means of the new objectives. One of the greatest advantages claimed for them was their use in photo-micrography, apart from the advantage of being able to obtain the same power with an $\frac{1}{8}$in. objective as he had obtained with the very much higher powers used in producing the negatives exhibited.

Dr. Crookshank said he had not yet had any opportunity of trying either the objectives or the projection eyepieces. His negatives were taken with a $\frac{1}{25}$in. by Powell and Lealand.

Mr. C. D. Sherborn and Mr. F. Chapman's paper "On some Microzoa from the London Clay Exposed in the Drainage Works, Piccadilly, in 1885," was taken as read, as it had been printed during the recess.

Dr. Anthony's paper on "The Observation of Opaque and Quasi-Opaque Objects in the Microscope" was taken as read, having been printed during the recess.

Prof. F. Jeffrey Bell said that the subject of grouse disease was always more or less attractive to those who were interested in these birds, but yet nobody seemed to know with any certainty what it really was. A short time ago two grouse which had been found dead on one of the moors were sent up to him, and he had made an examination of them with the idea of ascertaining if there were any appearances in their organs which would throw light upon the subject. There were, of course, any number of theories to account for the disease, and it had been often said that it was due to the presence of animal parasites in the liver. Another opinion was that it was caused by a worm (*Strongylus*) which was found by Dr. Cobbold, and was considered by him to have been the undoubted source; it was also said to be caused by a species of tapeworm (*Tænia*). He had, therefore, carefully examined the two grouse in question, but found all their organs healthy, with no sign of any disease likely to account for their death. Nothing of the nature of *Coccidia* could be discovered in the liver, and though he carefully examined the large cæca he failed altogether to find Dr. Cobbold's parasite, but he found that about 6in. of the intestine was occupied by a *Tænia calva.* This appeared at first to be of some importance, because when the large size of this tapeworm was considered, it was easy to suppose that a considerable stoppage might be caused by it. One of the grouse had two tapeworms and the other had three—the former of these had its fæces quite healthy, the latter had them more watery—but, so far as appearances were concerned, he came to the opinion that if the grouse were otherwise healthy and well-nourished, probably the tapeworms were not doing very much harm; for, whilst the grouse with the two tapeworms was in rather an emaciated condition, the one with three was in good condition and apparently perfectly healthy. He, therefore, came to the conclusion that the tapeworms were neither the immediate nor the remote cause of the death of the two grouse, and that they neither died from Dr. Cobbold's declared cause, nor from the presence of *Coccidia* in the liver. He was inclined to the opinion—which he believed was held by many sportsmen and gamekeepers—that the disease was due to some condition of the heather or whatever else the birds fed upon, rather than to the attacks of animal parasites.

Mr. J. Joly's "Note on a Needle for Manipulating Objects in Canada Balsam," was read by Mr. Crisp.

Prof. F. Jeffrey Bell said that during the present year he had been interested in a worm, the origin of which was undoubtedly exotic, and which had

not been found in this country except in hot-houses. It appeared to have been first noticed here in 1878, in the Palm-house at Kew, from which circumstance it had received the name of *Bipalium Kewense*. Subsequently it was found at Welbeck, and since then at the Zoological Gardens and other places which were in direct relation with Kew. More recently he had received it from various correspondents, some of whom were not in relation with Kew; but all were agreed that it had come to them in connection with orchids, and there seemed to be a general opinion that it had come from Burmah. Prof. Moseley, however, thought that it had come from Japan. A remarkable circumstance in connection with it was that no specimen had yet been found with generative organs, although it was quite certain that it multiplied and grew with rapidity. It was, therefore, a matter of wonder how such increase could, under these conditions, be accounted for, and the suggestion was made that it might possibly be by transverse fission, a process which had been the subject of some controversy. Sir J. G. Dalzell and others asserted that Planarians divided transversely, whilst, on the other hand, Schultze stated that he had seen large numbers, and kept them under observation, but had never seen any indication of transverse fission. It was further stated that this mode of reproduction only occurred in the case of those with straight intestines; but, again, in 1883 another observer, Von Kennel, reported that he had himself seen transverse fission take place in a Planarian with branched intestine. Whilst he (Prof. Bell) could not show conclusively from actual observation of the process, that *Bipalium* did divide in this manner; yet he thought he had obtained evidence sufficient to warrant the belief that such was the case. He received, some time ago, two specimens from Gosport (drawings of which he had made upon the blackboard). One of them had the hammer-head shape at one end; but the other, which was a very small specimen, had no trace of it, but was simply pointed at both ends. Unfortunately, one of the Gosport specimens got lost; but he watched the small one carefully day by day, and on the 5th of October—or 11 days after it had arrived—he noticed a delicate fringe running round the anterior end. This fringe had since grown and grown until at the present time it was very obviously a hammer-head, so that it was clear that a creature of this kind might, in the course of three weeks, attain the perfect condition. A specimen from Liverpool, which had been divided into two in the post, was afterwards found to be in three pieces. At first he thought the third might have been previously overlooked amongst the moss; but on measuring the portions he found one to be 27mm. and the other 16mm., so that it seemed tolerably certain that at some period between the 29th of September and the 5th of October, the piece which had originally measured 41mm. had divided into two. He thought it might be conceded that the observations proved: first, that spontaneously a *Bipalium* would divide into two; and, secondly, that given repose, a piece of a *Bipalium*, pointed at both ends, would thicken, and form the hammer-head extremity, which was a characteristic of the adult.

Prof. Stewart, in reply to the President, said he had no remarks to make with reference to this very interesting communication; but he might perhaps mention that, having had the opportunity of seeing the specimen which had reproduced its head, he had no hesitation in saying that it was a bonâ-fide head. He could, therefore, entirely confirm the observation, although he need hardly say that confirmation was quite unnecessary in the case of so able and careful an observer as Prof. Bell.

SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held on Monday evening, a paper was read on "Liquid Fuels," by Mr. Percy Tarbutt, A.M.I.C.E., and Fellow of the Chemical Society.

The author commenced by saying that, though the use of liquid hydrocarbons as heat-producers was by no means of recent date, yet special circumstances at the present time had brought it more prominently to the front. Liquid fuels were not confined to petroleum, but included also tar and residual oils from tar distillation, shale oil, by-products from blast furnaces, &c. Of these, petroleum, though long known, had only of late years been largely drawn from its almost limitless resources, chiefly in Northern Pennsylvania and on the shores of the Caspian Sea. Many other countries all over the world produce it in lesser but yearly increasing quantities. New discoveries were constantly being made, and the distribution of petroleum seemed to be as universal as that of coal. Gasworks were large producers of liquid fuel in the shape of tar and its products. With the increase in the supply of petroleum the modes of its conveyance had also advanced. Barrels had been superseded by tanks adapted for use on railways, roads, canals, and sea-going vessels. Pipe-lines for oil conveyance had wonderfully developed, there being 9,000 miles of them in the United States and great lengths in the Caspian districts, where 600 miles of pipe line was about to be laid down from the Caspian to the Black Sea, an undertaking that would revolutionise the oil markets of Europe. In making a comparison between the heat-producing values of coal and oil only a general average could be taken, the qualities of each varying so largely. Estimating thus from chemical analysis, the theoretical value of coal was 14·5lb. of water evaporated per pound of fuel, and of oil 20·7lb., the higher value of oil being due to the larger proportion of free hydrogen it contained. Practically, various circumstances, detailed by the author, increased the difference of value. He then described the ordinary modes of burning oil, in nearly all of which it was effected by the use of steam "pulverisers" or spray producers. Some attempt had been made to burn oil without steam spray-producers, as in Nordenfelt's trough arrangement, but these were not generally suitable for firing steam boilers. The essential condition was that the burning gases from the oil should be kept from contact with the boiler-plates, which were necessarily of so low a temperature as to prevent perfect combustion. The author then described his own furnace, based on heating by radiation only, and the starting apparatus used with it. It was found that there were great objections to the use of steam for the injectors for marine boilers. He had, therefore, devised a system of injection by compressed and heated air, which entirely overcame this difficulty, by which perfect combustion was obtained more easily than by using steam. The author concluded by giving comparative results communicated to him by some of the firms who had his system in constant use. These results showed that the work performed was from twice to three times that of coal, besides which there was considerable saving in labour, greater cleanliness, no smoke, and an increase in the steaming capacity of the boiler to which it was applied.

Alaska.—The *New York Times* publishes detailed reports of the proceedings of the expedition for the exploration of Alaska, which is commanded by Lieutenant Schwatka, of the United States Navy. On their way to Mount St. Elias, the expedition crossed a river the existence of which was previously unknown! Eight miles from its mouth its width was a mile, and it flowed at the rate of ten miles an hour. The glacier detritus which it brings down from the mountains colours the sea for miles; it is probably one of the greatest rivers which empty into the Pacific Ocean. It has been named the Jones River, after Mr. George Jones, of New York, one of the promoters of the expedition. Towards the east, the explorers saw a great glacier, fully 20 miles broad, which extended for 80 miles along the foot of the St. Elias range. Assuming that the surface of the ground on which it rests is level, they estimate that this glacier must be 1,000ft. thick. It was named the Agassiz Glacier, and another glacier, extending towards the west, was named after Prof. Guyot. A three days' march brought the party to a third great glacier, which was named after Prof. Tyndall. Starting from this point, they set about penetrating as far as possible into the interior of this magnificent but desert region. For this an unbroken march of 40 hours was indispensable. Leaving the bulk of their provisions and impedimenta behind, and taking only the minimum of what was necessary, they journeyed for 20 hours till they saw the southern face of the great mountain, which is defended by this great ice-zone. They saw before them glacier cliffs rising perpendicularly to heights varying from 300ft. to 3,000ft. They had been travelling over the Tyndall Glacier, which had not hitherto presented any exceptional dangers. But it now began to yawn with crevasses, sometimes 30ft. wide and of unknown depths, spanned by ice bridges as slender as the ridge-tiles of a roof. But the explorers surmounted all difficulties till they reached an elevation of 7,200ft. above the sea. Considering that the greater part of the journey had been well above the snow line, this must be regarded as very creditable. At this point they were surprised by a thick fog, which kept them prisoners in a most cheerless and even dangerous position for four days. On the advice of Mr. Seton Karr, an English gentleman who had joined the expedition, and who declared that any further advance in that direction was impossible, the explorers agreed to descend. Lieutenant Schwatka proposes trying the northern and eastern slopes of Mount St. Elias; he does not despair of yet reaching a greater height, and may in any case obtain valuable additions to our geographical knowledge. Most probably the summit will still remain inaccessible. During the expedition three new peaks were discovered, varying in height from 8,000ft. to 12,000ft. They were named after President Cleveland, Secretary Whitney, and Captain Nicholls.

SCIENTIFIC NEWS.

The scientific session opens with the month of November, and the societies will soon be in full work. The Royal holds its first weekly meeting on the 18th, and on the 30th the anniversary will be held, when the president, Prof. Stokes, will deliver his address, and the council and officers will be elected. The Mathematical Society meets on the 11th, when the retiring president, Mr. J. W. L. Glaisher, will speak of changes in the Mathematical Tripos and its influence on mathematics. Sir Jas. Cockle is proposed as president. The opening meeting of the Geologists' Association will be held to-day at University College, when the president, Mr. W. Topley, of the Geological Survey, will deliver an address on the "Erosion of the Coasts of England and Wales."

Next year will be the year of exhibitions, and amongst the most notable will be that held at Manchester. There will be eight sections, the principal of which will be industrial design, machinery in motion and general engineering, chemical and allied industries, and handicraft work in process of production. The site chosen is at Old Trafford, adjoining the Botanical Gardens, which will probably form part of the exhibition, and is easily reached by road or rail from all parts of Manchester and district. The guarantee fund already exceeds £132,000, and the council and committees include the chief men in their respective departments.

It is intended in May next to open at Saltaire an international exhibition in aid of the building fund of the new Schools of Art and Science, now being built for the Salt Schools, at a cost of over £12,000. The exhibition is to be chiefly of works of art, many of which are already promised on loan, and of industrial processes. It was originally intended to open the exhibition in June last, and advantage has been taken of the postponement to improve and extend the original plan very considerably, so that it is now expected that the exhibition will be on a scale not hitherto attempted in Yorkshire.

A fine art and industrial exhibition will be opened at Elgin towards the end of this year.

Glasgow is to have an exhibition in 1888 in Kelvin Grove Park. It will be international, a motion to make it exclusively Scottish being lost by 55 votes to 7!

The deaths are announced of Dr. Victor Pierre, professor of physics in the university of Vienna; and of Dr. Carl Heinrich Althaus, extraordinary professor of philosophy in the university of Berlin.

The free Saturday evening lectures given at the Finsbury Technical College have, it is stated, been appreciated by the public; but on another occasion it would be advisable to make them more widely known beforehand.

It is stated that carbonate of manganese has been discovered for the first time in this country, at a short distance from Harlech, in North Wales. Some years since an earthy deposit of the black oxide of manganese was found. It was worked for some short time, but being of little value the mine was abandoned. Recently, on exploring below the dark-coloured bed, a light-coloured deposit was discovered, which proved to be a carbonate of manganese. The owners of the Mostyn Ironworks have become the proprietors of this ore, and considerable quantities have been sent to Mostyn, to be used in the manufacture of spiegeleisen.

A patent has been obtained for the manufacture of ink from waste dye liquors. The spent liquor of bichromate of potash or soda which has been used for mordanting wool, &c., is boiled with spent logwood liquor which has been used for dyeing. A small percentage of sulphate of soda is added, and a fast and non-corrosive ink is obtained.

In his introductory remarks at Edinburgh University on the "Sense of Hearing," Prof. Rutherford discussed the theory of sound sensation advanced by Helmholtz, and the theory of the cause of concord between tones of the same pitch. According to Helmholtz, a compound vibration is analysed in the cochlea. If the blending of each sensation in a compound sound eventually takes place in the centre of perception, why, Prof. Rutherford asks, is there

any need to have the complex vibration analysed in the cochlea?

An exhibition of telephony is to be held in Brussels at the beginning of next year, under the auspices of the Société Belge des Ingénieurs et des Industries. The exhibition will be international, and will include all the apparatus and processes hitherto devised for the transmission of the voice to a distance. In addition to apparatus, plans, models, and diagrams will be received. No charge will be made for space during the five weeks the exhibition will remain open. Applications must be sent in before December 1st, to the secretary of the Society above named.

In Detroit, Michigan, the Edison underground system is being put down. The pipes are large-sized gas-pipes, and the wires, twisted in cables, are run through them. Every 20ft. there is a curve in the cables to allow for contraction in cold weather, and at these points are what are called coupling boxes. It is from these boxes that the single wires necessary to supply a building will be run through a small pipe. Connection can be made at any time with any building as easily as gas can be carried into a store or residence. The greater number of pipes and cables leading from the depot are called feeders. They carry the current to large junction boxes, located at convenient points, and from these junction boxes the supply current is carried in four directions, half-way to other junction boxes. Only the incandescent light will be supplied by the Edison Company.

The electric light is an advantage to vessels going through the Suez Canal, the *Salazie*, belonging to the Messages Maritimes, having recently made the passage in 16 hours, passing 22 vessels *en route*.

A recent addition to the French line of Transatlantic steamers running between Havre and New York, *La Bourgogne*, has made the trip from port to port in 7 days 5h. 8m. mean time; her average speed being over 18¼ miles per hour. She resembles the *Etruria*, of the Cunard line, as respects her general dimensions, except that she has less beam by 8ft., and is not quite so long. *La Bourgogne* is 508ft. long, 52ft. 2in. wide, and 38ft. 4in. depth of hold. She has a propeller, 22ft. 8in. in diameter, and has a maximum of 8,100 horse-power. The hull is made of steel. She is rigged with four metal masts, and her sails are hoisted and lowered by steam-power. The entire cost of *La Bourgogne* was £355,000. She registers 9,000 tons.

In consequence of increased demands from public bodies for grants of fish for the purpose of stocking depleted waters, the National Fish Culture Association have considerably widened the scope of their operations by erecting a new hatchery and enlarging the rearing ponds at their establishment at Delaford Park, Bucks. The association have also formed a series of additional ponds for propagating coarse fish as well as salmonidæ. A large consignment of German carp arrived at South Kensington last week, and further consignments are to be imported for distribution, as the German carp is superior to any we have in this country.

M. Laurent has recently described a series of experiments made to ascertain the influence of microbes on vegetable life. Seeds of buckwheat were sown in pots containing four different kinds of mould. In the first natural mould was employed, in the second the same earth sterilised and then inoculated with bacteria of the soil, in the third simply sterilised mould, and in the fourth sterilised mould with the addition of chemical manure. Precautions were taken to prevent contamination of the four receptacles. The production of wheat in each of the pots respectively was in the proportion of 94, 96, 23, 66. In all the experiments the third series was inferior to the others.

A paper was recently read before the Paris Academy of Sciences, on the temperature of the bed of oceanic basins compared with that of the continents at the same depth, by M. Faye. In connection with the reference made to this subject in the opening address of the President of the British Association at Birmingham, the author takes the opportunity of generalising the law already established by him respecting the more rapid and deeper cooling of the earth's crust under the seas than under the continents. Not only is this law applicable to the Polar seas, whose lowest depths have a temperature very near zero C., but also to those which do not freely communicate with the Poles. In these waters also the temperature decreases with the depth, the difference between them and the continents at the same depths being, within about 15°, as great as for the oceans.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE WORK OF A REAL MAN OF SCIENCE—TWILIGHT—REDUCING A STAR'S PLACE FROM A CATALOGUE — ARTIFICIAL HORIZON — ASTROLOGY AND THE LAW—STAR DISCS? —"PERFORMANCE GUARANTEED"—RELIEF MAP OF THE MOON—SOLAR SHADOWS ON THE EQUATOR AT THE EQUINOXES.

[26440.]—It is a pretty familiar fact that we are indebted for practically all we know on the subject of scintillation to that eminent Belgian savant, M. Ch. Montigny. Looking through a list of his works since the year 1851 in the *Bibliographie Académique* of the Royal Academy of Belgium, I find the titles of no less than sixty-three memoirs, reports, and essays, in addition to those of four others contributed to other societies, and numerous articles in *Ciel et Terre*. I wonder how many of our F.R.S.'s have done an equal amount of hard and honest work for science.

Would "R. E. F." (reply 60484, p. 177) mind giving us his authority for the statement that "the theory that twilight lasts until the sun is 18° below the horizon is pretty nearly absolete [*sic*] now"? I ask the question because, taking down a few books at random from their shelves, I find this given at the angle of the sun's depression when the last trace of light fades from the sky: for example, in Arago's "Popular Astronomy" (English edition), Vol. II. p. 117; Main's "Rudimentary Astronomy" (first edition), p. 37; Nichol's "Cyclopædia of the Physical Sciences," p. 749; Loomis's "Treatise on Astronomy," p. 57; Brinkley's "Astronomy" (revised by Stubbs and Brünnow), p. 45; Ball's "Elements of Astronomy," p. 154; Chauvenet's "Spherical and Practical Astronomy," Vol. I. p. 218, and so on. I must, however, add in fairness that Schmidt, from the mean result of observations made in 1865, found that astronomical twilight ended when the sun was 15° 55′ below the horizon. This would make the duration of twilight at the Equator one hour and about four minutes, instead of 1h. 12m. But, after all, meteorological conditions enter into the discussion, and considerably complicate the geometrical treatment of the question. This was shown more than 135 years ago by Lacaille, who, while on his voyage to the Cape of Good Hope, says—"On the 16th and 17th of April, 1751, being at sea and becalmed, with an extremely clear and serene sky, in which I could distinguish Venus on the horizon of the sea like a star of the second magnitude, I saw the crepuscular light terminated by an arc of a circle, as regular as possible. Having set my watch to true time at sunset, I saw this arc become confounded with the horizon, and I calculated by the hour at which I made the observation that the sun was depressed on the 16th of April to the extent of 16° 38′, and on the 17th to 17° 13′." Rothman, on the other hand, found that twilight did not absolutely cease until the sun had descended 20° below the horizon, while Riccioli determined the angle at the Equinoxes to be 16° in the morning and 20° at night; 18° then is about the mean of numerous observations. Dr. Mann is himself "quite wrong" in his definition of the cessation of twilight, which ceases at the instant that the crepuscular arc coincides with the horizon, and *not* when sixth-magnitude stars begin to appear in the zenith. Schmidt (*Ast. Nach.* No. 1495) gives the angle of the sun's depression as 11° 39′ when the 6th magnitude stars appear; but, as I have said above, determines that astronomical twilight does not end until the sun is 15° 55′ below the horizon.

In reply to the first part of query 60722 (p. 183), it is customary in practice to add together, each with its proper sign, the precession and proper motion of a star, and to multiply their sum by the number of whole years that have elapsed since the date of a catalogue to obtain the mean place of such star at the beginning of any given year, and then in the subsequent reduction to treat $\triangle c$ and $\triangle c'$ as separate quantities, and multiply them by the fraction of the year which has elapsed between January 1 and the date for which the apparent place is sought. Take, for example, "Veuton Veor's" own star, γ Orionis. The Greenwich Nine-year Catalogue for 1872 gives its mean R.A. for January 1 of that year as 5h. 18m. 15·926s., and its mean N.P.D. 83° 46′ 6·19″. Its annual precession, secular variation in annual precession, and proper motion in R.A. appear as + 3·2158sec., + 0·0048sec., and + 0·002sec. respectively, the corresponding quantities in N.P.D. being − 3·632″, + 0·463″, and + 0·04″. In order, then, to obtain the Mean R.A. and N.P.D. of this star for 1886, Jan. 1, we should proceed thus—

+ 3·2158sec. annual precession in R.A.
+ 0·0048sec. variation of ditto.
+ 0·0020 $\triangle c$ (in *time*).

3·2226
14

45·1164 seconds and 5h. 18m. 15·926s. + 45·116sec. = 5h. 19m. 1·042s., the mean R.A. of the star for 1886, Jan. 1. Similarly—

− 3·632″
+ 0·463
+ 0·440

− 3·129
14

− 43·806

and 83° 46′ 6·190″ − 43·806″ = 83° 45′ 22·384″, its mean N.P.D. Then the remainder of the reduction is familiar to your correspondent, save apparently in the case of $t\triangle c$ and $t\triangle c'$; the t in which is obtained by simply adding ·0029 to the fraction of the year (*vide* p. 489 of the *Nautical Almanac*). This, in the case of November 1st, is ·8323 and ·8323 + ·0029 = ·8352, our required multiplier t. Of course, ·8352 × ·002sec. = ·0016704 sec. or $t\triangle c$, and ·8352 × ·04″ = ·33408″ or $t\triangle c$. I cannot answer the second part of your correspondent's query offhand, and I really have no time to face the calculation necessary to do so; inasmuch as it would involve the computation of the places of several stars whose N.P.D. exceeds 90°, both with Airy's and Bessel's numbers, as well as by the independent quantities, in order to discover if any law governs the alleged discrepancy of which "Veuton Veor" speaks. Of course, though, as the R.A. and Dec. of a star change slowly, if we are dealing with a period very remote from that of the Catalogue, it may be a little better to use the independent constants.

The cheapest artificial horizon that "Jack" (query 60754, p. 183) can employ is simply a bucket of tar, as its slight viscidity renders it less susceptible to a breeze than a surface of water. Gauze, or muslin, would effectually destroy reflection, and no glass cover—save one composed of a sheet whose sides were ground rigidly parallel—would be of the slightest use.

I rarely, if ever, comment on anything which appears in the trade columns of this journal; but I cannot help observing that there is an announcement (dated from Bristol) in the middle column of p. viii. of the cover of the number for Oct. 22, which quite clearly brings the advertiser within the provisions of the Act 5 Geo. IV. c. 83, s. 4.

Unfortunately, my own series of the R.A.S. *Memoirs* only begins with Vol. XXXVI., so that I have no means of reference to the passage quoted by Mr. Sadler in the final paragraph of his letter (26413) on p. 190.

Were I "Enquirer" (query 60761, p. 203), I should refuse to accept any such vague warranty of a telescope as that contained in the words "performance guaranteed," and should insist upon the instrument dividing certain specified stars and exhibiting certain objects upon any average night.

In reply to query 60810 (p. 204) a relief map of the entire moon, or of any considerable part of it, would be a most arduous and difficult piece of work for any one to undertake, presuming, of course, that anything like accuracy was aimed at. Moreover, for obvious reason, it must be made on a globe (or, at any rate, a hemisphere), and so could hardly legitimately be called a "map" at all. To model an individual crater, careful micrometric measurements of it should be made, and a plan executed from them as in the case of a terrestrial survey. The heights of the various parts of the

formation must also be accurately determined in the manner described on pp. 554 et seq. of Neison's "Moon." Then, laying down the plan upon a planed board, wires must be inserted at the proper points, and cut off to the heights thus determined (reduced, of course, to the scale of the plan). The model is completed by filling it up to these various heights with modelling clay, or with the composition described by Mr. Browning as having been employed for that purpose by the late General Worster. It consists of prepared chalk, milk of sulphur, and gum water, which can be worked upon in a plastic state for some time, and sets very much harder than plaster of Paris. It can even be further altered then by moistening it with gum-water again. From this, when dry, any number of casts may be made.

Mr. Hampden is quite right in his supposition (expressed in query 60811, p. 204) that the shadows cast (at sunrise and sunset) by a vertical rod on the Equator at the date of Equinoxes are straight lines—in the sense that any short line is straight upon a sphere of relatively enormous radius—and that they point west and east at those times respectively. Of course, at solar noon, such a rod casts absolutely no shadow at all.

A Fellow of the Royal Astronomical Society.

VEGA AND STARS NEAR — VARIATION OF LATITUDE—THE NEW STAR OF 1572.

[26441.]—I AM much obliged to "F. R. A. S." (letter 26389, p. 171) for looking up the faint stars near Vega. Mr. Tarrant has also kindly observed them for me with his 10in. reflector. He rates A 9·8 and B 10·0 mag. in Σ's scale, and sees 16 out of the 50 other stars shown on the tracing from MM. Henry's photograph (letter 26177, p. 10). He rates δ 10·7, γ 10·8, ε 11·0, and ζ 11·2 mag. in Σ's scale; but he observes that in all cases of the nearer stars allowances must be made for the brightness of Vega. He marks the two brightest stars south of Vega (at about 168° : 240″ and 196° : 175″), as equal 9·8 mag.; the one at 168° : 240″ is, however, on the photograph about half a magnitude fainter than B, and the other at least a magnitude fainter. The bright star at 78° : 240″ is 9·6 mag., that at 245° : 250″ 9·8 mag., and the one at 356° : 172″ a little fainter than 10·0 mag. Σ. The star at 188° : 220″ is about 10·0 mag., and the remaining six seen by him range from 10·8 to 11·7 mag.

The paper by Prof. Asaph Hall, alluded to by "F.R.A.S." as appearing in the October number of *L'Astronomie*, is simply a *verbatim* translation (whether communicated or not by the author I am, of course, unable to say) of an article which appeared originally in the *American Journal of Science and Art* for March, 1885, and which was copied from thence into the *Observatory* for April, 1885. Dr. C. A. F. Peters's investigation appeared in *Ast. Nach.* No. 512 (1845); Dr. Magnus Nyrén's in his paper "Die Polhöhe von Pulkowa," and there is a paper by Mr. Downing on the subject in *Monthly Notices*, XL., page 430.

So far as I am aware, no Continental astronomer of any reputation whatever considers that the Nova of 1572 has a period of three centuries, or expects it within the next few years. I would refer "D. A." (letter 26415, page 190) to two letters on this subject by Mr. Lynn, which he will find in the *Observatory* for April and May, 1883, pp. 126 and 153. I may also perhaps remark that I briefly examined the evidence for the alleged appearances in 945 and 1264 in the ENGLISH MECHANIC for January 2nd, 1880. (Vol. XXX. p. 402, letter 16666.) Undoubtedly Leowitz confused the comets which actually appeared in 945 and 1264 with stars. There is about as much evidence for stars having appeared in the place assigned by Arg. and Hind to the Nova of 1572 in the years 945 and 1264 as there is for the identity of Nova 1572 itself with the star of the Magi. Statements of this kind are copied in popular handbooks of astronomy with parrot-like fidelity; the duty of verifying their quotations or investigating such matters for themselves, instead of copying blindly from one another, being one which is very lightly regarded by the authors of such works. Smyth says that Schuler first saw the Nova of 1572 on August 6th, and that Hainzel perceived it at Augsburg on the following evening. Lindauer undoubtedly saw it at Winterthur on November 7th, and Maurolycus observed it with instruments at Messina on November 8th. Tycho Brahe first saw it three days later. I notice that Prof. Pickering has discovered by his method of photographing stellar spectra that four more stars in Cygnus exhibit spectra crossed by bright lines. One of the new ones is the variable P. 34 Cygni (on which cf. *Observatory*, Sept., 1886, p. 314), and another is the red star Holden 186 (D.M. (+ 37°) 3821), alluded to in a note on the magnitudes of some stars on one of MM. Henry's photographs in the ENGLISH MECHANIC for June 25, 1886. Photographs of the spectra of stars near the places in which the Nova of 1572 and 1604 appeared would be of interest. The star supposed to be the Nova of 1572, A of the diagram on p. 402 of Vol. XXX. of the ENGLISH MECHANIC, is about 9½ mag., and its spectrum would therefore be bright enough to be photographed. As Dr. Hind once remarked to the writer, a further investigation as to the place occupied by Nova 1604 is desirable.

November 1. **H. Sadler.**

HOW TO WRITE THE D.M. STARS.

[26442.]—MR. SADLER called our attention to this subject in Vol. XLIII., No. 1106, p. 297. The following are the various methods commonly in use:—

D.M. + 21°, 576 according to Dreyer, Gore, Holden.
+ 21° 576 according to Schönfeld, Vogel, Dunér, the *Ast. Nach.*, and Pickering.
+ 21° No. 576 according to the *Observatory*.

The last must be adopted in the L. A. S. circulars in future, as it emanates from Greenwich.

Wolsingham, Darlington,
Oct. 26. **T. E. Espin.**

ALPHA ARIETIS.

[26443.]—IF "F.R.A.S." (letter 26389) will refer to the *Astronomical Register*, Vol. II. p. 54, he will see that the difficulty about Alpha Arietis has been discussed a long time ago. As far as regards the list of stars in Vol. I. p. 418, of the *Cycle*, employed by Smyth to test his objective, Mr. Dawes replied at p. 88 of the same volume of the *Register*. With respect to the supposed duplicity of Alpha Arietis, I beg leave to state that it is simply a typographical error for Epsilon Arietis, a well-known close double. This list of Smyth's tests is quoted in Loomis's "Practical Astronomy," pp. 25, 26 (first edition). Mr. Dawes's suggestion does not touch upon the difficulty of Loomis quoting Alpha as a light test at p. 24. At my request, the late Mr. Bird most carefully examined this star with his 12in. mirror, and failed in detecting any star at all answering to Loomis's 11th magnitude at 30″ distance. There can be little doubt it is an entire mistake. The three small stars following Alpha Arietis, mentioned by Smyth, *Cycle*, Vol. II. p. 52, were well seen by me with a 4in. refractor in 1864. **George Hunt.**

Alleyn Park, West Dulwich, Oct. 26.

ABNORMAL TELESCOPIC DEFINITION.

[26444.]—I AM glad to find, from letter 26413, p. 189, that Mr. Sadler has turned his attention to the matter of telescopic definition as affected by peculiar conditions of the atmosphere. From his intimate acquaintance with astronomical literature generally, and the exceptional facilities for unearthing observations that to most of us are practically inaccessible, his contributions are always valuable and deservedly appreciated. The letter alluded to is no exception to the general rule, and the extracts it contains are so insufficiently known that they will be new to most astronomical readers and observers. The various points raised are extremely interesting, and the whole subject of atmospheric influence on the performance of telescopes is one which deserves more attention than has hitherto been accorded to it.

My authority for quoting Sir W. Herschel was derived from that quaint old book of Dr. Kitchener's, "The Economy of the Eyes." The original is therein referred to as contained in Vol. XCIII. of the *Philosophical Transactions*, p. 217, &c. With regard to the phenomenon of triangularity in star discs, I do not think it can be considered that such appearance is peculiar to *refracting* telescopes, for I have repeatedly witnessed it during the past eight years, whilst using a large *reflector*.

The occasional spurious duplicity of stars is a very remarkable, though fortunately less frequent, effect. I can only call to mind one such case in my own experience, and that was in 1877 or 1878, when I was using a 5in. achromatic. It troubled me very much just then, as I did not know whether it might be due to the instrument, and I wrote to Mr. Webb about it, who told me that he remembered seeing something very similar to what I described. I have never seen it with the reflector.

W. G. Franks.

EGYPTOLOGY.

[26445.]—MR. HOWELL is mistaken (26417) as to the meaning of Genesis xv. 13, and Acts vii. 6. The latter is a mere repetition of the former, which says—"Thy seed shall be a stranger in a land that is not theirs, and shall serve them, and they shall afflict them four hundred years, &c. Also verse 16, "But in the fourth generation they shall come back hither again."

There is no vagueness in this statement. They were to go to some other place for 400 years, and return to that place afterwards. In the other place they were to be afflicted and made to serve others. Is it reasonable to suppose the writer meant to say that these people should spend half of the time mentioned in what he considered their own land, doing their own business freely? None but a theologian can think so, or some one quite under theological domination.

If Galatians iii. 17 contradicts Genesis xv. 13, then either must be wrong, and possibly both, as they differ from Exodus xii. 40 and 41, which says —"Now the sojourning of the children of Israel (mark the name, sons of Jacob) who dwelt in Egypt was four hundred and thirty years (not 400), And it came to pass at the end of the four hundred and thirty years, even the selfsame day (no vagueness here), it came to pass that all the hosts of the Lord went out from the land of Egypt." If Mr. Howell is right, Exodus should say: "Now the sojourning of the children of Israel who dwelt in Egypt was 215 years"; but it actually says quite the contrary. If Mr. Howell is right in his view of the time spent in Egypt, it is perfectly clear he ought to agree with me that reliance cannot be placed on Biblical figures, and I hope he will say so.

Galatians iii. 17 appears to be but a repetition of Exodus xii. 40, with a modification to get over the difficulty, which was probably known to the learned Jews at the time of St. Paul. The number of years mentioned is the same (430), but in one the date is from Abraham, and in the other from Israel The context in Galatians shows that Paul was not thinking about small technicalities, and would probably despise them, as he did genealogical questions (Timothy i. 4), which at present trouble many who intend to believe in the infallibility of the text. It would not be possible for Paul to claim certainty for his text, and the same for Exodus. He did not raise such a question; but it has been raised for us, and we must answer it somehow.

It is of no use asserting that one set of extracts settle the question, when the question is as to the veracity of the whole. If they contradict each other, it is absurd to say they are perfectly reliable.

Memnon.

[26446.]—MR. HOWELL necessarily finds a difficulty through a verse, Ex. xii. 40, which he is unaware is one of the few that the Jews of our first century managed to alter for the purpose of creating such difficulty. The Greek and Samaritan copies, out of their reach, retain the full text thus: "Now the sojourning (or proletariat) of the children of Israel *and of their fathers*, which they had sojourned in Egypt *and Canaan*, was 430 years." That rabbis who had the audacity to corrupt the chronology 16 centuries, by either altering or suppressing nearly every date of the forty between Adam and Abraham, should doctor chronological texts elsewhere a little, when possible, by only dropping two or three words, was to be expected. That the words were genuine, however, is plain by comparing the prediction, Gen. xv. 13, before Isaac's birth, that the promised seed should be afflicted 400 years. This began when Isaac in childhood was mocked and afflicted by Ishmael, and ended only at the Exodus, just four centuries after, but over six if you make the Egyptian bondage all the 430 years, instead of half.

A few other points essential to this Mosaic question, that seem utterly ignored, I would gladly hint at. The "Mosaic authorship of the Pentateuch" was a dogma closely resembling that Moslem one, that the Koran was never written, but existed in heaven from eternity. I am not sure that our clergy might not, by giving the claim that full extent, have strengthened their case. However, they have long abandoned it, and it only serves now, and may for ages, as a torture-instrument for such as "Memnon" to amuse themselves by goading such as "Ramases" with. Nobody decently educated now supposes any document older than it represents itself. There may be some parts of our Bible that can hardly be said to date themselves; but such is not the long narrative wherewith it opens, which is unbroken from Adam to the death of Samson, and plainly a single work, not seven. Sir Isaac Newton pointed out in nearly his last, and one of the carefullest of his writings, that this dates itself as frankly, and almost as definitely as any book whatever before dates were printed on title-pages. Gen. xxxvi. could not be written *before* all those generations of Edomites had lived, eight of their kings died, and a king reigned in Israel (v. 31); nor could Judges i. 21, *after* David took the stronghold of Jebusites in his eighth year. The composition limits itself to less than half a century at the very utmost, viz., Saul's reign and seven years after him; but this also fixes the authorship, or rather editorship, as it is plainly chiefly compiled from older books, many of which it names. The great prophet and judge, Samuel, must have issued it, because nothing so important could, in his time, have got credence but by his authority; moreover, hardly could anyone not so early devoted and educated as he in

those times have got the learning necessary to such a work. The materials had to be Hebraized from Moses' Coptic and various now lost tongues (though probably all Hamite) into that now called Hebrew, which was, as Isaiah calls it (xix. 18), the "language of Canaan," of the children of *that* son of Ham. Hebrews, we must remember, have never had a national tongue. According to Moses, they did not become a nation early enough. But as English is now the mother tongue of Jews born here, so were Greek and Aramaic those of Christ, so were Aramaic and Canaanite those of Ezra's people, but Canaanite alone of Samuel's, and Coptic of Moses. Their Canaanite literature, now the "Old Testament," was all produced between the times of Samuel and Malachi, which is no wider interval than divides us from Chaucer. But many Eastern tongues change less in eighteen centuries than ours in five. Modern Greeks, who can read no classic, are yet said to find less difficulty in the Gospels than we do in Chaucer.

Samuel, David, and their contemporaries, as Heman, Ethan, &c., then turned all the most venerable documents into Canaanite, as Job, the Seven Psalms of Moses, and many far older. What account can be given of two such psalms as those numbered for us 14 and 53, but that they are two men's versions of one original? The literary inferiority of the two books next the Pentateuch does not imply an inferior hand to Samuel's, but only scantier materials. He, as we read in I. Sam. x. 25, wrote "the manner of the kingdom, and laid it up before the Lord." The holy ark was then in Philistine hands, stripped doubtless of all its gold and more precious contents, and when afterwards placed in Solomon's Temple, a mere battered fetish, "there was nothing in it save the two tables" (I. Kings viii. 9), the granite slabs with the "ten words" in them "on the one side and the other," written (as is all native granite) "by the finger of God" (and wonderfully like old Coptic writing does any Sinai granite polished always look).

Now, the earliest books, nobody can suppose, were alphabeto-phonetic; but of the nature of our algebra, or Chinese or Mexican writing, and so may have been much of what Samuel interpreted for us, dating from Adam's time. Who could have pretended to keep such accounts as Gen. v. and xi. but in books of some sort? Both the Canaanite editions extant have plainly, in all those dates, been wilfully cooked, and differently, by two hands. It is not more Providential that the true numbers remain to us in the Septuagint and Josephus, than that the two corruptors should so contradict each other. The Jew altered the whole twenty generations down to Abraham; but the Samaritan was cunning enough to avoid clashing with other genuine chronology, by leaving those since the Flood untouched, to deal more impudently with those before it. (By "genuine," of course, I do not mean Manetho's, or any other of these lying Egyptians' self-contradictory rubbish that "Memnon" would import; but such as Chinese, Hindoos, Babylonians, &c., preserved, and that accord with the pleistocene geology). Adamite generations then, we learn, averaged a fifth of a life, or over two centuries, and the shortest over 160 years. Those of Shem's line to Abraham all exceeded a century; and one, Nahor's, the best reading gives 179 years; but if his son died before him, only the grandson Terah would be named. Thus I do not understand by the phrase, "Noah begat Shem, Ham, and Japhet," that these were his own sons; but three of his descendants—the only three (out of scores perhaps) whom he could persuade he was not mad. (He was Osiris, and Saturn, and Satyavrata—each of whom survived all his own children.) Now, as the immediate fathers of Shem, Ham, and Japhet were of those perverse "sons of God" who married mere "daughters of men"—of the short-lived flint-folk, and as these three saved ones would each have a wife of his mother's race, there is hardly ground to suppose even these (far less their children) were more alike than a Chinaman, European, and negro of to-day. Noah was the last Adamite "perfect in his generation," or pedigree (the last of those gods that Egyptian tradition painted red), and none since him can be of more than quadroon, or rather octoroon, Edenite blood; all of us of mainly flint-folk, and perhaps even of Hanahash, Eve's deceiver, who was doomed personally (not his posterity) to grovel on the ground. It was quite natural, too, for the lives of even the three Noah saved, to drop to about half his own Adamite longevity, and then, by further intermarriage, in Heber's time to a quarter, and finally an eighth. All the shortening of life was thus natural, even if the Deluge made no great atmospheric change; which, however, it doubtless did. A sudden precipitation everywhere of some 400ft. of water (for such all the traces attest) may well have added, too, so much azote, or oxygen, or both, as to change glacial climates to the present one.

Of course, Samuel had not the infallibity of modern critical history compilers. Probably his greatest mistake by far was embodying Gen. xx., which cannot be history, but a hash made of two incidents, what had happened to Abraham (ch. xii.), and a century later to Isaac (ch. xxvi.), and current, probably among the Moabites, as a tale to bastardise the whole Israelite nation. But it shows the extreme of error this scrupulous race could record there being neither a name nor a detail more than the two genuine stories gave; how far from aught like myth or legend, as generally understood!

Then there were places where details are left to the reader's common sense, as in the day of Hagar's dismissal. Of course, he who had been so generous to Lot, was equally so to his own concubine, and set her up as a Bedouin princess. Going with her and the lad, but having to part before sunrise, he appointed where the caravan of retainers and cattle he was about to send were to find them. But she lost her way near where Beersheba was afterwards built, and it was the heat of the afternoon, the luncheon and water spent, before they ("the shepherds," as Josephus calls them) did find her in distress. Another abused passage, Joshua's great miracle at Gibeon, might and ought, I believe, to be Englished thus: "Then spake Joshua to the Lord, in the day that the Lord subjected the Amorites to the Children of Israel; and he said in the sight of Israel, Sun of Gibeon, be silent, and thou Moon of Aijalon valley. And the Sun [oracle] became dumb, and the Moon [oracle] ceased, when the nation overcame their enemies. (Therefore is it written in the book of Jasher that the sun in the midst of heaven stayed, and hasted not to the west, about a whole day; and that no day was like that, before or after it, that the Lord attended to the voice of a man, because the Lord fought for Israel.)" The historian never quoted his contemporary Jasher as authority; but explains how the gross error of that poem arose. Though the Samaritan copy omits any miracle here, that of silencing those demoniac oracles was necessary, because the Israelites, having been cheated into an alliance with Gibeon, could not use violence against its temples; and unless the Gibeonite witchcraft were thus miraculously ended, it must have been perpetuated in the midst of the Holy Land.

Among proofs how genuine and ancient the materials for the Pentateuch must have been, there are two little details in the book of Numbers I never see noted. The matter comes from a generation who believed themselves more numerous than they were, and that is just what a multitude circumstanced like those with Moses would think; whereas their successors in any later generation would rather have minimised them, to show national progress (just as the fact that only 75 males had descended into Egypt was dwelt upon). Now we catch the exaggeration at its very root when we find in neither of the censuses any odd units, and in each only one tribe (Gad in the first, i. 25, and Reuben in the other, xxvi. 7) having odd tens. In each numbering, eleven tribes of the twelve have round hundreds. That implies they were numbered successively, and in each tribe, first those undoubtedly belonging to it. Then come those of doubtful pedigree, and at last some so uncertain that it became arbitrary with the numberers where to stop, which accordingly they did at a round number. So no fraction of a hundred got reckoned into any tribe till the last came. But even then, it was only odd tens, not units; and the reason for this we find on turning back to Exodus. In chapter xxxviii. 25, it plainly appears the counting was not of heads, but of money; the oft-told total of 603,550 (and presumably the other, 39 years later, of 601,730) being simply that of half shekels of silver, yielded by the poll-tax, required for every soul from a month old. Now, whether this was regarded as heavy or light will be plain enough on comparing it with the people's voluntary offerings, which had, as chapter xxxvi. says, to be restrained, almost like applications for Guiness's Brewery shares. The people brought more of everything than the plan of the tabernacle could find room for; but even of what was accepted, we find at xxxviii. 24 that the gold alone approached a third the weight of all the compulsory silver. This tax, then, was quite trifling, and as "there was not one feeble person among their tribes," every married man doubtless at once paid for ten, unless his household exceeded that number; in that cases for 20. If silver was coined at that early time, it was more likely to be in five-shekel pieces than in single or half ones, and then no tent would give less than one of those. In short, the 600,000 and odd was no muster of those "able to go forth to war," but simply (as Exodus shows) of those *paid for* as *possible*, and which the payers hoped might some day be able. But as the average household nowhere much exceeds five, this was probably not far short of double the full population, including infants; and any moderately attentive reader must have seen, long before Colenso, that the warriors, or rather married men of all ages, were certainly under 60,000, and probably much nearer half thereof. And had Samuel, or any later Hebrew, even Josephus, dealt with it like modern history writers, rather than mere compilers, they would have been anxious to minimise that multitude. **E. L. G.**

BODY FALLING FROM TRAIN IN MOTION.

[26447.]—Referring to Mr. Stretton's letter, page 194, the body does cease to be acted on by the engine, but the consequence is that its velocity neither increases nor decreases (but for the action of the air on it) and would remain uniform till stopped by contact with the step, and the body does travel by the side of the train till so stopped. The point where the body strikes the step depends on whether the train is moving with a uniform or an accelerated or a retarded velocity, and (2) on the force and direction of the wind. It is possible that, with a retarded train velocity and a strong wind in the direction of the train motion, the body will strike the step in advance of the point from which it fell. **J. S. C.**

[26448.]—In the correspondence in your columns on this subject, the writers seem to have overlooked the fact that, laying aside the resistance of the air, &c., there are two forces acting on the body. These are (1) the impulse due to the motion of the train, (2) that due to gravity.

Now, these two forces would constrain the body to take the same path as that of a particle, say, projected horizontally from a cliff—i.e., *a paraboloid curve*. Therefore, the moment that the body is dropped from the window the impulsive force of the train decreases, and the attraction due to gravity increases; so, that although the body would drop to the platform *behind* the point from which it was dropped, yet it would have described in its fall a parabola in the direction of the train's motion. This curve would be the resultant of the two forces above mentioned. I think if "Glatton" refers to "some elementary books on mechanics," he will find the correctness of my argument. **W. M. Potts.**

[26449.]—If Mr. Stretton chooses to assert (p. 195) when he is told (see letter 26400, p. 173), that the "resistance of the air is the sole cause" which could divert the falling body from a line which is vertical relating to the carriage, that "your correspondents refer to bodies let fall in vacuo," it is hopeless to attempt to convince him of his error.

In his next sentence he states the fact that a pistol let fall from the window of a carriage would fall on the footboard behind the point from which it was dropped, to be the sole question.

This is not, except in Mr. S.'s mind, the "sole question"; for no one has denied it as far as general conditions are concerned, although two cases are pointed out on p. 173 in which it is not true.

No, the sole question is whether Mr. Stretton was correct in asserting that the reason for this retardation was the law of falling bodies, by which, as I was careful to state, I understand the action of gravity.

I pointed out on p. 136, and more fully on p. 173, that the resistance of the air was the reason, and not the action of gravity.

On p. 155, Mr. S. admits that the wind would retard the falling object; but says this "would also tend to reduce," &c., evidently having the idea that inertia or some latent force which he does not name (query, gravity?) is the principal agent.

He is improving, however; for in his last letter there is no mention of the law of falling bodies, although he does not appear to admit that the sole reason for diminished velocity is that the air can act upon the body.

His question as to why the falling body does not travel by the side of the train, seems rather puerile. In the first place, because it does fall, and is stopped by the friction of whatever body it falls upon; in the second place, because of the resistance of the air which generally retards it while in the act of falling. If of same density as the air, and if the air was moving with and at the same rate as the train, the body would, as Mr. S. suggests, keep with the train.

I cannot think that Mr. S.'s having to trust to the lessons he learnt twenty years ago, is any reason for not knowing that the laws of falling bodies do not affect the horizontal component of the motion of a falling body, although, perhaps, a civil engineer who allowed such ideas to pass would not be too careful in correcting them. **Glatton.**

[26450.]—Perhaps the following remarks may make the matter a little clearer than it seems to be at present. If a person in a train is holding a pistol and lets it fall, it is evident that at the instant when the pistol is released it has the same forward velocity as the train. If nothing occurs to interfere

with the forward velocity of either train or pistol, they will evidently both travel onwards at the same rate, and the pistol will, therefore, strike the footboard immediately below the window. Now, as the pistol has been released from all connection with the train, there is nothing to modify its velocity except the (comparatively) slight resistance of the air, hence, if we neglect the resistance of the air, the pistol will travel onwards with its original velocity until it strikes the footboard. As far as the train is concerned, if the accelerating force of the engine is just sufficient to overcome the obstacles to the train's motion (such as friction, resistance of air, &c.), then its velocity will remain uniform; if, however, this accelerating force be increased or diminished, then the pistol will strike the footboard nearer the rear or the front of the train, as the case may be. Probably Mr. Stretton can tell us whether the motion of a train remains fairly uniform from one second to another, or whether it consists of a series of bounds, so to speak. I have been told that the latter is the case, but hardly think it is so. **C. W. Bourne.**

[26451.]—Mr. Stretton (26433, p. 194), no doubt knows the laws which govern this matter; but his mode of expressing them may very easily lead readers to suppose that he does not understand them.

It is, of course, true that "when an article is thrown from a train it ceases to be acted on by the engine"; but none the less it retains the velocity and direction of motion which it has already acquired from the engine.

The only way to understand this subject is to consider independently each of the several influences or forces acting. These are:—

(1) The action of gravitation, causing the body to fall vertically.

(2) The acquired momentum tending to carry the body alongside the moving train.

(3) The influence of the wind, including in this the friction of the body cutting through the air.

Each of these acts exactly as though it alone were in operation, and the ultimate point at which the body strikes is that which all three produce by their distinct actions.

Then comes in a new consideration. The body rebounds under a complicated influence, consisting of the actual motion it possesses at the instant of contact, and the elasticity of itself and the surface it strikes on.

It is obvious, therefore, that while the result is definitely produced by absolute law, it is impossible to predict that result, because we can never know or calculate all the varying conditions which come into action. **Sigma.**

IS VIOLET A PRIMARY COLOUR?

[26452.]—In his reply (26252), Mr. Reynolds still relies on his alleged synthesis by mixing blue light with a small amount of red, and on his supposed analysis of violet by means of coloured spectral images or "ghosts" projected upon a violet-coloured sheet of paper (or even the violet end of the solar spectrum), these "ghosts" having been impressed upon the retina by prolonged gazing at a red or blue object. Mr. Reynolds' mixed light can no doubt be separated again, by the prism or otherwise, into its original red and blue; and so also could the violet of his sheet of paper by the same means. But it appears to me that the question really is, Can the violet of the spectrum be so analysed? There can be no dispute that *to the colour-sense* violet appears to be a reddish blue; but in view of the well-known errors of that sense in judging of the nature of the colours yellow, blue, green, and, I may add, white, I do not think Mr. Reynolds should object to my treating with a little scorn its testimony regarding violet.

Mr. Reynolds' process of analysis by means of "ghosts" is founded upon the generally accepted theory of the production of these "ghosts"; which theory, as he says I do not understand it, he has been kind enough to explain at considerable length. Indeed, it has been familiar to me for very many years; and if it were a correct theory, I grant that it would perfectly serve the purpose to which Mr. Reynolds applies it. That it is not a correct theory I hope to show here more fully than space permitted in my first reply to Mr. Reynolds.

In the first place, we may dismiss as non-essential that part of it which supposes the visual nerves in the retina to be arranged in three distinct sets, each of which is appropriated to vision of one colour only, and direct our attention to the assumption that the colour of the "ghosts" for which the theory professes to account is derived solely from the light which the eye receives from the ground upon which the "ghosts" happen to be projected. In direct disproof of this I have already cited the fact that these "ghosts" may be seen upon a *black* ground, from which, of course, no light comes to the eye. Mr. Reynolds doubts this fact, having experimented in a certain way and failed to see the "ghost." If he will try the following method, perhaps the result will be different. Upon the lower part of a piece of black paper place two square pieces of brightly-coloured paper, their colours being as nearly complementary as can be procured (say blue and yellow), so that their upper edges shall be in line and their inner edges in contact. Now, after looking intently for some time at a point on the inner edges of the coloured pieces near where they touch the black, turn the gaze quickly on to the black. The "ghosts" of the coloured papers will now be seen projected upon the black; and being of complementary colours, placed side by side, they are more easily discernible than if either were presented alone. But besides the black background, coloured ones may be used which are defective in the very rays which usually form the colours of the "ghosts" which may be projected upon them. Instances of such backgrounds will be mentioned before I conclude.

There are several other phenomena connected with these "ghosts" which are also irreconcilable with the accepted theory. First, there is the fact that "ghosts" derived from objects viewed upon a white or light-coloured ground are always brighter or more luminous than the ground upon which they are projected. Now, according to the theory in question, the "ghost" ought always to be darker than the ground; because it is said to be due to the virtual absence from it of certain rays which the ground, indeed, supplies, but to which the observer has been rendered partially blind. In short, the "ghost" is said to be visible through defect of effective light. As the "ghost," however, shines with more light than the ground, I conclude that its extra luminousness must be due to something added to the impression received from the ground. This something, of course, is not light; but it is its equivalent—namely, a colour sensation impressed upon some part of the apparatus of vision in the process of forming the "ghost."

Second. Another phenomenon not in accord with the theory favoured by Mr. Reynolds is shown in the influence of the background on which the "ghost"-forming object is viewed upon the colour of the "ghost" projected upon another background. To illustrate this strikingly, lay a patch of black paper upon a brightly-coloured (say red) sheet of paper, and after forming the "ghost" of the black patch in the eyes in the usual way, transfer this "ghost" to a white sheet. Here the "ghost" will be seen to glow with a red colour (nearly but not quite the same as that of the ground upon which it was formed) surrounded by a green tint, which is, of course, the complementary "ghost" of the red sheet used in the experiment. Now, it cannot be said that this red "ghost" is the result of the eyes having been fatigued by gazing at a green object, for the object used was colourless black. A much deeper-coloured "ghost" is obtained if we use a white patch instead of a black one in this experiment. In this case, of course, the eyes receive from the patch a mixture of all the spectrum colours; but why they should elect to be fatigued only by the green remains to be explained. Perhaps it may be said that the "ghosts" in these instances appear red only by comparison with the "ghostly" green ground which seems to surround them; but I believe it will be acknowledged by all who try the experiment that the colour of the "ghosts" is far too positive and distinct to be so accounted for. I may mention that the "ghosts" thus produced have not the exact tint of the ground upon which the black or white patches are viewed in forming them, but one a shade nearer the middle of the spectrum.

Third. Another class of facts inconsistent with the theory that the "ghosts" are the results of partial colour-blindness in the observer is that already alluded to, in which "ghosts" are visible upon grounds of such colours that they cannot supply all the tints actually present in the colours of the "ghosts." A notable case of this kind is that mentioned by Mr. Reynolds, in which a blue "ghost" is visible upon a violet ground—a case which, to my surprise, he adduces as telling strongly against my explanation of the "ghosts." If Mr. Reynolds, instead of being satisfied with a purely hypothetical explanation of this phenomenon, will experimentally seek for its cause, he will be more likely to arrive at the truth regarding it. As thus: The blue "ghost" is the result, in the first place, of staring at a patch of red paper. The immediate effect of this first part of the process is that a *green* spectral image of the red patch is impressed upon, and for some time retained by, the eyes. This green "ghost" will appear still green if projected upon a white, black, or green ground, because there is nothing in the tints of these which can alter the green of the "ghost" when mixed with it. All other colours in the ground, however, are found to change that of the "ghost"; and they do this exactly in the manner in which we know by experiment that changes of tint are produced when two different coloured lights are mingled. Now when the green "ghost" is projected upon the violet ground, the result is the same as when we mix green and violet light—namely, the formation of blue; the green of the "ghost" mingling with the violet of the ground also forms blue, hence the blue "ghost" upon the violet ground. Mr. Reynolds is no doubt right in supposing that "a feeble spectral yellow resulting from exposure of the eye to pure blue light" would produce a white "ghost" rather than a red one upon a true violet ground. As this "ghost," however, in Mr. Reynolds' experiment appears to have been red, I am inclined to think his feeble spectral yellow must have had an orange tinge, or else that his ground was purple or lilac rather than violet. This latter point Mr. Reynolds can easily test with his spectroscope. If he will mix orange and violet lights he will get *a kind of red* analogous to his violet mixture of blue and red. These red and blue "ghosts" appear as comparatively light or bright patches upon the violet ground; and if they are held to be produced from composite violet light, it must be, not because the eye has been rendered insensible to one constituent of that light, but rather because it has acquired an abnormal supersensitiveness to the other constituent.

Besides these cases in which the colour of the spectral image combines with that of the ground to form the colour of the "ghost," there are others (to which I have already referred) in which the "ghost," like those seen upon a black background, is so vivid as to overpower the colour of the background altogether, and in which that background does not and cannot contribute any colour towards that exhibited by the "ghost." Thus, a red ground, which (as ascertained by means of the spectroscope) reflects neither yellow nor green light, may have "ghosts" of these two colours vividly shown upon it—the yellow "ghost" having been derived from a blue patch, and the green "ghost" from a red patch, both viewed upon a bright green sheet. This green sheet, of course, at the same time produces a red "ghost" of itself, which intensifies the red of the background upon which the yellow and green "ghosts" are exhibited.

Another point in which this ingenious theory of the colours of spectral images is contradicted by my experience, and doubtless by that of others, is the assumption that the formation of these images is a result of fatigue of the eye. In my own case, although I believe I have an exceptional facility in creating these images, I can truly aver that I never have the least feeling of ocular fatigue in doing so.

The foregoing rather lengthy attempt to refute a mistaken theory has left little space in which to notice the passages in Mr. Reynolds' letter in which he impugns what he calls my theory. (I disclaim having any theory on the subject.) To my suggestion that in a mixture of red and blue the red might be neutralised by the green constituent of the blue, Mr. Reynolds, in his first paragraph, objects rather captiously that red cannot be neutralised by green. Of course in strictness I should have said *bluish green* (which, however, is still a variety of green); but this bluish green contains that portion of the violet which Mr. R. seems to admit would complete the neutralisation of the red. Then he says it is not clear that *all* the green would be neutralised by the small proportion of red required. Whether all or only some of the green goes with the red to form the white, which undoubtedly dilutes the colour of the resulting mixture, it appears that so much of it does so that the remainder is too feeble to affect what I call the outstanding violet.

Mr. Reynolds' second paragraph I have already dealt with. In his third, he tries to establish a parity of assumption between his view of the nature of violet and mine as to the constitution of blue. Even if he succeeded in this it would be but a poor argument in his favour.

Admitting the statement in Mr. Reynolds' fourth paragraph that the effect of adding green to a certain blue is to make it still bluer, it is difficult to understand how this fact should tend to make him doubt the existence of green in blue. If it amounted to an actual disproof of that "hypothesis," as he calls it (as perhaps it does to his mind), of course it would strengthen his contention as to the effect of adding red to blue, because that effect could not be explained by supposing that the red neutralises the green of the blue if there were really no green present to be neutralised.

Mr. Reynolds' next two paragraphs deal with what are matters of mere personal opinion, founded solely upon the uncertain indications of the colour sense. A discussion of these could lead to no definite or useful result. I therefore pass on to his last paragraph, in which we are again among the "ghosts." Here he says that upon a blue ground, which, his spectroscope informed him, reflected abundance of green light (he does not tell us what were its other colour-constituents), he observed a green "ghost" after gazing at violet, and that upon a paler blue ground he saw a violet "ghost" after gazing at green. My own experience (which in the main is confirmatory of Mr. Reynolds') shows that, provided the proper tints of colour are chosen for the experiments, both green and violet "ghosts" are visible on the same blue ground. Of

course, Mr. Reynolds attributes his green "ghost" solely to the green light reflected from his blue ground; but the violet "ghost" he thinks must consist of a mixture of the blue of the ground with a rose-coloured spectral image derived from the white light, which no doubt dilutes the blue of the ground. Here Mr. Reynolds has surely made an unconscious slip. He explains the formation of the green "ghost" in his own fashion, and that of the violet "ghost" almost in mine. Can it be that in the latter explanation he could give an instance of a mixture of red and blue forming violet, while the former accorded better with the colour-blindness theory? Did his blue ground not reflect enough of violet light to form the violet "ghost"? Of course, I agree with Mr. Reynolds that the colour of the so-called violet "ghost" is partly composed of a reddish spectral image resulting from gazing at green. Similarly, I I hold that the colour of the green "ghost" is partly composed of a very green-yellow spectral image occasioned by gazing at violet. In both cases these spectral images exist ready-formed in the eyes of the observer, and do not require white or any other external light for their development. In proof of this, I appeal, as before, to the evident luminousness of the "ghosts" as contrasted with the ground on which they appear. There are, no doubt, cases in which the "ghost" is darker than the ground on which it is projected (Mr. Reynolds' darker blue "ghost" on a blue ground may be one of them). But these occur only when the spectral image is formed by gazing at a bright patch placed on a much darker background. The reason is that this dark background produces its own spectral image, which is comparatively light, and this serves to brighten the ground upon which the "ghost" is projected, so that the latter appears dark by contrast.

This may be shown by the following experiment: Place together a white and black sheet, with their edges in contact, and across the line of contact place a strip of bright colour so that one half of it lies on the white and the other half on the black. Then, after forming a spectral image of the whole arrangement by gazing steadily at the centre of the coloured strip, quickly transfer this spectral image to a white ground. Upon this the "ghost" of the coloured strip will now be seen lying, one half upon a brilliant white ground, the other half upon a dull grey ground, the white ground being brighter, and the grey ground darker, than the "ghost" of the strip. These white and grey grounds are the "ghosts" of the black and white sheets respectively.

In conclusion, I beg to offer one remark upon the colour sense in relation to green. Mr. Reynolds is of opinion that the popular notion that this colour is a compound of blue and yellow is founded solely upon experiments in mixing pigments. This I am inclined to doubt, and to hold that these experiments do no more than confirm the judgment of the colour sense. In my own case, at any rate, the colour sense shows every variety of green to contain both yellow and blue, as distinctly as it testifies that red and yellow are the constituents of orange.

Joppa, Midlothian. **Walter M. Hardie.**

NEW TELEPHONE TRANSMITTER.

[26453.]—BEFORE replying to "Linnæus" (query 60515), it may be well to make a few additional remarks in continuation of letter 26285, No. 1122.

There are several very good transmitters, and it is little use in adding to the number, unless the new instrument can do something more than what the old has already accomplished. But the question arises: Is there really anything to be desired in this direction more than what has been done already? The answer is: Very great improvements must be made before the telephone can be considered a satisfactory instrument for sending messages even over very short lines. How much has yet to be accomplished is best known to those who are in the habit of using the instrument. Besides, the problem of long-distance telephony is yet to be solved. Now in order to understand how far this new transmitter may be an improvement on the old forms—to what extent it deals with the problems of induction and long-distance transmission—it is necessary to study the action of the instrument itself. The first question that naturally arises is: What is the object of having two vibrators? The answer to this question cannot be stated in a sentence. The following features will, however, be sufficient to indicate the direction in which a reply may be given, as well as to point out the great utility of this transmitter.

1. Since the vibrators are similar and similarly acted upon by the sound waves that impinge upon them, the vibrations of the one assist the vibrations of the other. The action of the box and vibrating plates is to gather up and practically to strengthen the sound, somewhat as a tube would do, but with this important difference—there is no mumbling sound heard in the receiver, because the sound-waves are not entirely confined in the transmitter.

2. Since the vibrators act independently, the same message may be sent at the same time to two different stations—for instance, A at Birmingham can send the same message, at the same time, to B in London and to C in Manchester. Or A can converse with B in London, and with C in Manchester, at the same time. Or suppose A to be a "clerk in charge" at Birmingham; then B in London can converse, through him, with C in Manchester, should anything render the state of the line in such condition that A might take the part of telephone relay, and with this advantage—B knows whether the relay sends the message correctly, because he is listening while the message is being repeated to C. And, in the same way, C is listening while the answer is being sent to B.

3. Since at least four microphone electrodes may be placed on each vibrator, the same message may be sent at the same time to any number of stations up to eight. The utility of this does not appear at first sight, nevertheless it has an important bearing on the problem of long-distance telephony, and also on the question of induction. Further on it will be pointed out how "Linnæus" may perhaps be able to make use of this power to transmit to several stations with the same instrument.

4. Several batteries may be employed with this transmitter. The current from each may be sent along the same wire, or along different wires. Or the different wires and currents may be so employed as to form a protected zone round any particular wire carrying a transmitted message. A wire forming the path of a current may be said to be in a protected zone, when there is nothing in the space surrounding the wire that will change the character of the current passing over same.

5. Larger battery power can be used with this than with any other transmitter, which can be done without causing injurious sparking at the loose carbon contacts, and without lessening the electromotive force necessary for any distance or purpose.

6. The new transmitter may be called a duplex transmitter, or a multiplex transmitter, for by its means not only can the same message be sent at the same time to different stations, but the same group or system of vibrations, or undulatory currents, may be sent along the same line in successive intervals by one operation of the voice. For instance, a given undulatory current sounds R in the receiver; now, by sounding R once in the transmitter, two R's can be sent along the line, in such a way that the vibrations or undulations forming the one group follow the undulations of the other—the one group, as it were, clearing the line for the following group. The first undulations reaching the receiver may not give the required sound, while the following group renders the word intended.

7. A telegraph message cannot be sent across the Atlantic at the same rate as on a short line, and special means have to be employed to send a message at all. Could the telephone be used, the rate of transmission, with the aid of a shorthand writer, can be made fourfold. He, therefore, who wishes to send the first telephone message to America, has only to make use of a properly constructed duplex transmitter to enable him to do so. How to construct, and how to use, this duplex transmitter has been indicated in these letters.

In a week or two I hope to send "Linnæus" a short description, with sketch, of a simple, but most efficient transmitter. **Vibrator.**

CHAMBER ORGANS.

[26454.]—As Mr. George Landel particularly desires my opinion anent the question of wood stops for Chamber Organs, and says that he feels reluctant to go on with his organ until he hears from me, I hasten to reply to his letter in last week's issue.

I certainly felt somewhat surprised at his determination to use metal pipes only in his contemplated instrument, being under the impression that all past experiences had pointed to one conclusion, namely, the advisability of using both wood and metal stops in all organs. I am aware that certain organ builders have, of late years, advocated the exclusive use of metal stops; and I unhesitatingly affirm that a falling off in tonal quality has been the result of this stupid practice. One has not to look far for the reason of the practice. Wood pipes are more troublesome to make, and infinitely more difficult to voice, in a perfectly satisfactory manner, than metal ones; and an organ containing both wood and metal stops is more liable to go out of tune with changes of temperature, and, accordingly, makes greater demands on the tuner than an instrument entirely of metal. These are gains, certainly; but gains involving the sacrifice of beauty of tone, richness, and variety of effect. I wonder what the great Schulze would have said if any person had asked him to build an organ with metal stops only; but, then, he was a master of his art, and knew the value of, and how to voice, wood pipes. I remember a conversation I had with the builder of the largest organ in this country while I was examining the instrument in course of construction. He drew my attention, apparently with no little self-satisfaction, to the fact that he was using, with a single exception, metal stops throughout all the departments. I asked him, "What are you going to do for *wood tone* in the instrument?" He replied, "We can get wood tone out of metal pipes, and *better*." "Probably," I responded; "but it is the *better* that we do not want." I received no answer. The organ is a failure so far as general tone is concerned—at least, that is my opinion.

I strongly advise Mr. Landel to follow the good old school of organ building so far as the union of wood and metal stops is concerned. I know the value of the wood in my own organ too thoroughly to advise him otherwise. Mr. Landel says: "True, some of the wood stops are extremely beautiful, but I have yet to learn they cannot be imitated, or even surpassed, by those of metal." There is a striking parallel between the *and better* of the aforesaid builder and the *even surpassed* of Mr. Landel. Let me assure him we want, in a Chamber Organ, *the true wood tone*, not *a wood tone bettered*, or *even surpassed*.

Mr. Landel alludes to "several French builders who now only use metal stops." Of all modern schools of organ building let the French be avoided. The hatred of everything German must surely be warping the judgment of the French builders who have abandoned the eloquent teaching of the Schulze school. Let it be remembered that even the great Cavaillé-Col has never succeeded in building a decent Chamber Organ, and never will until he gives up many of his present ideas. It is satisfactory to know that all the great builders of the day are not blindly following this all-metal-pipe mania. The most renowned American organ builder—Mr. Hilborne L. Roosevelt, of New York—has assured me that he never intends displacing the wood stops, or attempting to introduce the *improved wood tone* from metal pipes. His organs present examples of wood stops unsurpassed in manufacture and artistic voicing by anything of the kind made in Europe. I have one beautiful example of his work in my own organ, a unison *Doppel-flöte*, which is, to the best of my knowledge, the first stop of its class ever introduced in an English organ. The *Doppel-flöte* is a covered wood stop, of German origin, consisting of pipes of oblong section, nearly twice their width in depth, with two mouths, one on each of the narrow sides. The tone is singularly full, rich, and refined in quality. When voiced, as in my organ, on a low pressure, it imparts much dignity to the tonal structure of a Chamber Organ. It occupies considerable space on the wind-chest, and that I am afraid would spoil its charm in Mr. Landel's estimation. I was content, however, to give it all the space it demanded, and have no cause to regret its insertion.

G. A. Audsley.

THE RED VARIABLE STAR V CYGNI—31 MESSIER ANDROMEDÆ.

[26455.]—YESTERDAY evening, at 6.30 L.M.T., I examined the beautiful red variable star in Cygnus, discovered by the late Mr. Birmingham on May 22, 1881, and situate 2° 51·7′ north of α Cygni. I find it is now at one of its minima, being about the same brightness as the twelfth magnitude star lying 60″ ± north of it; and a careful watch should be kept on it, being now favourably placed for observation.

In a letter of mine early this year in the "E.M." I gave some estimates of magnitudes at various times, and it would be desirable to have at least an approximation of its period.

After examining the above star, I turned the 4·3in. Wray equatoreal, with a power of 113, on 31 Messier Andromedæ, which I had not looked at since last spring, and, in the feeble light of the crescent moon, low down in the S.W., I was surprised to find that the nucleus of the nebula appeared to be much brighter than it was some months ago, being condensed into a blurred stellar aspect; but it had not the *double star* appearance I noticed when the nova was of the same apparent relative brightness as the nucleus twelve months ago.

In the *Astronomical Register* for this month (just to hand to-day) there is a paper copied from the *Astronomische Nachrichten* with an account of some observations made early last month on the Continent, where it was stated some apparent change in the nebula had been detected, and the nova was supposed to have again become visible; but the Kiel astronomers failed to detect any change a week later.

Belfast, 1st Nov. **I. W. Ward.**

LATHE MATTERS.

[26456.]—I HARDLY think a sketch is needed of the method of covering inner part of front bush. I should simply extend the boss till it neatly met the inner edge of bush, size the nuts to pass into it, and provide them with a loose annular cover of sheet metal, which could be held by slipping it on the boss, removing it when it was desired to set up

the nuts, &c. The nuts would, of course, have to be kept clean. The reversed sides are a minor matter, and each could choose his own style in case any subscribers care to make up the lathe or order it. The bottom slide could have the screw covered by adopting the American plan of a solid plate carrying the vees, with the nut carried down and under from the top slide. There is room for it, and it would do away with the need of increased clearance lengthwise, and stand heavier cuts. The bottom slide would then be a trifle more difficult to take apart; but that is not of much import. As the guidance of the tool from a rigid surface is desirable, I think both gibs on the top rest ought to be at the other side. In the case of the bottom slide, the gib could be attached by hexagon-headed screws, not countersunk, so as to leave no difficulty in tightening. In the case of the bottom gib of front slide, flattening the angle would not only ease the screws, but would also reduce the pressure on the surfaces, and increase durability and ease of travelling, reacting on the clasp nut and lead screw favourably. About 50° would be sufficiently acute for top vee, I think. The clasp-nut should at least be made to move side to side of saddle. The expense would not be great, while the improvement would, if the lathe were long, be an extension providing a socket still further to tail, and might advantageously be employed. Would not phosphor bronze be the metal for the bushes?

The size of mandrel "F. A. M." gives would do work of a larger size than 6in. diam. with fair cuts. I have a common lathe with each size of mandrel that cuts 13in. diam., and I believe would cut fairly on 18in. It runs rather stiffly at high speeds on small brass or wooden articles; but I run it much faster than is usual, with 7 to 1 gear, treadling at such speeds as will keep the treadle from flying when foot is taken off; 7 to 1 is easy enough, though my bearings are nearly half as long again as "F. A. M." proposes, being about $1\frac{1}{2}$ and $1\frac{1}{4}$in. long; 10 to 1 would not be too difficult treadling, I think. With regard to that important item, the mandrel, it should be noted that spring temper is not hard enough for the centring of the Edmunds model; in fact, the "J.K.P.," or well-finished screw centring, is the better fitted, as is also the male cone and ferrule attachment. The last seems to me the best for amateurs' own making, as spring-temper is not friendly to fine finishing of screw threads, and there would be least cutting to waste to get shoulder. A little increase in the overhang is the main defect of the cone, but everything else is more easily got.

Has "F. A. M." settled on his plan of loose-head? I hope that eventually we shall develop a good, serviceable, comprehensive lathe that will come into use and demand. **Vulcan.**

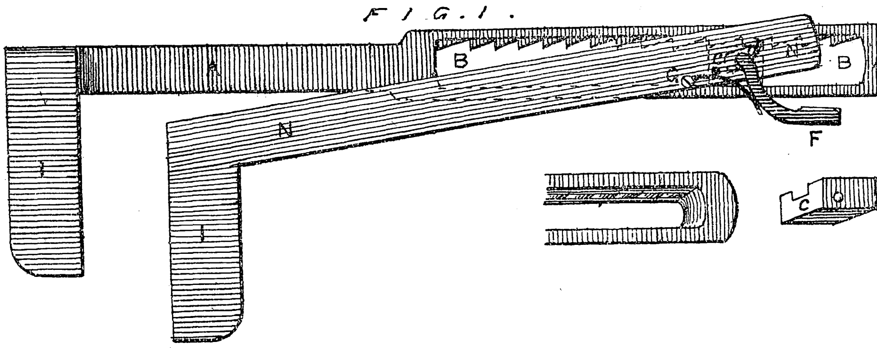
LATHE MATTERS—HOOKE JOINTS, SCREWING DEVICE, &c.

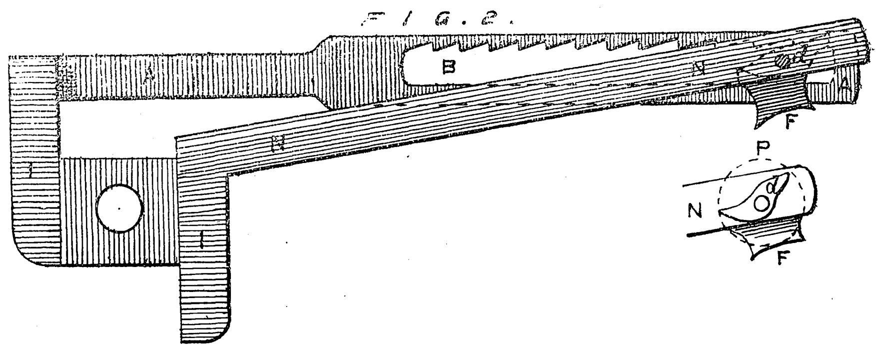
[26457.]—Referring to "Glatton's" remarks on page 191, I have no doubt that he is right in saying that forks of the intermediate shaft ought to be in the same plane: it is an important matter, and I am very glad he was good enough to point it out. Would it take up too much time and space to give the demonstration of what he tells us? Though I think I see that what "Glatton" tells us is right, I do not feel able to prove it. Moreover, though the inequality would be corrected where the first and third shafts are parallel (as they would be when using the long slide upon a flat surface or a parallel cylinder), and we could, therefore, cut true screws and flat surface spirals, I fear the result would be unsatisfactory if a spiral were attempted upon a cone. Mr. Evans uses the Hooke joints in this way, whilst Holtzapffel uses, I believe, spherical wheels, possibly to obviate this disadvantage. Also the pair of Hooke joints are used on the American milling machines, and therefore they must produce incorrect spirals when these are cut with the "spiral bed" placed obliquely, and therefore the spirals of all twist-drills must be inaccurate. I had my doubts about the matter, but supposed I might safely follow the milling machine.

The screwing device sent by "W. E. D." is, I think, the simplest I have seen. I know that the little cutter will work beautifully. Removing the work to the "nose" on the screw will be sure to make it run "out" a little, and cut the thread deeper on one side than the other. The nut C and the guide screw B will require to be very long. I would have the nut made in two parts, mounted one at each end of a T 6in. long, which T might fit into the rest-socket; the screw B might then be 7in. or 8in. long. The work could be fed up to the cutter by rapping the sole of the rest-socket with a hammer. Probably the chaser would remove the inequality of depth of thread. **F. A. M.**

ADJUSTABLE SPANNER.

[26458.]—I venture to inclose you drawings of an adjustable spanner, which appears simpler and more handy than the one figured in No. 1,126, p. 166, insomuch that it has fewer parts, and also that, after giving a turn to the nut, the jaws loose their hold of it, thus avoiding the necessity of removing the wrench to get another hold on the nut.





This wrench consists of a long arm, A A, with a rack screwed into a slot, B B, leaving about $\frac{1}{4}$in. of plain metal on each side of rack, whereon the sliding block *c* runs, which block has a catch, *d*, to engage in ratchet teeth.

The shorter arm N N is pivoted at E, which pivot also runs through thumb lever F, sliding block *c*, and catch *d*, and is secured on the other side by a suitable nut. The catch *d* is kept against ratchet teeth by spring G, which presses against thumb lever. Both arms, A A, N N, are provided with suitable jaws, I I.

If, for example, you wish to turn a nut, press down lever with thumb and slide short arm N N along, till the jaws I I grasp the nut. On the forward stroke the jaws grasp and turn the nut, but on the back stroke N N falls away a little, and slips round the nut. On another stroke being taken, the jaws again close on the nut.

Fig. 2 is the same wrench, but simpler, where the finger must keep the catch in the ratchet teeth by pressing lever up. **J. C. W. Kershaw.**

GLASS FOR THE WIMSHURST ELECTRICAL MACHINE.

[26459.]—In my former letters I have always endeavoured to press upon your readers the great necessity of testing the quality of glass about to be used for electrical purposes, and now for the information of so many as may also be the makers of electrical machines, I may state that, notwithstanding my full knowledge of the necessity of testing, yet I have fallen into the trap. It occurred in this way. I was wanting a considerable number of discs, and before buying I obtained and tested several samples of glass. The results not being satisfactory, the dealer then obtained for me a case of the "Bell" brand quality. From this I again made tests, and found everything to appear to be as I wished. The natural supposition was that the many samples tested fairly represented the quality of the whole, and I proceeded to cut thirty discs from the flattest of the sheets. It was only when the machine was finished that the truth became manifest, for then out of the first eight discs put into use three were of such bad quality glass that not only did they refuse to work, but, further, they conveyed away nearly all the electricity produced by the other discs. Of course, the three bad-quality discs have had to be replaced by others.

The lesson is that testing by sample is not sufficient. Each disc ought to be separately tested before being put into use. **J. Wimshurst.**

ZINC AND STEEL PENDULUMS.

[26460.]—Before I answer Mr. Buckney's letter published in your paper of the 22nd October, I would ask you to allow me space for a few lines, not bearing directly on the difference of opinion between Mr. Buckney and myself.

Most people know that clocks with ordinary pendulums will go slower when the temperature is hot than when it is cold; therefore it is necessary, in order to obtain correct timekeeping, to construct the pendulum in such a way that, for the purpose of timekeeping, it is under all changes of temperature of the same length—that is, the distance between the centre of suspension and the centre of oscillation should *always* be the same.

There has been constructed a large number of different kinds of compensation pendulums, but only two kinds have been generally adopted all over the world—that is, the so-called mercurial pendulum, and the pendulum made of zinc and steel tubes or bars.

In order to have correct timekeeping, the different parts of the compensated pendulum *should act at the same time*. That is the most important point in a compensated pendulum, and a point I beg to be remembered, because that is where the difference is between Mr. Buckney and myself. Mr. Buckney denies the truth of two of my statements—namely, that the mercurial pendulum used and described by him is badly constructed; also that that kind of pendulum is superseded long ago.

Anyone taking the trouble to think over the matter one moment will see at once that my argument does not admit of a doubt; it is as clear as daylight. The mercurial pendulum used by Mr. Buckney, would probably have a steel rod less than $\frac{1}{2}$in. in diameter, and a solid column of mercury about 2in. in diameter and not less than 7in. high. Supposing there is a rather sudden change of temperature, the comparatively thin pendulum-rod will certainly contract or expand long before the large column of mercury, and such a pendulum is, therefore, badly constructed. The object of my letter was to point out that Mr. Buckney had not proved by his paper published that mercurial pendulums were bad on the whole.

To make a mercurial pendulum with the bob of iron or steel with the pendulum-rod screwed in the top is a very objectionable construction—the temperature only acts on the outside of the cylinder; besides, the whole bob having to be turned to regulate the clock, would most likely affect the beat of the clock at the same time.

The second statement, that that kind of pendulum used by Mr. Buckney has been superseded long ago, could perhaps more correctly be stated that they have never been adopted. I may not trespass upon your valuable space any longer; but should Mr. Buckney, or anybody else, favour me with a call at 23, Great Portland-street, I shall be most happy to show them a mercurial pendulum superior to the one used by Mr. Buckney. **Christian Lange.**

SAFETY-LAMPS.

[26461.]—I am glad to see that this subject has not been dropped, and that two more letters have appeared.

I have not yet seen the Morgan lamp; but I notice that Mr. Shippey (letter 60634) says that it is simple in construction. I should not have thought so from the letters of "Practical" (page 179) and W. Clifford. The former speaks of it as "complicated," "too many parts," and the "short life of the gauzes," &c., and the latter mentions that the lamp has "four gauzes."

I happen to know Mr. C. E. Rhodes, and, thanks to his courtesy and kindness, I have inspected his

testing apparatus and witnessed some of his experiments.

I believe he has had a McKinless lamp under examination with good results; but I should like to know particulars. I always noticed the *bright* condition of the gauzes at his collieries, and I believe they are brushed with flint-dust. It would be interesting to know whether this does not soon alter the size of the mesh, and if to a dangerous extent.

Mr. Shippey asks why I object to wire gauze? I reply that I don't consider it reliable. I have no belief in uniformity in the mesh, as I have, under the microscope, been able to detect great differences in make and mesh, and, from the very nature of the material, it cannot be very durable, and when *properly* cleaned soon wears thin.

Only yesterday I used the McKinless lamp for several hours in the pit, and also tried it in fire-damp, and I can only say that I was thoroughly satisfied with its performance. It went out instantly in gas, gave a capital light, and did not get too hot. **Henry Palmer.**

East Howle Colliery, viâ Ferryhill,
October 29th.

HORSE-POWER AND MEAN-PRESSURE DIAGRAM.

[26462.]—If this identical diagram has been previously published, of course I have no "rights" to reserve.

Like "A Twelve Years' Subscriber," I have many similarly-shaped diagrams for various purposes of my own design; but excepting that some of them are composed of straight lines arranged in a triangular form, they cannot be called similar, as they serve different purposes.

"A. T. Y. S.'s" diagram appears, from his somewhat meagre description, to give nothing but the mean pressure, and apparently not even the effective mean pressure.

I have given both these and also the horse-power, and afford facilities for directly comparing engines with different back-pressures as well as different initial pressures.

Will "A. T. Y. S." give the name of the publisher of his diagram? **C. H. Wingfield.**

A GOOD BATTERY.

[26463.]—The following details of a primary battery test will probably interest some readers of "Ours." The cells were constructed with the object of obtaining a constant current of about three ampères over a long period of time, and are my own invention; the test was conducted by a Doctor of Science well known in London, and I did not even see the cells after I had charged them.

A few experimental tests were first made to ascertain the internal resistance, total capacity of the cells, &c., and then sufficient resistance was placed in outer circuit (which was not altered during the whole of the test), and a current of 3·45 ampères per cell was taken. The following extracts from the table of results will show the constancy:—

At start	3·45	ampères
11th hour	3·45	"
50th hour	3·45	"
98th hour	3·30	"
122nd hour	3·13	"
155th hour	2·27	"

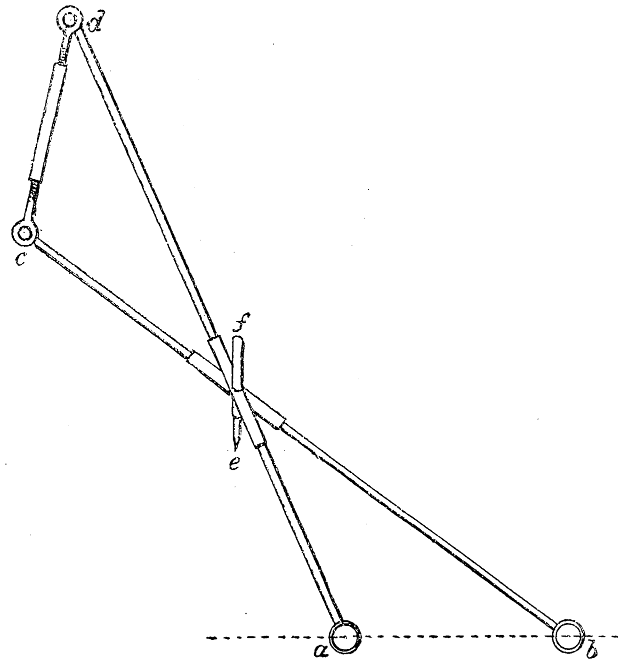
The E.M.F. was slightly under one volt per cell, and up to the 130th hour only fell eight decimal points. The actual internal resistance was ·087 ohm per cell at starting.

A cell was then tested for local action. After being short-circuited for 9½ hours, the positive plate was weighed accurately and replaced in the cell. At the end of eight days it was again weighed, and was found to have lost only 3·80 grammes, or practically *nil*.

I should like to have the opinion of some of "our" electricians as to its value for the vexed problem of household lighting; and as commercially these figures are of no value without actual cost, I may mention that a battery giving 63 volts and 12½ ampères constant for 126 hours would cost 30s. for the term, or under 3d. per hour for the electricity evolved. I shall be happy to give any further particulars to those interested. **Cato.**

A NEW ELLIPSOGRAPH.

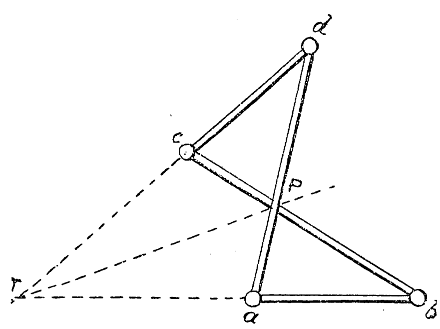
[26464.]—In the English Mechanic, page 167, you have an extract from the *Journal* of the Franklin Institute, describing a new ellipsograph designed by G. B. Grant. I write to say that three years ago I devised and constructed, *not only* the same thing, but also the improved form with sliders, which he suggests might be added, a rough sketch of which I inclose herewith. The pencil *e* is fixed in a socket, which is fast to the under slide; the handle *f* is similarly attached to upper slide. The link *c d* is formed in three parts—i.e., a socket screwed through half its length with a



left-hand thread, and through the other half with a right-hand thread, into which are screwed the two joints working on the ends of the links *a d* and *c b*. If the socket is turned one way the link *e d* will be shortened; if it is turned the other way, it will be lengthened to suit any required foci. **J. Riley.**

[26465.]—Mr. G. B. Grant's ingenious ellipsograph, figured in the last number of the "E. M.," (22nd October) was published some years ago in the *Educational Times*, but I have not the reference by me.

Mr. Grant does not do full justice to all the capabilities of his construction (which ought, I think, to be given in elementary books) as will appear from the statement below, and the accompanying diagram.



If the points *a b* are fixed, and the frame is made to move round the fixed link *a b*, P is the locus of an ellipse having *a b* for foci, axis major = *b c*, eccentricity = $\frac{a\,b}{b\,c}$: also T P (the line joining P to T the intersection of *a b* and *c d* produced) is a tangent to the curve at P.

If, instead of *a b*, the link *b c* is fixed and the frame moved about it, T will be the locus of a hyperbola having *b c* for foci, transverse axis = *b c*, eccentricity = $\frac{b\,c}{a\,b}$, P T a tangent to the curve at T, and the asymptotes will be parallel to that position of the links *a b*, *c d*, in which they are parallel to one another. **E. J. L.**

POLARISATION AND LATENT LIGHT.

[26466.]—When a ray is reflected or refracted it always loses more or less brightness thereby; but the loss is much greater for some angles of incidence than for others. And that angle which the ray must make with the surface, so that the loss of brightness is the greatest possible, is called "the angle of polarisation."

A single refraction can only partially destroy the brightness; but a second refraction is capable, on the one hand of totally destroying it, or, on the other, of restoring it almost to its original state. The following arrangement of prisms, though probably not the best for purposes of polarisation generally, seems best adapted for showing the extremes of the variation which the brightness may undergo.

Take two equal prisms, having one angle equal to the polarising angle, and it will be convenient, though not necessary, to make the sides containing the said angle squares. Place one of them so that a ray shall fall upon it at the polarising angle, in which position the loss of brightness by passing through it will be a maximum. Then place the other against it, with the square faces coinciding, and in such a position that the two shall together form a *plate*. In this position the brightness lost by passing through the first will be in great measure restored.

Finally, turn the second prism round through 90°, keeping the faces in contact as before. In this position no ray will be seen to emerge from the second prism. The question, therefore, will be asked, "what has become of it at all?" The answer which first presents itself is, "why, of course, it has ceased to exist." But this view, like many others which may at first sight present themselves, may certainly be shown to be fallacious. It will be found that the ray, instead of being improved out of existence, as is generally supposed, *has only been rendered latent*, and may easily be rendered again visible.

To do this, take a third prism, similar to the others, and place it in contact with the second prism, and in such a position as to form a plate with it: the ray will again reappear. And that it will do so is evident, even without special experiment. For, as happens in the first case, the brightness lost by passing through the second prism will be in great measure restored when another prism has been applied to it so as to form a plate with it. Now had the ray been reduced to non-existence by the first two prisms, it is self-evident that no addition of another prism could possibly make it visible. From which we conculde that it has only been rendered latent.

By latent light then we mean light which exists without being perceptible to the senses. And in this respect it bears a close analogy to heat, which is sometimes latent in like manner.

Now if it is asked, "what does latent light consist of?" the question will best be answered by seeing, first, what it is that common light consists of, and, next, what it has been deprived of by passing through the two prisms. What remains of it will be latent light. We may give an explanation as follows:—

Common light has been supposed in letter 26251 to consist of three sets of vibrations, one of them longitudinal in the direction of the ray, and of transversal ones, which may be resolved into two sets—the one of them in the plane of incidence, and the other perpendicular to it. After passing through the first prism, it is admitted on all hands that there is no longer any transversal vibration in the plane of incidence, and after passing through the second, there is no transversal vibration at all; so that there remains only longitudinal vibrations. These, therefore, are what the light must henceforth consist of, and as they are not evident to the senses, the light is latent. It may be noted that the light does not become insensible through the smallness of these vibrations, but from their being of a nature not to affect the eye with a sense of light, however large they may be, unless there are transversal vibrations at work, the action of the two kinds being explained in letter 26361.

We may now see how it is that the third prism makes the ray become again visible. If, as is

commonly supposed, there are no longitudinal vibrations, and the transversals had been removed by passing through the prisms, the ether would be reduced to a state of quiescence, and the ray would simply have become non-existent, and could not reappear. But from the ray becoming again visible through passing the third prism, it is evident that there must again be transversal vibrations.

We are now able to give a simple account both of the disappearance and the reappearance of the transversal vibrations, both of which facts would be wholly inexplicable, but for the existence of longitudinal vibrations. The case is simply one of the composition and resolution of motion. The longitudinal vibrations in the latent ray are resolved into longitudinal ones in the ray refracted through the third prism and transversal ones, as is shown by the reappearance of the ray; while on the other hand, the longitudinal and transversal motions which exist in the original ray become compounded into longitudinal ones only in the refracted ray.

The three prisms, therefore, show the existence of the three vibrations; the two first of the transversal, and the third of the longitudinal. Three mirrors properly placed would doubtlessly show the same.

In the next letter we shall try to show why the angle of the prism should be equal to the polarising angle. **W. G. Penny.**

(*To be continued.*)

THE CONTINUOUS BRAKES RETURN.

[26467.]—The return relating to continuous brakes in use during the first half of the present year has recently been published by the Board of Trade, and it confirms the opinions expressed at the Congress as to the very unsatisfactory state of the brake question.

The following table gives a summary of the rolling stock fitted on the 30th of June, 1886:—

—	Engines Fitted with Brakes.	Engines Fitted with Apparatus for Working the Brakes.	Carriages, &c., Fitted with Brakes.	Carriages, &c., Fitted with Pipes or Chains only.
Total amount of stock returned as fitted with brakes which appear to comply with conditions of Board of Trade	2,604	1,376	22,230	4,623
Total fitted with brakes which do not comply..	1,216	1,435	13,111	3,274
Total fitted	6,631		43,238	
Not fitted with continuous brake	849		8,552	
Total passenger rolling stock therefore	7,480		51,790	

From these figures it will be seen that out of a total of 7,480 engines and 51,790 vehicles, only 2,604 engines and 22,230 vehicles have brakes which even "appear" to fulfil the conditions laid down by the Board of Trade, and from my recent examination of all the systems I find that several returned as efficient are not really so in actual practice; and in the return, page 28, the Board of Trade add a note that "These totals are the numbers of engines and carriages returned by the railway companies as fitted with continuous brakes. It will be observed, however, that some of the brakes so returned but very imperfectly fulfil that designation." Since the Railway Servants' Congress I have, as an officer of the Amalgamated Society, carefully examined the brake return which has lately been issued, and the result is that I find it so full of incorrect statements that for all practical purposes of comparison it is absolutely useless. Brakes are included in the list of those which "appear" to comply with the conditions, which do nothing of the kind. The Board of Trade return shows 1,376 engines fitted with apparatus only, and 4,623 vehicles with pipes as appearing to comply; but, in fact, this rolling stock does not fulfil any condition. What possible brake power can there be when an engine has simply the *apparatus* for working brakes on trains, but no brake-blocks upon its wheels? or what value can a train of pipe vehicles be in case of accident?

I have now before me details of a case where a train was sent out with an engine with no blocks on its wheels, and 18 vehicles, 14 of which had through pipes only. Such a train would be returned to the Board of Trade as working a certain number of miles with a continuous brake; but, in fact, it was in almost as bad a position, so far as stopping goes, as a train without such a brake, and so long as horse-boxes, fish trucks, and other vehicles are run in passenger trains, it is essential that they should be provided with the continuous brake gear complete.

The returns relating to "failures" are as usual very incorrect: a large number of cases are not reported at all, and others are either placed under the wrong headings or even charged to the wrong brakes. It is also important that the companies should be required to furnish the *name* of the place where the failure occurs, as without this information it is impossible to trace a case or to know if it is reported or not. The Metropolitan Company, for instance, gives about a page of cases in which "a train overran the platform of *a station*." The Great Eastern and Glasgow and South-Western also omit the names of stations. The Lancashire and Yorkshire Company report an actual failure to act on February 25, at Hindley, simply as a delay, whereas it is a case which ought to have been recorded under Class 2. The same company records ball-valves and vacuum apparatus out of order, as belonging to the Westinghouse brake.

The Midland Great Western of Ireland also reports three actual failures of Smith's vacuum brake as simple delays.

The simple vacuum brakes *failed to act* no less than 71 times in the half-year, and in three of these instances collisions were caused—namely, at Kirkstead, Sutton Coldfield, and Birmingham.

The policy of the London and North-Western Company in removing the chain brake and substituting the simple vacuum is most unsatisfactory, and is but a waste of the shareholders' money, as without doubt it will at some future time have to be altered or removed.

For some years it was urged by some companies that the adoption of good brakes would cost too much. This cannot now be urged, for it is a fact that enough money has been spent and wasted upon fitting, altering, and removing inefficient brakes, and upon fitting two systems to one vehicle, to have provided every vehicle in this country with a good continuous brake.

Railway servants and practical men of course know that no brake has ever been invented equal to the Westinghouse in efficiency, and those who desire to see safe railway working must necessarily regret that it was not years ago adopted as the brake of this country, as hundreds of lives and thousands of pounds would by this time have been saved.

It is now perfectly certain that the companies never will settle the brake question until forced to do so; therefore it is to be hoped that Parliament will deal with the subject as early as possible, and before any more fearful accidents occur.

Leicester. **Clement E. Stretton.**

RAILROAD FARES.

[26468.]—Outlay of capital has something to do with railroad fares; hence perhaps the following table will be hardly less interesting to subscribers than that lately communicated by "H. B. F." (26395):—

Comparative average outlay of capital on English and foreign railways, as proved before the Select Committee on Railway Rates and Fares, 1881-2.

	Per Mile.
Great Britain	£40,000
France	32,800
Austria	21,000
Germany	20,500
Holland	20,000
Belgium	20,000
United States	11,800
Denmark	10,120
Norway	6,490
Sweden	6,401

Again, State railways, State guarantees, and subsidies are common things abroad, whereas there is nothing of the sort in Great Britain.

C. J. Tahourdin.

"Baynards," Wallington, Surrey, Oct. 26.

RAILWAY SIGNALS.

[26469.]—I have been laid up. Mr. Stretton appears to doubt my veracity. It would be useless for me to adopt a nom-de-plume and give the name of the railway for the signalling of which I am responsible; and with regard to the examining of the signals, referring to the concluding paragraph in Mr. Stretton's letter (26425, p. 193), I am afraid some of the readers of the "E. M." will come to the conclusion that "Libra" is one of the aliases of Mr. Stretton's detractor. Would you be kind enough to verify my address by a directory and note at the foot, not the address, but that it is correct? **Libra.**

[We cannot undertake any responsibility of the kind.—Ed.]

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60196.]—**Locomotives (U.Q.)**—Caledonian engine No. 128 (Class 125—129) 4-coupled: wheels, 7ft. 1in.; cylinders, 18 × 24; number of tubes, 186; weight, 41½ tons.—A. J. H.

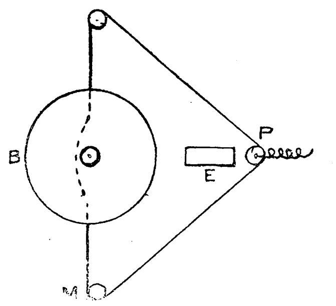
[60216.]—**Mineral Waters (U.Q.)**—As this puestion has remained unanswered, I have cut out the following from my "System of Hygienic Medicine," pages 66 and 67. It partly answers the query:—"Many believe in mineral waters. They say they are at least natural (i.e., to be used medicinally by man), and will alleviate our ailments. Now, is not this absurd, for mineral waters are the results of well-known conditions. The earth is composed of about fifty different metals, scattered more or less in the substance of the globe. Water is evaporated by the sun from the land and sea; it forms clouds, these in time break in showers. The rain has absorbed some carbonic acid in the air, it falls on the earth, and, percolating through it, dissolves some of the substances that it comes in contact with. In limestone districts the water is hard, because the rain, containing carbonic acid in solution, dissolved some of the lime from the rocks it came in contact with. If the soil contains any soluble salts, then the water dissolves these and is impregnated with them. Underneath the ground, water collects in large reservoirs or beds, and will then be forced upwards at one spot by a well-known natural law. This is a natural spring, and according to the rocks in the neighbourhood so will the water be. If pure limestone, then we get a hard water. If iron is in the soil we get ferruginous or chalybeate springs. If salt beds are under the soil we get salt springs, as at Droitwich; if the spring is in a metaliferous district we get the salts of iron, arsenic, lime, soda, magnesia, lithia, &c. This, in plain fact, is the way our medicinal springs arise, and as long as the medicinal, or drug, treatment of disease is reckoned good, so long will they be looked upon favourably. There is plenty of water in the world, some wholesome, like pure spring water, some not, like sea water, or water contaminated with mineral salts. There are a few good natural springs, such as those of Malvern; here the water is about the purest that can be drunk next to distilled water. This water carries little mineral matter to the system, but can carry a lot of waste material out; hence it is useful in gout, rheumatism, and other diseases. Many persons derive undoubted benefit from visits to places where there are springs, but this must not be put down to the waters drunk. We must reckon first the change of scene and possibly a purer air, absence from the worry of every-day home life, or absence from business cares; perhaps a simpler diet and more regular hours. Then there is the object in going there, and the banishment of ennui in seeing the company, listening to the bands, going picnics, in mixing with new faces, and getting new ideas of people. These and many more little items most often account for the good done by visits to mineral springs."—T. R. Allinson, L.R.C.P.

[60275.]—**New Banjo.**—If "Sam Koe," who gave such a good description of the "Dobson" banjo in reply to this query on page 157, would favour me by giving particulars of the "silver one of the latest pattern for 5 strings," which he speaks of in his reply, I should be extremely obliged to him.—Black Bones.

[60306.]—**Photographic Engraving.**—Mr. Roper does not indicate in what respect he failed; but I think he will find that the gelatine which has been unacted upon by light must be washed away in a dark room before the plate is placed in the etching bath. The advantage of using copper plates is not quite clear, for zinc is much cheaper and has been adopted by most of the skilled workers who now produce "process blocks." Mr. Roper might read a letter on p. 509, last volume, and an article on "Zincography," which appeared in No. 1,074, p. 155. He might also find some useful information in the book noticed by you so recently as Oct. 8, p. 123.—Saml. Ray.

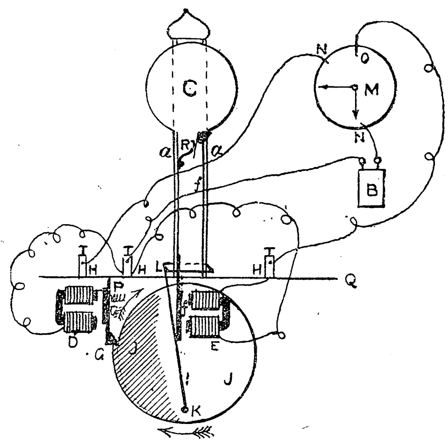
[60316.]—**Electric Time Ball.**—The following is the simplest method I have been able to devise:—B is the hollow ball with a piece of tube across a horizontal diameter. It has a hole at the top and at the bottom through which a cord passes. M is a self-starting electromotor having on its spindle a ratchet wheel which allows it to run in one direction only. P is a pulley, which, by means of a spring, stretches the cord tightly. It has an iron block attached to it. E is an electro-magnet pulling in the opposite direction to the spring. Two or three minutes before the hour the clock completes the circuit of the motor, and the ball is slowly raised. The friction of the cord on the tube in the centre

of the ball prevents its falling. At the hour the electro-magnet E, acting on the armature attached



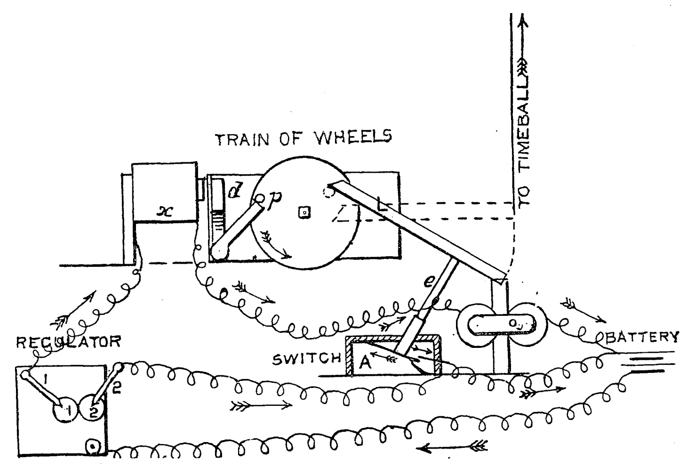
to P, slackens the string, and the ball falls.—G. BOWRON.

[60316.]—**Electric Time Ball.**—Some years ago I successfully constructed a time ball to rise and fall. Particulars as below. The sketch is obviously not made to scale, but is drawn to make details as plain as possible. *c* is the ball fitting round the upright (*a*) which has a groove cut up to receive the ratchet *f f*. This, at the hour, is attracted by the



electro-magnet E, allowing the ball to fall. J is a disc of brass equal in diameter to the upright *a* from the base of the ball to the floor Q. K I L is a piece of brass terminating at L in a square ring going round the support and fixed at K as a pivot. The whole disc is actuated by clockwork (not shown) to move in the direction of the arrows, and kept in its place by the ratchet G, which is kept pressed against it by the spring P, until acted on by the electro-magnet D at five minutes to the hour, when being attracted the disc is released, and, travelling round, raises the ball by means of K I L to the top; there the ball is kept by spring R pressing the ratchet outwards. Guides for the ratchets, &c., are not shown. The wires are connected up as shown to the battery B and clock M. The spring R must be only just strong enough to keep the ratchet in place, and the contact to raise the ball very finely adjusted in order that the electro-magnet D may be demagnetised in time to allow the ratchet G to catch the disc directly it has revolved once. If I have not succeeded in making my plan clear, I shall be pleased to afford further information.—S. HENRY SMITH.

[60316.]—**Electric Time Ball.**—Having been engaged constructing such an instrument for display in my own window, but had to lay it aside for some time owing to press of other business, and having seen the above query some two months ago, I became interested in what would follow; but, unfortunately, nothing of a practical nature has made its appearance. I could no longer resist the earnest appeals that have been made; consequently, I have sent rough sketch, and the following explanations of my design for the consideration of "Original Querist," so that by comparing notes he may be able to attain his long-wished-for desire. I raise my ball by means of a train of wheels, set in motion and stopped by a current of electricity, two minutes before every hour. C is the front plate of my regulator, with the two minute wheels and two levers: one lever is used to raise the ball, the other to let it fall; A is a box with three pieces of hammer brass fixed as shown. When the ball is in its normal position the long spring from the top of the box is in contact with the upper one of the two short springs; but when the ball is raised the long spring is pushed into contact with the lower short one, thus changing the current from electro-magnet *x* to electro-magnet *o*. The dotted lines show position of lever during the 58 minutes



of the hour. Suppose at two minutes to the hour lever No. 2 is in contact with pin on wheel (No. 1), a current passes in direction of arrows from battery to clock and lever (No. 1) to electro-magnet (*x*) attracting the armature (*d*), releasing the pin (*p*), allowing the wheel to turn as indicated, and raise the lever (L), the end of which is attached to the ball above, until it snaps into a catch on the armature of electro-magnet (O); attached to this lever is an arm (*e*), which presses upon the button of swivel, and charges the current from E M (*x*) to E M (*o*), releasing the armature (*d*), which resumes its original position in time to stop the wheel on the arrival of pin P; the whole remaining in this position for two minutes until at the hour, lever (No. 2) is in contact with wheel (No. 2), thus completing the current through electro-magnet (*o*) and dropping the ball. I use an insulated arrangement, so that the levers fall on to minute wheel pins exactly at the time required. The levers themselves are also insulated from the clock. The whole arrangement is placed underneath the window; the train is actuated by a weight. I trust I have made matters sufficiently clear to enable my brother in trade to proceed at once to finish his undertaking.—NORTHERN COUNTIES.

[60334.]—**Falling Bodies.**—"Vulcan's" seems to me the nearest answer to this question; but in a case like this, would it not save both time and space for some mathematician such as "F.R.A.S.," as "Vulcan" says, to send a reply? The question is interesting, to say the least. I still hold my opinion as to the earth behind retarding the stone. I did not say the body was retarded by the "spherical shell" (part of which is in front of it), but by that part behind it. Practically, "R. E. F.'s" statement admits this, although given as a flat contradiction. The earth is supposed homogeneous in this question, I understood. I quite agree with "R. E. F.'s" suggestion that "corrections" should be well founded.—M. YORK.

[60334.]—**Falling Bodies.**—Will "Dublieniensis" kindly give his authority for the statement he makes to-day, that "Every ellipse, no matter what its ellipticity, and no matter what its magnitude, described by a body round a centre of force, the force varying directly as the distance, will be described in the same time," as I should like to consult the work on astrological matters? Also, will "R. E. F." support me in stating that gravity is greater at the Equator than at the Poles, because a pendulum gains at the north and south of the equator on one thereupon? I suppose it will shortly be, as it appears it ought to be, a well-known fact that the slower a body falls, the greater is the attracting force. It cannot be too well known that "the force of gravity at the depth of a mile is far from being diminished, actually increased, so that a seconds pendulum at the mouth of a deep mine may gain several seconds a day on a similar pendulum at the bottom of the shaft." Many will be glad to learn that the faster a pendulum goes the less the force of gravity. Can particulars of this experiment be given? If a body is not retarded by the matter behind it, it amounts pretty much to the same thing, as the attraction ceases, and acceleration due to it, the matter in advance of it being diminished also. The proof afforded of the lack of homogeneity of the earth by the pendulum going more slowly at the bottom of a mine is indeed new. It is exactly what one would expect if the earth were homogeneous. Perhaps over deep soundings in the ocean the force is more at the bottom than at the surface, water being so much less dense than land. If this has been tried I shall be glad to hear the results; also if a pendulum has been found to go faster at the bottom of any mine. I have some recollection of reading the latter somewhere. A body passing through an unresisting earth might have its rates of acceleration varied by the varying densities of strata passed through, but would certainly not "be alternately accelerated and retarded," however the strata varied in density. I am under the impression that the average density of the earth has been ascertained for astronomical purposes, from observations, being about $5\frac{1}{2}$ times that of water, so that it would be very interesting to know of reliable data pointing otherwise. There is nothing in the action of gravity to compress any ordinary substance into extreme density, as towards the core of the earth the pressure would be slight; if earth is homogeneous the pressure should be greatest at surface, and if only $5\frac{1}{2}$ water is its density, the substances below ought to be pretty much of same density as on surface. Am not sure about the $5\frac{1}{2}$, but that is about the figure, I believe.—VULCAN.

[60428.]—**Silvering Glass.**—The original querist asked "where he could find an account" of the silvering process, and I gave exactly the information he desired. What *is* the matter, "Enquirer No. 2"? Why this savage onslaught? I am so sorry not to meet your views as to condescension; but even if our Editor were willing to fill a number or two, I do not feel it my duty to copy pages of other correspondents' letters to save you 2d. I was at some trouble to find the reference I gave, and no doubt you could obtain No. 794 for the above sum. I have no experience in this, or I would give it, with pleasure.—GLATTON.

[60432.]—**Architecture, &c.**—As the question of Protestant nationality has been put forth in regard to Gothic architecture, I may supplement my former reply by stating that Augustus Welby Pugin, the great originator of the present Gothic movement, has called Gothic architecture "Catholic architecture" in his "Ecclesiastical Architecture in England." As some people have considered the name "Gothic architecture" to be unsuitable, it may therefore be supplanted by the name "Catholic architecture," which is quite appropriate, both from historical connections and from its being the term adopted by its foremost reviver, whose dictum was, "Let us choose the glorious epoch before the Reformation as our type."—DELTA.

[60455.]—**Chemical.**—This query is not sufficiently explicit. Is the mark required to be "raised" in the ordinary meaning, or merely made? May the pencil be used wet—that is, dipped in water occasionally? Perhaps querist will answer these questions, and then he may obtain a more or less useful reply; but at present what he wants is rather too much of a puzzle, at all events for—NUN. DOR.

[60456.]—**Balm of Columbia.**—Impossible to answer this question without analysis. Perhaps it is a mixture of the tincture of cardamoms and of cantharides.—SAML. RAY.

[60458.]—**Old Oak.**—Unfortunately, the querist does not say what difference in shade has been produced; but a solution of permanganate of potash will produce a brownish tint, and a weak solution of iron a purplish black, both of which are modified by rubbing in linseed oil or wax.—NUN. DOR.

[60460.]—**Telegraph Circuit.**—It is not an easy matter to lessen the induction, and not easy to suggest a remedy in the absence of any knowledge of what "Amateur" would be permitted to do. He will find in back volumes a good deal on the question of induction, and may possibly, by diligent search, discover a remedy for the special case. Possibly, the best remedy is to put the speaking-circuit wires as far as may be from any others.—AN A.S.T.E.

[60464.]—**Coopering.**—There is no practical work on coopering, that I know of; but there is, in back volumes, information on the subject, and perhaps if the querist would ask definite questions he might receive replies, for there are plenty of readers, I am sure, who feel a pleasure in replying to queries, who would not undertake to instruct in the whole art of coopering.—BOOGE.

[60466.]—**Emery Wheel.**—Has this querist tried marine glue, or one of the waterproof cements which contain indiarubber? But why—oh why—does he not use a proper emery wheel? It is cheapest in the long run.—NUN. DOR.

[60470.]—**Malt.**—Is it permissible to ask this querist whether such a thing as he asks about has ever been done, or whether he wants someone to invent a new process for him?—NUN. DOR.

[60474.]—**Shirt Collar-Studs.** — The metal covers are stamped out near the size and are then "spun" on.—NUN. DOR.

[60475.] — **Gelatine Moulds for Plaster Casts.**—Has "Barium" tried the addition of a little bichromate of potash to the gelatine? Alum hardens the gelatine, but the bichromate, after the mould has been exposed to light, renders it insoluble. Let him omit the alum and add a little solution of bichromate.—NUN. DOR.

[60477.]—**Saccharin.** — "Sugar Baby" asks questions which are answered in the very pages he mentions. Of course, saccharin is soluble in water, as plainly intimated in pp. 500, 522, last volume, and no doubt any of the wholesale druggists would supply him.—F. I. C.

[60484.]—**Twilight.**—Although I cannot lay claim to be a first-class astronomer, I am sufficiently well acquainted with the elements of astronomy to know that the faintest stars visible to the naked eye are not rated fourteenth magnitude but the sixth. A reference to almost any book on astronomy would have saved "E. L. G." from falling into this error. He also ssys innocently that he has been in the same latitude without noticing any short twilights; but does he actually think that places of the same latitude have the same climate? For instance, Scotland and Labrador are in the same latitudes, yet what a difference in their climates! The following words of Dr. Robert Mann, F.R.A.S., F.M.S., may be of interest:—"It was at one time conceived that twilight lasted until the sun was 18° below the horizon, and then ceased. As a matter of fact, this is an altogether unsatisfactory and illusory conception. There is sometimes a very bright twilight long after the sun has reached this depression, and at other times there is absolute darkness considerably before. Alexander von Humboldt found that the duration of twilight was restricted to a very few minutes in the intertropical regions of South America. . . . By the astronomer's estimate, twilight is conceived to be at an end the instant a sixth magnitude star can be seen twinkling in the sky overhead." It will take a first-class astronomer to convince me that it is the appearance of a fourteenth magnitude star low down on the N. horizon that determines the limit of twilight.—R. E. F.

[60490.]—**Bookkeeping.**—Purely a matter of opinion. Every manager of a business keeps books in his own way, though there are certain general principles which can be found in any of the textbooks. T. Jones's "Bookkeeping," a complete treatise, at 12s., Simpkin Marshall, or any bookseller, will help him; but there are several lower-priced manuals.—SAML. RAY.

[60492.]—**Mechanical.**—In my answer to this, on page 137, there is an omission by the printer of the number 14 between 6 and 50 in the first line of the example.—LIBRA.

[60493.]—**Sewing Machine Cams.**—Surely this querist should give some idea of what sort of cams he means—"sewing-machine cams" is really too vague.—NUN. DOR.

[60498.]—**Induction Coil.**—One would need to see this coil before an answer could be given.—B. D.

[60500.]—**Coil.**—A street coil 9in. by 4in. would be a tremendous affair. Surely the correspondent knows that there is a large amount of "padding" in these appliances. It is bad economy to use cotton-covered wire in any coil. Look through indices for coils—medical and street.—NUN. DOR.

[60501.]—**Inks.**—I think "Nemo" can easily ascertain himself. The other ink is, I believe, made with logwood decoction and bichromate of potash.—J. T.

[60504.]—**Watch Jewelling.**—The stones are usually set in the holes by sinking them slightly below the surface of the plate and then burnishing the edges with, say, the point of a round broach. The stones with brass collars round them are for the top plate, the jewels being held in position by screws, the heads of which are partly sunk in the plate, and partly in the jewel-hole setting.—J. B.

[60505.]—**Salt and Lime in Water.**—If the lime is carbonate, it can be nearly all precipitated by the addition of lime cream to the water—stirring well; but the salt cannot be easily taken out. Querist should use purer water.—NAVAL ENGINEER.

[60514.] — **Silvertown Firing Battery.** — Having made these batteries up in large quantities, and used them while in the Torpedo Service of the Royal Engineers, I can give you full dimensions. Outer cell ebonite, two graphite plates fixed together by strips of lead at each end, from lead cap to lead cap; one zinc plate, same size as one carbon or graphite plate. Zinc plate is inserted into coarse flannel bag, and the sal-ammoniac packed round the plate; then tie bag round top close under lead cap; stand all three plates in outer cell, and pack round with carbon, &c., up to ½in. of top; cut four pieces of wood ½in. square, fit in top of cell to keep carbon, &c., in. Then seal with paraffin and pitch; the caps stand higher than top of cell.—J. SUTTON, late Royal Engineers.

[60540.]—**Tricycling Matters.**—Since writing my last letter in response to "Gamma Sigma's" query, I have thought of another reason why large level-geared wheels do not give such good results as small ones geared to the same height, and that is because the rider has to communicate his power through such a great distance to the rim, which means a loss, more or less, according to the size of the wheels; for instance, a pound pressure on the pedals would not represent a pound at the rim, so small wheels economise the rider's strength. What makes me think so is because small geared-up bicycles have not the same relative advantage over the ordinary bicycle, because the chain makes the distance about the same except up-hill, and that is easily explained by the rider not being thrown so far back, and therefore can keep over the pedals more. The Rover type is also faster over rough ground on account of the rider being placed between two wheels, not feeling the roughness so much. And both the Kangaroo and Rover type are better against the wind by reason of the low positions of the rider.—G. TOWNSHEND.

[60540.]—**Tricycling Matters.**—I cannot account for the superiority of small wheels geared up being more satisfactory to riders than large wheels geared equal, except it is the advantage gained by less windage—that is, assuming that it is a fact. "Gamma Sigma" has no need to look for any scientific matter from our present cycling press, as at present they, the various members of the staff, have nothing but racing on the brain. A few lines now and again as a slight change are devoted to blackballing any one in the trade who is honest enough to speak his mind. The stuffing-box to a certainty will take the place of the automatic. Now, by way of example of how the best ideas are treated by the cycle trade, some time ago (March 30th, 1885) I took out a provisional protection for the stuffing-box as applied to the steering handle of rack-and-pinion-steered machines. I submitted it to the trade, and they pooh-poohed it. If I had taken the full patent, I should now be able to have reserved a royalty on all the Crippers which will be steered by that means in the future. I think "G. S." could not have ridden a Cripper tricycle; otherwise his criticisms of the cross handle bar would have been very different, as the amount of support that can be obtained for the body when brought forward on the machine is one of the principal advantages; also, when needed, the pull upon the handles is very effective. There have been several machines through my hands with both handles to steer, which I could not sell. I should be most happy if "G. S." would give me a call and ride out with me. I will find a machine near to his idea, and he shall also alternately try the Cripper, when I think he will be convinced that the tricycle of the future is of the Cripper type.—C. LENI.

[60548.]—**Copper Boiler.**—Am sorry I overlooked this, but "Glatton" has supplied all you want. Taking sheet copper at 13 tons square inch and a factor of safety at 13—to allow for the riveted joint—will reduce it to 1 ton per inch sectional area, and as you have only $\frac{1}{16}$in. in the two sides, that will only allow 150lb. for the 7½in. diam., or 20lb. per square inch about.—T. C., Bristol.

[60548.]—**Copper Boiler.**—I am obliged to "Puzzled" for pointing out a mistake in my reply on page 178. The rule should be: Working pressure for *very* good brazing and properly-stayed ends $= 2{,}000\ \frac{t}{d}$; where t = thickness, and d = diameter in inches. This allows a working stress of 1,000lb. per square inch on the copper. Your pressure $= 2{,}000 \times \frac{\cdot 035}{7\cdot 5} = 9\cdot 31$lb. Test to 20lb. with cold-water pump.—GLATTON.

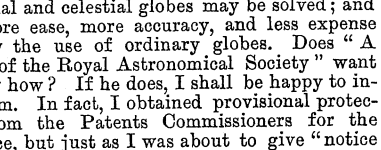
[60591.]—**Hardening Spring Steel.**—Carriage springs are hardened by heating them to a red heat and dipping into cold water. You must then draw it through the fire, at the same time pressing the end of a piece of chisel-rod till it flares off. You can harden small springs in the following way: Heat the spring to a red heat, dip it in cold water, now warm it sufficient to melt some tallow, hold it in a clear fire or gas flame till it flares off, and lay aside till cold. You will find this the right temper.—A. E. KEMP, Ramsgate.

[60591.] — **Tempering Springs.** — What is "Springee" trying to make poor fun of? Evidently of something he knows nothing of—that is, getting the temper of springs with a stick. My experience of getting the temper this way is confined to cart or carriage springs, and that goes back to 50 years. I have helped one of the best spring-makers I ever saw, and that was his way of tempering. I have seen plenty of others do, and have done it myself scores of times; and should I want to harden a spring to-morrow, I should do it that way. I am not entering into the different methods, only say it can be done and a good job made. The way is: after the plate is set, and made a dull cherry-red, dip in the water, then pass your plate back and forwards through your hollow fire; then take your bit of dry chisel-rod, and rub the end of it back and forward, and if hot enough, the end of the wood sparkles when the temper is low enough; in fact, you can almost tell by the feel when hot enough or getting near that way. The wood slips over as if the steel were greasy.—F. G. F.

[60619.]—**Cornwall.**—I think that the following should meet "T.'s" requirements. "Bibliotheca Cornubiensis," by Boase and Courtney, three vols., published by Longman and Co.; and Tregellas's "Cornish Worthies."—PENWITH.

[60622.]—**Astronomical.**—Suppose your celestial globe is of glass, and that you place your eye exactly at the South Pole, having first elevated the North Pole to the lat. of place. What you now see transferred on paper (as a picture) is a perfect planisphere. The wooden horizon appears an "oval" or ellipse; the stars in the south hemisphere seem farther from each other, being nearer to the eye, &c. The globe turning on its axis on the fixed wooden horizon will present exactly the same panorama of stars rising and setting as the said picture or projection turning on its centre against the upper disc or "aperture" of the planisphere, the representative of the wooden horizon (though in the latter it is the horizon that is made to revolve, but with exactly the same effect.) By the way, apropos of this, I may be permitted to add what I wrote for, but did not send to, the MECHANIC more than seven years ago, having reference to a reply which "F.R.A.S." made to my query (37811, Vol. XXIX. page 635). *Planispheres.*—Thanks to "A Fellow of the Royal Astronomical Society" for having so kindly replied to my query. But I must inform him that what he (and, indeed, other eminent men to whom I wrote) think "absolutely impossible," *ex necessitate*, is quite simple and feasible. In other words, a planisphere can be constructed by means of which all the problems (without exception) on terrestrial and celestial globes may be solved; and with more ease, more accuracy, and less expense than by the use of ordinary globes. Does "A Fellow of the Royal Astronomical Society" want to know how? If he does, I shall be happy to inform him. In fact, I obtained provisional protection from the Patents Commissioners for the appliance, but just as I was about to give "notice to proceed," I was informed by a respectable nautical instrument publisher, of London, that a retired Navy Schools Inspector had anticipated my ideas. I therefore desisted, as I placed the fullest reliance on the publisher's statement. He said that my model was almost identical with Mr. ——'s. "It works the problems in navigation, including latitudes, longitudes, azimuths, amplitudes, great circle sailing, &c."—in other words, every problem in spherical trigonometry. How wonderfully some important things are concealed while the world knows very often the most insignificant trivialities! Having invented this instrument, I applied to the most eminent astronomers in the three kingdoms, and not one of them knew of planispheres that solved every problem on globes, while some of them thought such an apparatus an impossibility. In azimuths and great-circle sailing especially, a problem of ten minutes' tedious calculation can be solved with this appliance by simple inspection only—no calculation required.—D.D., Youghal.

[60622.] — **Astronomical** — α **Arietis.**—As "F.R.A.S." has already replied to this query, I would only add that the reason why α Arietis was not entered in "Webb" or the "Star Guide" was owing to the distance of Smyth's *comes*. He gives a position angle of 107·3°, and a difference in R.A.



of 19·5°, which would make the purple 11-magnitude of which he speaks about 283″ distance. He says "The large star is followed by three small stars, forming a line across the parallel, of which the middle individual is B." I append a copy of his diagram. I am not aware that the actual distance has ever been measured. The annual proper motion

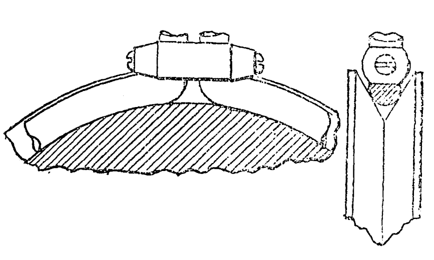
of α Arietis is about 0·246″ in 126°. Loomis, through some mistake, gives the distance of the *comes* at 30″. In Darly's "Astronomical Observer," the following passage occurs: "Mr. George Hunt *glimpsed* a minute star close in the rays of α, 15th January, 1864, 4in. aperture. A very close faint star, S. of α, was observed on the 4th January, 1864, with Mr. Younge's 9½in. aperture."—H. Sadler.

[60625.] — **Astronomical.** — Errata. — Two errors occur in my reply. The first is mine, the second the printer's. Line 42, for "about five times the sun's own apparent diameter," read "about ten times, the a. d. being sometimes a little more, sometimes a little less, than half a degree." Last line, for "the old man in the new moon's arms" (fie Luna!) read "the old moon in the new moon's arms."—George Bell.

[60646.]—**Cracked Gongs.**—I had a hand bell which was cracked. Solder was sweated into the crack, which quite restored the sound; but in a month it gave way again. A small patch of thin brass was then soldered over edge of crack inside the bell, and it has stood well, and sounds exactly as it did before being cracked. The bell is about 3½ to 4in. diameter; the crack about ⅜in. up, and the patch about ½in. square.—T. F. S. T.

[60654.]—**Locomotives.**—I can only answer part of this query. (1) M.R. engines: 1292, 1299, 1286, 1301 all belong to the 1282—1311 class. Dübs and Co., 1876. Coupled wheels 6ft. 6in., and cyls. 17½ × 26. Illustrated in the "E. M.," Vol. XXX. page 69. 109 to Class 101—110, by M.R. Co., 1877, 6ft. 6in., cyls. 17½ × 26. 1377 to Class 1377—1406, 6 coupled tank shunting engines by M.R., 1878. 169 to Class 165—169, M.R., 1870, and rebuilt at various dates, 4-coupled, 6ft. 8in., cyls. 18 × 24. (3) S.E.R. No. 159 (Class 150—160) 4-coupled, 6ft., with leading bogie, 3ft. 6in. wheels, cyls. 18 × 26, diameter of boiler 4ft. 4in. (4) G.N.R. No. 229 (Class 229—240), 7ft. single, cyls. 17 × 24.—A. J. H.

[60669.]—**Gut Driving Bands.**—Cut your gut to right length. Slightly taper both ends (by cutting) to enter hook and eye easily. Nip your gut in vice lengthways and screw on fastenings. If hook comes off, before putting it on again run a pointed tool round the whole inside thread to clear it out; otherwise the thread will not bite on the gut. I have discarded gut bands with their annoying fastenings, and have used for the last two years (with entire satisfaction) a fastening (of which I send sketch) together with stout plaited



sash-line or leather bands. Ordinary rope and gut do not answer quite so well, as they are liable to untwist. This fastening stands the utmost strain the lathe will bear, and is attached in a moment. For sawing heavy cuts and any purpose requiring a reliable tight band, it is admirably suited.—Hendon.

[60700.]—**To Draughtsmen, &c.**—I am greatly obliged to "E. L. G." for his interesting and instructive reply, and if it would not be troubling him too much, I would like further information. Would you give me a description and sketch of the instrument you name, the old-fashioned sector for the division of straight lines and circles, with its scale of polygon sides, and if it be the most royal road, why suggest the beam compass? I ask this last in no hole-picking spirit, but for information. Also, please describe the working of the lazy-tongs, with their construction, as I am not clear on that. And if any other correspondent is acquainted with other instruments for these purposes a description would doubtless be interesting to very many readers besides myself, as I think an instrument for these purposes ought to be in every workshop —a thought born of my own experience. In the shop where I presently work there are, besides myself, four men, including the foreman, any of whom, having a circle to divide, just step round first time with some random chord, and gradually get nearer each trial-stepping—a time-devouring process; and yet these men are, I believe, not below the average for mechanics in middle life as to education. As for myself, until recently I calculated the chords by trigonometry, but being a dabbler in inventing, I have invented an instrument for these purposes. This is my reason for asking all this, as, being correctly described by my *nom de plume*, the cost of a patent is to me a very considerable sum, so am feeling my way before proceeding.—Workman.

[60726.]—**Cement.**—Yes. Indiarubber would do, only it won't dissolve in spirits of wine. The solvents commonly used are naphtha, benzol, chloroform, and bisulphide of carbon.—Paul Ward.

[60728.]—**Steel and Iron Tubes.**—My reply to this in last week is mixed up. What I wrote was 90 × 12 = 1,080lb., say ½ ton, which would require ¼in. sectional area, that is ⅛in. plate.—T. C., Bristol.

[60737.]—**Mathematical.**—There is no simple general solution.

$$\left.\begin{aligned} x^3 - y^3 &= a \\ x + y &= b \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Let— $x - y = u$

Then— $x^2 - 2\,xy + y^2 = u^2$

and— $x^2 + 2\,xy + y^2 = b^2$

$\therefore\ 4\,xy = b^2 - u^2$

and— $2\,(x^2 + y^2) = u^2 + b^2.$

Factorising (1) we get—

$$u\left(\frac{u^2 + b^2}{2} + \frac{b^2 - u^2}{4}\right) = a$$

i.e.— $u(u^2 + 3\,b^2) = 4a$; or— $u^3 + 3\,b^2\,u = 4a.$

Let— $u = p + q$

adopting Cardan's sol. of cubic, then—

$$p^3 + q^3 + 3\,pq\,\overline{p + q} + 3\,b^2\,\overline{p + q} = 4a$$

and let the remaining condition between p and q be—

$$3\,pq + 3\,b^2 = o;\ \text{or—}\quad pq = -\,b^2$$

the equation becomes—

$$p^3 - \frac{b^6}{p^3} = 4a$$

or— $p^6 - 4ap^3 - b^6 = o$

$p^3 = 2a \pm \sqrt{4a^2 \times b^6}$

so— $q^3 = 2a \mp \sqrt{4a^2 \times b^6}$

$$\left.\begin{aligned} p &= \sqrt[3]{2a + \sqrt{4a^2 + b^6}} \\ q &= \sqrt[3]{2a - \sqrt{4a^2 + b^6}} \end{aligned}\right\} \text{or } w\,.\,\sqrt[3]{\ \text{do.}} \left.\begin{aligned} & \\ & \end{aligned}\right\} \text{or } w^2\sqrt{\ \text{do.}}$$

$$\text{or } w^2\,.\,\sqrt{\ \text{do.}} \qquad \text{or } w\sqrt{\ \text{do.}}$$

w, w^2 being the cube roots of 1

$$\begin{aligned} 2\,x &= b + u = b \times p \times q \\ 2\,y &= b - u = b - p - q \end{aligned}$$

hence x and y, by putting above values of p and q. —No Sig.

[60743.]—**Cast-Iron Piston Rings.**—I have made several piston-packings this way. I turn them the diam. of piston and cut them; I cut a piece out if not tight enough, and lay a piece of brass is to stop passage of steam.—B. Helme.

[60743.]—**Cast-iron Piston Rings.**—If the piston block is in halves, or, more properly speaking, has a cover on, you will find bolts or other means of fastening them together; if not, you will have to carefully spring them on, most probably the latter, as the springs are only narrow. When I draw rings of this description, I get a tool like a hammer, but with one end in the shape of an axe, but very dull, so as not to cut the metal. Lay the spring on an anvil, or something very solid, and carefully hammer inside, taking care that the slight indent the tool makes goes square and even across the spring, or it twists; taking care that the spring is solid every blow you give, or it will snap. Keep trying it very gently until you hear that it is solid, then hammer round; but I may say that rings when hammered never fit as well again, be they ever so well done. Could you not get some steel ones, as they are safer?—A. O. H.

[60744.]—**Question in Dynamics.**—E. Conry should be more cautious: he has stepped into "Humbugged's" trap. The monkey cannot "begin to run up the string with velocity," not even if he goes to work "gently and regularly," as E. C. modestly requires. He could only raise himself by exerting a pull on the rope greater than that of his dead weight; but as m cannot meet that pull, being only just heavy enough to balance his dead weight, motion must ensue—that is, on the least contraction of the monkey's muscles in the effort to rise, up goes m and down goes the monkey as far as the rope will allow. The motion is not accelerated —here again E. C. is wrong—for after it is once started no unbalanced force is acting on either body. What can he mean by "accelerating through momentum"?—W. A. S.

[60744.]—**Question in Dynamics.**—I see a reply to this query in the last number of the "E. M." (October 22nd), which I do not think is correct when tested by the laws of dynamics. A string passes over a pulley, having a monkey at one end and a weight at the other, the mass or weight of each being the same. Suppose the monkey to be strong enough to raise its own weight 8ft. in a second, or 2ft. in a quarter of a second, and suppose for the present that the ascent is made by a series of bounds each 2ft. high; now, at the first bound the monkey would use a force which would raise his body or m 2ft. in a second, and the reaction of this force would tend to lower the end of the rope from which he starts with the same force; therefore the end of the rope would be lowered with the same force and velocity as the monkey raises his body, or, which is the same thing, the weight at the other end of the rope would be raised with the same velocity, so that at the first bound the monkey and opposite weight will both be raised a certain distance. Now the monkey can only raise m 2ft. in a quarter of a second; hence, as the weight raised in the first bound is 2 m, the height to which it and the monkey is raised is 1ft. Now it is easy to suppose the bounds that the monkey makes to be reduced in length, although the time of ascent will be the same, and finally, when these are sufficiently reduced, we get a continuous motion. The result will be that the weight will rise as fast as the monkey, and both will rise at a speed of 4ft. in a second, just half of what the monkey could do if the rope were fixed.—M.I.C.E., Bath.

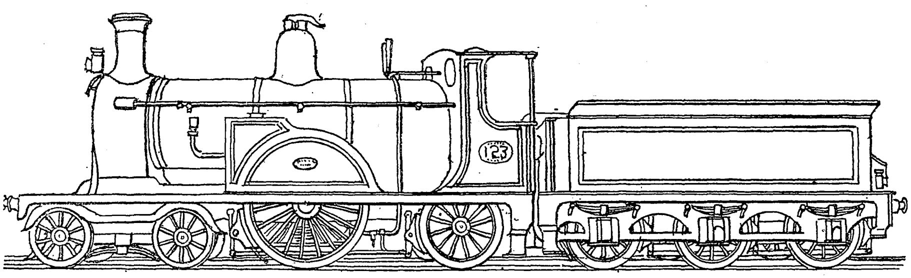
[60748.]—**Electricity at the Science and Art Exams.**—Kindly read replies 60557 in last week's English Mechanic, as also in the week before. To these I can only add: Read carefully Silvanus P. Thompson's "Electricity and Magnetism," also Sprague's "Electricity." Join, if possible, one of the science and art classes in your neighbourhood. If you cannot, then read a chapter, and repeat every experiment therein described until you have a practical knowledge of the subject. Write for the questions given for the last ten years to the secretary of the Science and Art Department, S.K. When you have them, try to answer every one, a few at a time, and check your answers with your books. If you go in for "honours," you stand a fair chance of getting ploughed if you do not know mathematics; but arithmetic will carry you through the "advanced." —S. Bottone.

[60748.]—**Electricity at the Science and Art Exams.**—To pass the advanced stage you will need a good all-round acquaintance with the facts of electrical science, and to obtain this requires some genuine study. The best thing to do is to attend a class conducted by a really good man. If you cannot attend a class, study two or three new books, and make careful notes as you go along. Silvanus Thompson's book is very good; you cannot do better than obtain it for one. I would especially recommend you to work out the examples he gives at the end, a lot of exact information being acquired in that way relative to measurements, &c., which would otherwise be missed by merely reading the work. Many of these questions, too, are a fair sample of what you will have at the exam., so that you cannot do better than work up at leisure the information necessary to answer them. As for other text-books, those of Sprague and Fleeming Jenkin may be mentioned, though I have not seen the former. In any case, you ought to have more than one, because different authors put the same thing in different lights—hence, a point not very plainly elucidated by one becomes perfectly clear to the comprehension when a second is consulted. It is hardly needful to observe that you should seize every chance that may offer itself of seeing and examining the costlier kind of electrical apparatus. This is by no means absolutely necessary, but it will be a help. If you intend going up for the exam. as a private student and not as member of a class, it will be requisite to apply for a paper to the local secretary of the district where you reside about the end of March, and pay, if I remember rightly, the sum of 2s. In addition to obtaining a paper, the secretary will also, in due course, advise you when and where the exam. will take place. With respect to mathematical knowledge—no, you will not need much. Silvanus Thompson's book gives nearly all necessary. Is the exam. a stiff one? Well, tolerably, but nothing whatever to be afraid of. It would be worthless if *very* easy. This year 1,627 persons submitted themselves in the advanced section, of whom 182 secured first classes, 752 second classes, and 693 failed. In the honours section not a single individual passed in the first class, and there were only seven seconds—and this for the United Kingdom. What are our electrical students doing? —First-Class Advanced.

[60753.]—**Light.**—To W. G. Penny.—Mr. M. York, M.I.C.E., seems to think that, to say that a ray falls obliquely upon a surface is to imply that the surface is flat.—W. G. P.

[60762.] — **Engine Flywheel.**—This seems about right for the engine, but as regards the engine you do not give the steam-pressure, so cannot give H.P. You would require a good pressure to drive the saw as it should be driven. Have a long strap, say 15ft. centres.—T. C., Bristol.

[60747.]—**New Caledonian Single Engines.** —I made a sketch of No. 123 at Edinburgh and send herewith. It appears this is not entirely novel in design, as Mr. Park has employed the same arrangement—i.e., inside cylinders, single driving wheels, and leading bogie, in engines on the Great Northern of Ireland since beginning of 1885. The Caledonian engine looks very well in its dark blue



colour, with its silvery-looking mountings and pickings. As the dimensions have already been given, it is useless to repeat them.—B.

[60765.]—**Area of Sewer.**—The area of a sewer 2ft. diameter is 2 × 2 × ·7854 = 3·1416. Now ascertain by proportion what must be the area of the sewers for 10,000 and 15,000, and then find their diameters by dividing the areas by ·7854 and taking the square roots. They are 2ft. 9in. nearly and 3ft. 4in. nearly respectively.—LIBRA.

[60765.]—**Area of Sewer.**—As you say 2ft. diam. for 5,500, I assume you mean circular in section. Of course there are other sections; 2ft. diam. = 4 circular feet, therefore 10,000 would require $\frac{10,000}{5,000} \times 4 = 7{\cdot}3$ circular feet, or a diameter of 2ft. 8½in. For 15,000, area would be 11 circular feet., or a diameter 3ft. 4in.—T. C., Bristol.

[60765.]—**Area of Sewer.**—For 10,000 the diameter would be—

$$\sqrt{\frac{10,000}{5,500}} \times 2 = \frac{10}{7{\cdot}4} \times 2 = 2{\cdot}7\text{ft.}$$

For 15,000 the diameter would be—

$$\sqrt{\frac{15,000}{5,000}} \times 2 = \frac{5{\cdot}5}{3{\cdot}3} = 3{\cdot}3\text{ft.}$$

—A. E. F. Manchester.

[60765.]—**Area of Sewer.**—This question can be worked by simple proportion if we put the area of cross section of sewer instead of the diameter, the reason being that the area of a circle of radius 2 is not twice but four times that of a circle with radius 1. The area of a circle 2ft. diameter being π feet, we have—

$$5{,}500 : \pi :: 10{,}000 : 5{\cdot}7119$$
$$5{\cdot}500 : \pi :: 15{,}000 : 8{\cdot}5679$$

We have now to find what diameters correspond to areas of 5·7119 and 8·5679 sq. feet respectively; this we may do from the formula—

$$d = \sqrt{\left(\frac{4a}{\pi}\right)};$$

the diameter of the sewer being, for 10,000 people, 2·697ft., and for 15,000 people, 3·303ft. This may not be the shortest way, but it is the simplest to follow.—R. E. F.

[60767.]—**Exploding Gas by Electricity.**—As you intend to use a Bunsen cell for exploding the gas, it would be better to explode it by means of a short length of very fine platinum wire, which would become heated sufficiently on closing the circuit to explode the gas. Glass tubes let into the cylinder would be the best insulators.—A. E. F., Manchester.

[60767.]—**Exploding Gas by Electricity.**—The spark from a Bunsen cell might explode gas in a cylinder, but there would be greater chance of success if the Bunsen were connected to a small induction coil. Guttapercha will do for insulation where the wires pass through the side of the cylinder, the "terminals" being simply a small part of the wire stripped of its insulation.—BOBADIL.

[60767.]—**Exploding Gas by Electricity.**—(1) An ordinary Bunsen will do; but it is not the most convenient form by any means, and for intermittent work is about the most clumsy and costly you could get; moreover, the E.M.F. of one cell is so low that you would not, without the aid of an induction coil, get it to spark across the smallest space without actually touching the wires together and then parting, and even then the spark would be so small that I should doubt its power to explode any charge of gas. (2) Guttapercha or a small bone ring filled up with melted indiarubber. (3) Platinum.—E. CONRY.

[60767.]—**Exploding Gas by Electricity.**—"Volta" will hardly find a Bunsen cell sufficient to explode the gas; it would be necessary to use an induction coil. If the cylinder is made of glass, it would only be necessary to fuse the wire in, and that would be sufficiently insulated, glass being, as "Volta" knows, a non-conductor. The terminals ought to be made of platinum; if the diameter of the cylinder is not very great, "Volta" will find no great difficulty in fixing the wire. How far the points are apart must be decided by the length of spark you have at command.—V. B.

[60770.]—**Field-Magnet Winding.**—TO MR. BOTTONE.—I do not think you will do much with your machine, as the shape of the armature is bad. However, before discarding it, put about 20lb. of No. 16d.c.c. on each limb of the F.M.'s, and couple all four up in series. This will probably give you enough to light 12 five candle-power lamps.—S. BOTTONE.

[60771.]—**Ventilation.**—For ground floor, put an air-shaft each side of fire-flue, and carry them up to same level. Put a Sheringham or mica flap ventilator in both ground and first floors (near ceiling) into the right and left hand air-shafts. Tobin tubes should now be placed as far as possible from fireplace. The area of each shaft should be about 60 square inches, and tubes about 30 square inches. In hall, I would suggest two circular or rectangular adjustable gratings at floor level, and in ceiling at top of staircase a wire gauze, connected by means of a tube to louvre ventilator on roof. For attics, adopt same method, and have gauze over gas jets if possible in both cases. A gill stove in hall would be useful. If you go "twisting or prolonging" your hot-water service you will perhaps have to pull down half your house to get at them when repairs are needed. —S. M. S.

[60771.]—**Ventilation.**—I should recommend "A. A." to have a central shaft in the centre of chimney stack, and let it be the next to the kitchen flue, that always being warm, and connect each room to air-shaft with opening as near the ceiling as possible, and have an Arnott ventilator, either with cloth or mica flap. Sheringham ventilators are for the ingress of air, not for egress, which Arnott's are. A Sheringham may be put in the wall connecting with the outer air, which can be admitted at will, or Tobin's tubes in two corners of the room; also, at least, a 3in. or 4in. pipe under floor to a ventilator in the hearth that would only want to be opened when the fire is being used. This arrangement will ventilate his rooms very fairly, and ordinary register stoves can be used; the air-shaft would want to be carried up 3ft. or 4ft. above chimney pots.—F. G. F.

[60771.]—**Ventilation.**—The following method is suggested:—1. In Cold Weather.—Inlets: Opening below gill stove in hall; admit air to rooms by opening over lintel of doors. Outlets: Opening in ceiling flowers over chandelier, passing into chimney. 2. Warm Weather.—Inlets: Sash windows, with sash blocked open 3 or 4in.; or openings in walls 6ft. high, fitted internally with some form of diffuser. Outlets: Tube opening near ceiling, passing into shaft running up near kitchen chimney. Warm by slow combustion grates, fitted with air chamber on Galton's plan (this makes an additional inlet to each room). Calculate inlets on basis of each inch, admitting 125ft. per hour. Arrange to change air three times per hour; 24ft. of gas (equal 80 candles) is excessive for a moderate-sized room, if properly burnt. —MEDICUS.

[60771.]—**Ventilation.**—In building my own house I made all the flues in duplicate to each room as A. Alabaster intends to do. These double flues are uncertain in their behaviour, owing to the fact that fresh-air inlets are not sufficient, and therefore the flue with the weakest draught sometimes reverses its current. I made fresh-air inlets in different forms and positions in different rooms, and they all had to be closed for the simple and all-sufficient reason that we neither have nor can have a warming apparatus in the house competent to deal with the enormous volume of air passing up the flues, which in the whole house is probably not less than 2,000 to 4,000 cubic feet per minute. A heating apparatus capable of raising this volume of air, say, 10° Fahr., and at the same time keeping it perfectly fresh and sweet, is anything but a simple matter; we tried two in succession, but both failed after a time. When fresh air is allowed to leak in at all crevices it is so distributed as to be only a limited nuisance, and this way, which has been followed by house builders from time immemorial, is, perhaps, the safest for A. Alabaster to adopt if he does not want to spend a fortune in experimenting and failures. In my own case, the matter was seriously considered before we commenced to build, a special room was set apart for an air-warming apparatus, horizontal flues were built in the walls to supply air to the rooms, double flues to every room terminating as chimneys above the roof, and the result is a thorough and complete failure. I cannot advise A. Alabaster to go and do likewise.—998.

[60771.]—**Ventilation.**—It is one of the absurdities of architects to think about outlets for foul air, and leave the inlet to chance. The result is, of course, draughts—then sand-bags to windows, draught preventers to doors, resulting in smoky chimneys. They also put the outlets near the ceiling to carry off the warmed air, with the result of giving the inmates a cold stratum of air about their legs, and a half-poisoned air to breathe. Now, the real secret of good ventilation is the very reverse of all this. Provide adequate inlet, and in all probability the fireplace will amply control the supply. Let the fresh cool air enter at the ceiling, and it will sweep the foul air away to the chimney, and give good air to breathe and an equal temperature at the head and the feet. A thermometer will often show a difference of 10° or 15° between these in ordinary rooms. The best of all modes of ventilation is to make an opening in the wall, preferably just over the door and into a passage. I take out two bricks for the purpose, and then cut away above them on each side, so as to have a good slope; I then make a wood casing, sloping a little below the opening up to within 6in. or 7in. of the ceiling, where it forms an opening 3in. wide. The air, as it is drawn in strikes the ceiling, and spreads out in a sheet, which then begins to descend, and tends towards the fireplace, thus giving a free inlet. The casing is covered by hanging a picture over it, and one can be adjusted in the passage so as to conceal the opening without interfering with the inlet of air. I fit up every room in my house in this way, so that the bedrooms are always fresh and pleasant. Of course, it would be an improvement to use in sitting-rooms the new gas-burners, which can be provided with a separate outlet for the products of combustion into the chimney, and prevent them from mixing with the air of the room.—SIGMA.

[60771.]—**Ventilation.**—In reply to Arthur Alabaster, I would advise him not to use Sheringham's ventilators as inlets from the outer air, and not to use special air-flues running up to the stack with the smoke flue. Such air-flues are apt to act as inlets, unless there is an ample supply of air from other openings, and when they do, smoke will sometimes leak from the smoke-flue into the air-flue, and thence into the room. If the smoke-flue is lined with a 9in. pipe, it will serve both for smoke and air perfectly well. Carry a zinc pipe, 5in. square, from the centre of the ceiling into the flue. Provide a wire grating in the pipe, and a silk valve against it to prevent any back draught. Let the pipe open through the ceiling covered with any kind of ornamental device desired. A solid plaster boss, about 12in. diameter, with a space of 2in. between it and the ceiling through which the air can pass freely from all sides, answers perfectly. Use grates in the room of the kind supplied by the Coalbrookdale Company for controlled combustion. Over the door have openings about 3in. deep and 18in. long, to allow air to come in freely from the passage or hall. These openings can be covered with any ornament desired. In the hall have a gill stove, or other warming apparatus, and an opening from the outer air equal in area to all the flues in the house, to supply fresh air. No Tobin tubes will be then required. Arrange this inlet in such a way, if possible, that the wind will not affect the current of air into it. A shaft from the top of the house, open freely to the air above, is the best way to secure this, but rather expensive. If not arranged thus, a valve must be provided to regulate the ingress of air. Do not overlook the fact that when ventilation of the rooms is arranged thus: the warmest air in the room, that near the ceiling, is constantly being removed, and that a corresponding amount of heat must be supplied to keep the rooms warm enough. On the other hand, the warmest air is also the foulest, and the air you specially want to get rid of. The stove in the hall should be equal in heating power to at least 120ft. of 4in. hot-water pipe. —A. G.

[60772.] — **Running Lathe Backwards.** — Drill a hole into mandrel and chuck; cut a thread in mandrel, and fit a screw that will enter chuck. I have one that has been in use for years.—OLD NOVICE.

[60772.]—**Running Lathe Backwards.**—Why use a chuck for the grindstone? Have a slightly conical hole in nose of mandrel, and turn end of grindstone spindle taper to fit. This will drive the stone, or even a drill, either way.—T. C., Bristol.

[60772.]—**Running Lathe Backwards.**—As you use your lathe for grindstone, you cannot damage it much more by boring a hole right

through the driving chuck and mandrel nose. When the former is screwed on the latter, taper the hole slightly and insert a pin, which will effectually stop the chuck from working loose. You can also put a set-screw in your driving chuck and drill a small hole on your mandrel nose for the point of the screw. If your lathe is of any value, never use a grindstone on it.—DYNAMITE.

[60773.]—**Legal Query.**—"Optotypi" would run a great risk in practising and calling himself an oculist without qualification and registration. By the Medical Act, 1858, persons practising in medicine or surgery must be duly *qualified*, and their names registered according to the Act. "Optotypi" must know that, although an oculist is a specialist, he can do nothing that is not included in "practising in medicine or surgery." Besides the risk of prosecution and a fine of £20, he runs a still greater risk of any dissatisfied patient getting a big sum in damages for maltreatment. This would be on the ground of non-qualification, even although "Optotypi" had treated the case quite as well as any regular practitioner would have done.—B.SC. (and Solicitor), Plymouth.

[60775.]—**French Wire or Sheet Gauge.**—The numbers 0000, 000, 00, and 0 do not belong to the French decimal gauge, the thickest wire being No. 20 and the thinnest No. P. Perhaps you mean the Birmingham wire gauge or the American wire gauge, both of which contain the numbers mentioned. Below are the sizes of the French gauge, with nearest British standard gauge numbers:—

British Standard Gauge.		French Decimal Gauge.	
No.	Diam. in in.	No.	Diam. m.m.
6	·192	—	5
7	·176	20	4·4
8	·160	—	—
9	·144	19	3·9
10	·128	18	3·4
11	·116	17	3·0
12	·104	16	2·7
13	·092	15	2·4
14	·080	14	2·2
—	—	13	2·0
15	·072	12	1·8
16	·064	11	1·6
17	·056	10	1·5
—	—	9	1·4
—	—	8	1·3
18	·048	7	1·2
—	—	6	1·1
19	·040	5	1·0
20	·036	4	·9
21	·032	3	·8
22	·028	2	·7
23	·024	1	·6
24	·022	—	—
25	·020	P	·5

—W. PATON, Weaste, Manchester.

[60776.]—**Boiler.**—This is small for a 6-horse nominal; it would, perhaps, with a good draught, give 6 H.P. actual. The flue should extend up the sides to, say, half the diameter of boiler. There is no occasion to have a straight flue and side return flues, but have it as indicated above.—T. C., Bristol.

[60776.]—**Boiler.**—"Willing to Learn" will find a plain cylinder boiler 12ft. by 3ft. will supply his 6H.P. engine if properly set, and if he cuts off at about two-thirds of the stroke. The boiler must be carried on angle plates, the fire bars must be 3ft. wide and 2ft. long, and not more than 12in. clear between top of bars and bottom of centre of boiler. A single flue the shape and width of the lower half of the boiler, and as shallow as possible, will be required; our own flue is the shape of the lower half of the boiler, and only 5in. deep. What is considered as the bridge in an ordinary boiler setting is continued in ours the whole length of the boiler to keep the flame, and heat up to its work. At the end of the boiler should be placed the water tank for feeding, the flue surrounding this after it leaves the boiler. Our own boiler is a simple cylinder, 3ft. 6in. in diameter, 15ft. long, and using ordinary gas coke as a fuel, drives a 12H.P. engine easily. If "W. to L." lives in Lancashire, it may, perhaps, be worth his while to see our boiler setting and arrangements. The Editor of the "E.M." knows my address.—998.

[60778.]—**To Mr. Bottone.**—You must either use more of your cells coupled up in series, or else, if you do not care to run the lamps for more than three hours at a stretch, you can use two or three cells of the chromic acid battery described and figured by me about six weeks ago.—S. BOTTONE.

[60779.]—**Clark's Gas-Lighter.**—The battery is a chloride of silver one, solution salammoniac. If you are not a mechanician, take it to a philosophical instrument maker. It used to be the practice, a year or so back, to unscrew the bottom (battery) half of the instrument, and take it to the shop where the lighter was bought, and receive a fresh battery in exchange by paying a shilling or two.—PAUL WARD.

[60779.]—**Electric Gas-Lighter.**—Clarke's first patent was a small circular battery of the sort known as Clarke's or Delarue's chloride of silver cell, working an induction coil. His second was a most ingenious adaptation of the Wimshurst or Voss statical induction machines, being a little glass cylinder on a spindle revolving within another similar cylinder, with brushes of loose wires hanging down and touching the glass, to act as collectors. The spin was given to the cylinder by a small train of cogwheels put in motion by the pressure of the thumb upon a button which projected through the side of a vulcanite cylinder containing the whole. You can renew the battery by unsealing, scraping the used-up chloride of silver off the silver plate, replacing it by fresh chloride generally about $\frac{1}{8}$in. thick, covering that with thin white flannel, which probably you will find already there, and which should be washed first (blotting-paper is also used), moistening the whole thoroughly with salammoniac and water, saturated solution, rolling the whole again round the central wooden cylinder, replacing it within the zinc cylinder, re-marking connections and sealing up again within outer case.—E. CONRY.

[60780.]—**Wimshurst Electric Machine.**—"Electric" cannot do better than obtain the ENGLISH MECHANIC of the 6th November, 1885, and then read the "Few Practical Hints upon the Working of the Influence Machine." He there will see the cure for almost all the points which can possibly arise.—J. W.

[60781.]—**Corundum for Aluminium.**—It depends entirely on the method you intend to adopt in the manufacture, whether the corundum of the composition given would be suitable.—A. E. F., Chemist, Manchester.

[60783.]—**Battery Power.**—Seven cells of the size named will be required to light the 8 12-volt lamps, but you would get a better light with eight cells. The lamps should be in parallel. I do not think the battery would give the current required—viz., about eight ampères—for more than three hours.—W. A. W.

[60783.]—**Battery Power.**—Your particular lamps, if tolerably economical, will require a current of 16 ampères, and your 12in. by 16in. double-carbon battery should easily furnish this current. The number of cells you will requre will be six or seven, coupled in series according as to how correctly the lamps have been labelled as to voltage. Run your lamps in parallel. If you use double the number of cells coupled, two in multiple and 6—7 in series, you will, of course, get light for double the time.—PAUL WARD.

[60783.]—**Battery Power.**—Depends entirely how you intend to couple your lamps. If in series, then $8 \times 12 = 96$ ohms. Now a well-made bichromate cell gives about 1·85 volt. As about 1 ampère is needed in each lamp, you would require about 50 cells in series to do the work. Supposing that you couple up in parallel, then 12) 8 (1·5, about $1\frac{1}{2}$ ohm. resistance in the entire circuit. But as each lamp requires about 1 ampère to light it, so you would want at least 8 ampères. To get these 8 ampères through an external resistance of 1·5 ohm, along with, say, ·08 ohm internal resistance of the battery, equal to, say, about 1·6, you would want (to be on the safe side) about 16 cells, coupled up in series.—S. BOTTONE.

[60785.]—**Induction Coil.**—If well made, it will give 1in. spark, under the given conditions. Shall be happy to reply to any query you may desire to ask.—S. BOTTONE, Stanley-road, Carshalton.

[60785.]—**Induction Coil.**—Six Bunsens connected to Dyer's coil are about equal to the battery power Dyer himself recommends—viz., six Groves. With the latter the spark obtained is about 1in. long.—BOBADIL.

[60786.]—**Colouring Photographs.**—This can be done in either water or oil. For oil, mount in the usual manner on stiff millboard; then coat over with a warm solution of gelatine; paint with the common tube colours, using, however, only the transparent and semi-transparent ones. For water-colour, take the mounted photo and brush it over with a solution of ox-gall in water until the moisture lies evenly all over, or, what is better, lick the photo with the tongue until the same result ensues; after this take care not to touch with the fingers. Use ordinary good water-colours (transparent or semi-transparent), and in rubbing down on the palette add a drop of gum solution to the water. For skin, use chrome No. 3, light red or Indian red; for shadows on the face, crimson lake. After colouring, some pour over the photo plain collodion as a varnish and to deepen the shadows; these are also deepened by brushing over with gum arabic solution.—B.SC., Plymouth.

[60787.]—**Earth Connection—Leakage.**—The connection to earth at point M would not matter unless C or L were also in connection with earth, when there would be a short-circuit on; as then, instead of going round the rest of the circuit between M and L, or M and G in the orthodox way, your current would divide itself, part going from M through the earth to C or L, and part through the circuit to the same point, as the earth circuit would be in the position of a shunt to the other, just as the field-magnets are to the external circuit in a shunt-wound dynamo, and the current would divide itself between this earth-shunt and the orthodox path through the remainder of the circuit inversely according to the relative resistances of the two paths—e.g., if this remaining part of the circuit were, say, 4 ohms resistance, and the earth-shunt 2, the current say of 12 ampères would be divided in the proportion of 2 to 4—i.e., inversely, 4 ampères going through the remainder of the circuit, and 8 through the earth. The efficiency of your battery would also be seriously altered by the diminished external resistance thus occasioned.—E. CONRY.

[60789.]—**Coil.**—This coil will give about $\frac{1}{2}$in. spark with a two cell bichromate, and $\frac{3}{4}$in. with five or six such cells. Use about 50 sheets of tinfoil $7'' \times 5''$.—S. BOTTONE.

[60789.]—**Coil.**—A good condenser for size of coil given consists of fifty sheets of tinfoil 6 by 5. The length of spark should be 1in. with everything right.—BOBADIL.

[60790.]—**Model Boiler.**—If the firebox is well stayed, so as to be as strong as the shell, the boiler will stand $\frac{1}{6}$ of $\frac{2240}{5\frac{1}{2}}$, say 70lb. per inch, allowing a strain of one ton per square inch sectional area of plate.—T. C., Bristol.

[60791.]—**Tangent Galvanometer.**—Theoretically the following equation gives the relation between the current in ampères and the deflections. In the equation c stands for ampères, d the angle of deflection, a the radius of the ring, n the number of turns in the coil, h the horizontal component of the earth's magnetism. Then, $c = \frac{a}{4{\cdot}504\, n} \text{H} + \tan d$. In practice, each tangent instrument requires calibrating separately, so as to get the value of at least, 1 ampère in degrees. The others can be easily calculated.—S. BOTTONE.

[60793.]—**Wine Cellar.**—Unless "Wine Cellar" is in the trade, it is of very little use his troubling to bond spirits. Any respectable wine merchant will supply him with a well-matured article at a fair price. Whisky blending should not be attempted on a small scale, and good distillers would not supply "Wine Cellar" unless in the trade. If he likes to advertise his address in our Address Column I shall be happy to send him address of whisky blenders where I get my own whisky (with small sample), which I consider perfection.—R. P.

[60793.]—**Wine Cellar.**—The best casks for whisky are old sherry casks. Get the stave with the bung hole in it taken out, and put the tap-hole half-way up the cask in the new one. Do not attempt to blend yourself, but get various good blends in various quarters, and mix them. Having got whisky from all over the country, and having made a most successful cask of my own (of which I will send you a sample if you like), I should recommend you to go to Messrs. Hill and Thomson, 45, Frederick-street, Edinburgh. They will show you the whiskies as they come from the various distilleries, and will blend for you. I have no interest in recommending Messrs. H. and T. or any other house. In the cases of brandy and rum, it is only a question, I believe, of getting good stuff and keeping it long enough.—OWEN H. P. SCOURFIELD.

[60794.]—**Brazing Teeth of Broken Change Wheels.**—File the broken teeth off level, screw three steel pins in the place of each broken tooth, and file them up to shape of tooth. This is far better than attempting to braze the broken casting.—THOS. FLETCHER.

[60794.]—**Brazing.**—"Young Turner" can get a new tooth put into his cogwheel, as I have seen many thus repaired.—DYNAMITE.

[60794.]—**Brazing.**—To "YOUNG TURNER:"—To repair tooth in broken spur-wheel, cut a dovetail groove where the tooth was and fit a piece of steel in, then ease off the hole a trifle at each end of the hole (like a counter-sink), and lightly "rivet" the tooth to prevent its drawing out, then trim it to shape.—T. F. S. T.

[60794.]—**Brazing.**—Cut it off flush and dovetail a wrought-iron substitute into the rim. If not, screw two pieces of iron tightly into rim, and file up same to shape of teeth.—S. M. S.

[60794.]—**Brazing.**—There is no occasion to braze this in. You cut a groove—slightly dovetail—and fit in a tooth, a snug driving fit, but not too tight. This will do all the work of the original tooth.—T. C., Bristol.

[60794.]—**Brazing.**—Don't try to braze a tooth in your change-wheel; but take a piece of steel wire a trifle thicker than your cogs, and drill and tap your wheel and screw in with good fit two, three, or four pins, cut them off to depth of cog, and then file them to shape of tooth and the repair is done.—F. G. F.

[60796.]—**Spark from Wimshurst Machine.**—"T. E. F." will find that the greatest length of spark can only be obtained from a machine in which the design contains the greatest possible lengths between the several parts; so arranged, discs of $17\frac{1}{2}$in. diameter will give sparks of $9\frac{1}{2}$in. length. For discs of 24in. diameter the stanchions of the frame ought to be 18in. apart, the bosses made to fill that space, the driving bands being near the ends of the bosses. The sectors should be 4in. long and very narrow at the inner ends; not more than twelve of these sectors on each disc, and let them be placed so as to be near the circumference of the discs; the ends of the collecting combs should not reach nearer to the spindle than the small end of the sector, and be covered with vulcanite cap. So designed, and with Leyden jars about 12in. long and $1\frac{1}{2}$in. diameter, the bottom $2\frac{1}{2}$in. coated with tinfoil, he may easily obtain sparks exceeding 12in. in length. Larger Leyden jars, or condensers, will give denser sparks, but they will be shorter.—J. W.

[60797.]—**Bookbinding.**—In reply to A. Adams I may say that the glair used in finishing needs little or no preparation. All that is necessary is to make sure that the eggs are fresh, and when breaking to be careful to keep back the yolk. If a large number of eggs are used, so as to lay up a large stock of glair for future use, the best way is to put it in bottles with a few drops of vinegar on the top of each. It will be quite thin and ready for use in a day or two, and will improve with age. But if only a few eggs are broken, and the glair wanted for immediate use, it must be well beaten. Beat until there seems to be nothing but froth. It cannot be too much beaten. Let it stand some little time, and it will all fall again and will be quite thin. In using glair, give cloth one coat only; leather work two coats, allowing the first to dry before giving the second. For large surfaces use a sponge, and for small ones, such as titles and bands, use a camel-hair brush or pencil, in every case putting on as little as possible. I could not, in the meantime, undertake to write a series of articles on bookbinding. But perhaps in a month or two, if the Editor could find space and would be willing to receive them, I might try to find the time to do so.—PRACTICAL BOOKBINDER.

[60798.] — **Fixative for Drawings.** — Gum mastic in powder, dissolved in spirits of wine, or good methylated spirit, in proportion of one drachm of powder to 2oz. of liquid, makes a perfect fixative. Shake up frequently for a few days until there is a clear, yellow liquid like sweet oil, and apply with spray apparatus.—H. P.

[60799.]—**Screw-Cutting.**—I recently gave a rule for holes in the nut before screwing. Let d be outside diameter of threads of bolt—then hole must be $d - 1\frac{2}{3}\,p$—where p is pitch of screw in inches. Thus $1\frac{1}{4}$ screw = 7 threads to inch. $\therefore$ pitch is $\frac{1}{7}$in. and hole must be $1\frac{1}{4} - (\frac{5}{3} \times \frac{1}{7}) = \frac{5}{4} - \frac{5}{21} = \frac{85}{84}$; but 1in. full would do.—T. C., Bristol.

[60799.]—**Screw-Cutting.**—The hole in the nut should be bored slightly smaller than the bottom of thread on screw, say $\frac{1}{64}$, the 64th being allowed for chasing, the bottom of thread of $1\frac{1}{4}$in. dia. being $1\frac{3}{64}$in.; therefore bore the hole to $1\frac{1}{32}$in. The actual depth of $1\frac{1}{2}$in. thread is $1\frac{1}{4}$in. and $\frac{1}{64}$in. or $1\frac{17}{64}$in.; but bore the nut slightly under $1\frac{1}{4}$in., and so in the $1\frac{3}{4}$in. actual depth of thread being $1\frac{15}{32}$in.; but boring hole in nut $1\frac{7}{16}$in., and the same with a 2in., the depth of thread being $\frac{1}{32}$in. under $1\frac{3}{4}$in., but bore the hole $1\frac{11}{16}$in.—WALLACE NEWLAND.

[60799.]—**Screw Cutting.**—A $1\frac{1}{4}$ diam. Whitworth screw has 7 threads to the inch; therefore $\frac{1}{7}$ of an inch is the depth of thread, and $\frac{2}{7}$ the size of reduction for hole in nut; but as $\frac{1}{6}$th of the original screw is rounded off top and bottom of thread, $\frac{1}{6}$th of $\frac{1}{7}$ must be added to the above size. Consequently we get $(1\frac{1}{4} - \frac{2}{7}) + (\frac{1}{6}$ of $\frac{1}{7}), (\frac{5}{4} - \frac{2}{7}) + \frac{1}{42}\,\frac{105 - 24 + 2}{84} = \frac{83}{84}$, or 1in., nearly. Any size of hole can be worked out in a similar manner, but always allow a trifle larger rather than a trifle smaller hole for your tap to work in.—DYNAMITE.

[60801.]—**Mechanical.**—Should not the heading of this query have been "Electrical"? The ratio between the resistances should be as follows: Supposing the external resistance (the plating bath) be 1 ohm, then for a series machine the resistance of armature should be $\frac{1}{20}$ of an ohm, and the field-magnets about $\frac{1}{25}$ of an ohm. If for a shunt machine, then the armature being as before $\frac{1}{20}$ of an ohm, the field-magnets should have a resistance of 20 ohms.—S. BOTTONE.

[60802.]—**Spanish.**—"Paralos" will do well to procure "A Practical Method for Learning Spanish," written by Genl. Alejandro Ybarra, and published in London by Trübner.—W. J. R.

[60810.]—**"Relief Map" of the Moon.**—Without laying claim to having had much experience in modelling lunar features, I think "S. R. C." will find plaster of Paris, or, failing this, a mixture of sulphur and whiting (in equal parts) suitable materials to work with, adding gum-water to the latter to render it plastic. As to scale, this will depend in great measure on the size and character of the formation he selects. Many years ago I made a model of *Theophilus* in plaster of Paris on a scale of about eight miles to an inch. On this scale the altitude of the loftiest peak is about $\frac{3}{8}$in. above the interior, and the general height of the wall about $\frac{1}{4}$in. A smaller scale than this would hardly be effective. A strongly-made shallow wooden tray, about 14in. square and 2in. deep, was used to receive the plaster. Templates cut out of veneer or stout cardboard, representing the cross section of the object to scale at selected points and long enough to reach from side to side of the tray, will be needed to insure the accuracy of the work as regards the height of the principal peaks, depths of interior, &c., the upper edge of the tray being taken as a datum. Of course, before commencing a model it is necessary to observe and draw the formation under as many conditions of illumination as possible, so as to thoroughly master its details. I am hoping that our good friend, "F.R.A.S." will have a word to say on this subject, as, unless I am mistaken, some years ago he dealt with a similar query in the "E.M.," though I am unable to find his reply.—THOS. GWYN ELGER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "A. J. H." has replied to 60196; T. R. Allinson, 60216.

60249. Brakes, p. 587.
60251. Dipping Pewter Goods, 587.
60269. Range Finder, or What? 588.
60272. Tuning English Concertina to Equal Temperament, 588.
60278. Grape Sugar, 588.
60290. Bottle Brush, 588.
60291. Blue Bricks, 588.

60445. G.W.R. Engines, p. 95.
60461. Starch in Yeast, 96.
60471. Electric Clock, 96.
60486. Oscillating Engines, 96.

QUERIES.

[60813.]—**Narrow Gauge Railways.** — Will any reader of the "E.M." kindly inform me what is the greatest speed obtainable by passenger trains on a 3ft. gauge railway with safety, with a permanent way laid with 60lb. rails and 9in. by 5in. sleepers?—C. D.

[60814.]—**Modified Leclanche Battery.**—A few details respecting this battery (patented by Octavius March), as to voltage, resistances, &c., would oblige—PEREGRINUS.

[60815.]—**The Sun's Radiation.**—The tables furnished from the Meteorological Office give the heat recorded daily by the dry and wet thermometer, also the maximum solar radiation in vacuo, the latter being sometimes 20°, at other times 40° or 50° above the former. I shall be glad if any correspondent will point out any possible advantage arising from this knowledge. I suppose when the sun shines for any lengthened time, the modicum of air confined in the glass containing the vacuo thermometer becomes more heated than when it shines but a short time, and so gives a higher record—just as a garden plant may be roasted by placing one or more hand glasses over it.—B. R.

[60816.]—**Gas-Engine.** — Will any brother reader please assist me in the following? I am in charge of a gas-engine, which drives a 60-light dynamo, and two or three times during the evening there is an explosion takes place—something like the report of a gun: it seems to come from the exhaust box, or the air box. Is there any danger? If not, it is not at all pleasant. I have been to the makers respecting it. They came and took out the piston and well cleaned the cylinder; also reground in the exhaust valve. It went better for a short time; but now it is nearly as bad as ever.—ENGINE DRIVER.

[60817.]—**Windmills.** — Could any of your readers kindly answer the following questions? (1) In the ordinary four-sail wind corn mill, what is the amount of energy transmitted by the sails to the mill, the power of the wind being taken as 100? (2) What is the reason for the variation of the angle of sail with whip at different portions of its length? (3) Have fan-shaped sails with axis of mill at right angles to the direction of the wind and the portion below the axis sheltered ever been tried, and, if so, with what success? Any information on the subject would oblige—MOTION.

[60818.]—**Coil.**—I have made a coil 6in. by 3in., the core is $\frac{5}{8}$in. diam.; primary, two layers of 16 gauge, cotton-covered wire; secondary, about 1,000 yards of 28 gauge, silk-covered. Over the primary are two or three thicknesses of varnished paper, and each layer of secondary divided by a layer of paper and a coat of pitch and resin. I can get a $\frac{1}{4}$ spark with a small bichromate cell for a few minutes, when the platinum of the contact-breaker seems to corrode and the spark fails. I may add that the result is, if anything, worse with a large battery. The condenser is composed of 40 pairs, about 4in. square.—G. B.

[60819.]—**Portable Electric Lamp.**—I read a notice, extracted from the *Builder*, referring to the Regent Electric Lamp and Lighting Company, and giving a description of a portable electric lamp, the battery being placed within the pedestal of the lamp. If there is such a lamp, and it is not too expensive, it would be of great use in many houses. Do any of our readers know anything about it, and its value for domestic use?—MANCHESTER.

[60820.]—**Chamber Organ.**—TO MR. AUDSLEY, OR "URANIUM."—I propose, if possible, building a chamber organ, and will be greatly obliged if either of these gentlemen will assist me by advising a specification of about 12 stops for a 2-man. and pedal organ, giving scale of pipes, dimensions of instrument. Will they also state the probable cost of metal pipes and keys? I will gladly advertise my address to learn the best place to purchase pipes, &c., and to receive any hints and suggestions.—TAUBE.

[60821.]—**Battery Work.**—Will Mr. Bottone, or any of our readers, please answer the following? What chemicals are used for stripping old gold and silver-plated articles? How can I use the same over again for plating purposes? Is a dynamo or battery best for plating?—DUPLEX.

[60822.]—**Submarine Mines.**—Would some correspondents be good enough to give a description of the method employed by the Royal Engineers in marking the position of submarine mines or torpedoes? Reference to any books on the subject would also be useful.—SASSENACH.

[60823.]—**Redecorating Harp.**—I have, in my leisure moments, been amusing myself with redecorating a harp. I just rubbed down with pumice stone and sandpaper the old coat of black paint (in many places taking this paint quite off). I then repainted with about fifteen coats of very thin cream paint, made with oil and turpentine in equal quantities. Each coat I rubbed smooth with fine sandpaper. I have produced a very thin opaque and smooth result; but, unfortunately, although several weeks have elapsed, the paint, instead of being hard as I should like it to be, is everywhere very soft, so much so that if anything hard touches it it is readily indented, and anything happening to rest against any part sticks so firmly that it can only be detached at the sacrifice of the paint. Can any of your readers suggest a remedy for this, and tell me what is the kind of varnish used by professional harp decorators, and which, under their manipulation, dries hard, clear, and smooth? Would copal varnish do? Would the varnish, whatever it may be, have the effect of hardening the paint, or by drying hard and firm on the top of it obviate the defects above pointed out? I am anxious to gild some pattern, such as a vase of flowers, or a group of ornamentation, on the broad part of the sounding board on each side of the strings. Can any of your readers supply me with such a design, and tell me how it should be done?—ARPA.

[60824.]—**Dynamo.**—TO MR. BOTTONE.—I have one of Mr. Jones' small dynamos, wound as you advised, for plating—viz., No. 16 on A., and 4lb. of 20 on fields. I have been thinking of getting a second A. wound with, say, No. 30. What I want is to get as high an E.M.F. as possible, at the same time to lower the ampères as much as possible. Will you kindly say if that is the best way to get the desired effect?—F. G.

[60825.]—**Draw-Vice.**—Could any reader kindly give me a sketch of a good draw-vice for telegraph work, with sizes? I presume wires are first tightened by means of blocks. What is the best size of galvanised iron wire to use for short lines? Is standard wire easier to run than the ordinary, and is it considered better?—J. J. H.

[60826.]—**Small Dynamo.**—I am making a small dynamo. I have made armature from particulars given by Mr. Bottone in "E. M.," Vol. XLI., No. 1050; but instead of making it with twelve cogs I have made with ten, and wound it with 1lb. No. 20 s.c. wire; it is $3\frac{5}{8}$in. in dia. at points of cogs, and $2\frac{1}{4}$in. wide. Will Mr. Bottone kindly tell me what size and quantity of wire to put on poles for a compound-wound machine. The poles are 6in. high and $1\frac{1}{2}$in. in dia., made of cast-iron annealed. I also wish to know at what speed it should be driven. I have a quantity of c.c. wire, No. 16, I should like to make use of.—WILLIAM DAVIDSON.

[60827.]—**Photography.**—Could any reader kindly say if any of the recent photographic processes could be utilised for the republication of a copyright book, now almost out of print, containing diagrams, &c., and if the cost would be less than that of ordinary type reprinting?—S. R. C.

[60828.]—**Kamptulicon.** — Will any reader inform me what is used to cause kamptulicon to adhere to the wood of knifeboards, and how to prepare it?—OLD NOVICE.

[60829.]—**Electric Star Lamps.**—Will Mr. Bottone, or other friends, give me their advice if a small hand dynamo or battery would be best for this purpose: I wish sometimes to light a 16c.p. lamp, at other times four 4c.p. lamps, and occasionally a small star or fairy lamp, as worn in the hair, 2c.p., and one on the end of a wand held in the hand 4c.p.? Is it necessary to have lamps of the same c.p., or can I use the 2c.p. and 4c.p. lamps on the same leads? Batteries are such a nuisance to me, travelling about so much.—STAGE FAIRY.

[60830.]—**Jaw Chucks.**—Will any of your readers inform me how to make one—the jaws, &c.? I have the castings. It is 10in. dia., for three jaws; it is also solid round the outside. There are three slots, but no opening for the necks of the screws in the face. I have heard of them being made with two pins for keeping the screw in its place, but never saw one.—A. L. K.

[60831.]—**Photography.**—Will some of our expert photographers please inform me as to the following? About what angle, and how are for depth of focus the following lenses: Dallmeyer rapid rectilinear, Dallmeyer wide angle rectilinear, Ross rapid symmetrical, and Ross portable symmetrical? 2. I travel a great deal in the East, and am desirous of obtaining views of places I visit, and things I see; but, Oh! misfortune with dry plates. I took a batch with me this year; but the Turkish Custom-

house Officials are, in these days of dynamite, much like their Continental brethren, very incredulous, and would not allow them to pass without seeing them, the result of which spoilt my temper and the plates too. I am now desirous of preparing my own plates, and think of trying recipe given on page 442, Vol. XXXVII.; but can I make the emulsion and take it with me, so as to coat plates as I require them? If so, how is best to preserve it? Is there a more simple method than this? If so, will someone kindly give it? References to English books are almost worthless to me, as I am living nearer the Black Sea than the Thames, and, not having friends in England, it is almost impossible for me to obtain English works.—HAZIR-IM.

[60832.]—**Diatoms.**—Will any microscopist kindly assist me in the following matter? I place a little material on a slide containing diatoms under the microscope, and I wish to separate them from the surrounding matter and transfer them to a clean slide to mount them; but cannot succeed. I have tried with a sable pencil containing only two hairs; also a single hog-hair split at its end; but cannot get hold of the diatoms. I shall be very thankful for any information concerning the mounting of diatoms.—NO SIG.

[60833.]—**Micro. Objectives.**—When buying second-hand objectives, is there any means by which anyone can tell their angular aperture? Any information will oblige—NO NAME.

[60834.]—**Noise in Boiler.**—I have just had new boiler put in my kitchen for heating h.w. for bath, which makes a very unpleasant noise, sounding like someone thumping a large drum. What is the reason of this, and how can I remedy this unpleasant noise? I have searched back volumes, but find nothing relating to same.—CONSTANT READER.

[60835.]—**Analysis of Sugar.**—Will any reader kindly tell me how to make a complete analysis of loaf sugar? The sample I have is not nearly so sweet as loaf sugar usually is, and when dissolved in water leaves a slight sediment. It also appears less in bulk compared pound with pound of another sample. I can have the use of a well fitted-up laboratory, and I have done a little in inorganic analysis.—A. W. W.

[60836.]—**Electric Light.**—Will Mr. Bottone, or some other reader, inform me how many 5c.p. or $2\frac{1}{2}$c.p. incandescent lamps I shall require to light a room 12ft. square? Also, what would be the best dimensions to make a dynamo to effectually light them, keeping it as small as possible? I wish to make a dynamo whose armature will not heat, and, being a novice at this work, I shall be greatly obliged if anybody will give me the necessary information for its manufacture, or tell me of some paper which contains it. Will a quarter horse-power water-motor drive it, and at what number of revolutions should it be driven? I wish to do with as small a dynamo as possible through not having much power.—A. B.

[60837.]—**Steam.**—Would "T. C., Bristol," "Glatton," or others, kindly give me rule to find the size of boilers for small model engines? Do they stand in some proportion to the size of steam cylinder? I suppose the rule will hold good for all sizes. Also the rule to find the nominal horse-power of compound engines for condensing engines. The rule is the area of cylinder × by distance through which the steam piston travels per minute ÷ by 6,000. Does this rule hold good for compound engines? If so, which cylinder is taken?—NOVICE.

[60838.]—**Mechanics.**—A compound wheel, an axle with a diam. of 6in. and 4in., and the length of handle 20in.; would the ratio of velocity of the handle to that of the weight raised be as the following? The larger part of the axle has a circumference of 18·8496in., the smaller a circumference of 12·5662in.; the difference of these two, = 6·2832in., will be the difference which the load is raised in one turn of the axle, but the end of handle travels 125·664in. Would the ratio of the velocity of handle to that of the weight raised be as 1 is to 20? The rope hanging down forms a loop. Does the loop double the power of the machine and make it 40 to 1, or 1lb. lift 40lb.?—NOVICE.

[60839.]—**Mounting Plates of Wimshurst Machine.**—I should be glad if some of "ours" who have had experience in constructing this machine would furnish a few hints as to the best method of attaching large glass plates, say of 16in. and upwards, to the bosses. There appear to be three ways of doing this in general practice: First, having the spindle in two lengths and cementing the plate to the boss without piercing a central hole through the glass; second, a central hole in the plate and cementing to the boss; third, as recently described by Mr. Wimshurst, cementing a disc of hard fibre to the inner side of the plate and screwing up to the boss with small screws. Now, the first and second of these methods have the disadvantage that it is very difficult to get a large plate to run true. The slightest inequality in the thickness of cement (tricycle tire, or otherwise) throws the plate out of truth, and, of course, the larger the plate the more serious the error becomes. The last method offers the advantage of enabling one to true up by slackening the screws and inserting paper or other thin material between the boss and the plate; but, on the other hand, when tightening the screws again, it is necessary to be extremely careful, as a very small amount of unequal pressure results in a crack. I have been unfortunate myself in this way, having lately broken two. What is wanted is a method of mounting the plate, so that it can be safely and easily trued-up when on the spindle.—SODIUM.

[60840.]—**Oven.**—What is the best method to be adopted to construct an oven with, say, brick, to bake, say bread? It is contemplated and partly carried into effect, the following course—viz., the bottom of oven to have 2ft. of shingle, and over that 6in. of sand, and in the sand will be put the floor of oven, consisting of Bridgwater tiles; the ewens to be built with Stourbridge firebrick, laid in either Cornish fireclay or in a mortar consisting of blue lias lime and common white lime and sand; the crown of oven to be built with Stourbridge fire-brick, and each brick before it is laid to be dipped in a thin wash of Cornish fireclay and water, and after the crown is put in to lute it over the top with a wash of Cornish fireclay and water; the crown, when finally completed, to be covered with 6in. of sand, and then 18in. of shingle, and then floored for a dry with Bridgwater brick in sand. I wish to know your opinion of this arrangement, and whether you think it is a good one and will answer well? If it should be considered by anyone to be defective, and could be improved on in any respect, I should like to learn how. Two points in particular I desire information about:—whether fireclay is a good material to put the crown and ewens together with, and whether there would be any danger of its becoming crumbly and going to dust in the back part of the oven where the heat is more moderate than in other parts, and so not answering the purpose required; and also whether a mortar of either common lime and sand or blue lias and sand would answer equally well or better for the purpose of the crown and ewens than the fireclay would?—AN INTERESTED ONE.

[60841.]—**Porous Pots.**—Will someone say what is gained by using porous pots that have a high resistance, say from 2 to 3 ohms, made I believe for bichromate solutions, as such would lessen the current by increasing the internal resistance of the cell? Also, is it possible to get any difference of electro-motive force by increasing the size of cell of Bunsen battery, as I take the following from a list of batteries giving the size and E.M.F. of Bunsen cells? Thus:

Pint size	E.M.F. = 1·90	internal rest	·30
Quart size	Do. = 1·93	Do.	·26
3-pint size	Do. = 1·96	Do.	·22

I might say this is taken from the list of batteries of a big company.—C. R. N.

[60842.]—**Flat Music.**—I live in a flat. My neighbours above and below are addicted to music, and between their respective instruments my nerves are ground like grist between millstones. Music, even bad music, is not a nuisance in law, so I have no remedy in that quarter, and my neighbours decline to abate a note of their scales and their pieces. Would any reader who is skilled in mechanics or acoustics suggest a remedy? I have thought of carrying an organ-pipe from the interior of the ceiling to the interior of the floor, and of letting the players pour their noise into each other's apartments. Would that have the desired effect, or would it even partially insulate me from the sounds? My landlord cannot interfere, and I am, unluckily, bound to the premises by a lease.—D. B. MCLACHLAN.

[60843.]—**Lantern and Microscope.**—As I am contemplating the purchase of an oil lantern with microscope attachment, I should be thankful if any of our readers would give, from their own experience, any information on the following points: (1) Is it possible, with any modern oil lantern, to obtain anything like a reasonable-sized disc, say 3ft. or 4ft., with the microscope front, and using such objects as would come within the range of the 1in. and 2in. micro. objective? (2) Is there much danger of spoiling balsamed slides by the heat, as I believe this is much overstated? (3) Can such living specimens as Hydra, Volvox, and the like be shown with any degree of successs? (4) Has anyone tried Mr. Hughes' "Pamphengos" lantern for this work?—D. B.

[60844.]—**Steam.**—We have a mill six stories high. How could we heat it by steam and return the water direct back into the boiler? Would anyone please state the size of pipes? Suppose the mill to be 80ft. high, and suppose the steam pressure to be 50lb. at the bottom, what pressure would there be at the top (plain figures please)? Is steam calculated like water for pounds pressure? Also we are working a small engine in the same yard, and the distance from the boiler to the engine is 356ft.; pressure in boiler, 56lb. What pressure will then be at the end of the pipe when steam is shut off and the engine standing? I think it ought to be like the boiler pressure. Size of pipes, 2in.—FIREMAN.

[60845.]—**Polishing Silvered Goods.**—Will some of our practical readers give me full particulars how to polish articles such as spoons, forks, urns, &c., on which I have deposited a coating of silver? Also the different brushes or buffs and material required for foot-lathe polishing generally?—ELECTRO-DEPOSITOR.

[60846.]—**Electro-Deposition.**—Will someone kindly inform me of the present system in large works of the arrangement of the rods of electro-depositing vats which suspend anode and cathode? Also, how can the anodes be raised or lowered at will, or if the dynamo be used, can the anodes be wholly immersed and the current regulated accordingly? If so, how is best to suspend them for large operations?—ELECTRO-DEPOSITOR.

[60847.]—**Faulty Coil.**—I have made a spark coil; core, $\frac{1}{2}$in. by 3in.; primary, two layers of 22 cotton-covered wire; secondary, $4\frac{1}{2}$oz. of 36 silk-covered wire, insulated with one layer of paraffined paper between each layer of wire, primary and secondary well insulated from each other; condenser, 40 sheets of foil, 3in. by $3\frac{1}{2}$in. I mounted it roughly on an old coil base, and got a good $\frac{1}{4}$in. spark when connected to two chromic-acid cells—size, carbons 2in. square, two carbons to one zinc; but since I have mounted it on a new base the spark has dwindled town to 1-16in., but when the wires almost touch the spark is much larger, and covers about $\frac{1}{8}$in. of the wire. The condenser makes no difference to the size of it. What is the cause, and how can I cure it? If I have to rewind it, must I make the insulation thicker? I have tested for continuity, and find it all right.—J. MARSHALL.

[60848.]—**Electric Light.**—Will Mr. Bottone, or any other scientific reader, tell me how many 5c.p. lamps I shall require to light my workroom, 12ft. square, allowing the necessary light for a lathe? Also what size dynamo (amount of wire and dimensions of magnets and armature, &c.) I shall require to make to light them effectually. I have obtained Mr. Bottone's book on the dynamo, but should like to make an armature which will not heat. Will anyone give me the necessary information for its manufacture? I have a 1-horse-power water-motor made from Wheeler's castings. Would it give power enough?—N. S.

[60849.]—**L.N.W.R. Locos.**—What is the average time a driver is on duty daily, and how is it made up? How long running, standing, and what time consumed in shed before and after running? How long are engines usually kept in steam? Why are two tender engines, Marston 479 and Vulture 1165, kept to do shunting at north end of New-street station, Birmingham, and a saddle tank, 913 class, at the south end? What engines work Central Wales line, and what engines are stationed at Shrewsbury, Craven Arms, Swansea, Hereford, and Newport (class and date)? Can any reader give the Crewe links of passenger engines, showing number of hours worked daily by each driver? If the number of engines required each day at any station is six, how many engines would be required to be stationed to do that amount of work? What is the object of taking numbers off old engines and placing them on new ones? I saw one numbered 3050 the other day.—BALFOUR.

[60850.]—**Mid. Ry. Locos.**—What engines work Hay and Brecon Line? Where is No. 80 Midland engine, and to what class does she belong? How many passenger tanks of the 1266 class are built? What kind of passenger tanks are the M.R. building now? What is the full number of vehicles which can be drawn at a moderately fast speed by engines of the 1282, 84, 98, 121, 104, and 1747 classes? Where are the following classes of goods engines stationed, and what are their dimensions: Nos. 414, 353, 1443, 952?—BALFOUR.

[60851.]—**Sheet Wax.**—Will some kind reader inform me how to make sheet wax and how I can colour it black—something similar to what wax flowers are made of?—THETA.

[60852.]—**Gilding Glass and China.**—I have seen some glass and cheap French china goods that are gilded with a very glittering gold, and it is baked on them. I understand it is laid on with a pencil, and is in the form of a brown paint. I should feel very much obliged if some of our chemical friends will tell me how the gold is prepared, as I should like to make a little for myself.—AMATEUR.

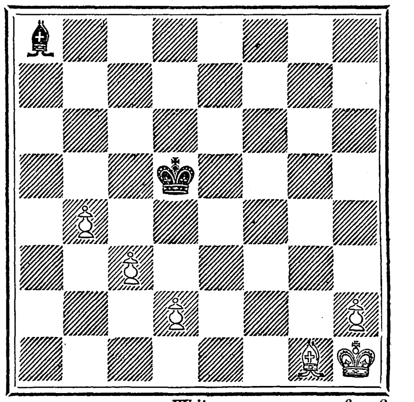
[60853.]—**Artificial Teeth.**—What are they made of, and how can I fix them on to gold plates?—E. W. GOUGH.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXVI.—BY J. P. TAYLOR.

Black.



White. 6 + 2

White to play and force Black to mate in three moves.

SOLUTION TO 1,014.

White.	*Black.*
1. R-Q R 5.	1. Anything.
2. Q or Kt mates.	

(Four variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,014, by Link, J. Mackenzie, A Dean, A Beginner, P. H. (specially good problem), G. A. A Walker; to 1,013, by J. Thompson, G. A. A. Walker, A Beginner, G. A. A. Stringfellow (but variations not given), Link; to 1,012, by Link (this arrived too late to be taken into account in Tourney list. Had it been, Link would have been bracketed 7th with F. W. S.

WHITE PAWN.—If in 1,014 2. Q-K 5, Black takes Q with B. In your attempt at 1,012, what is to prevent the Black King on the second move going to K B 5; and then how do you mate?

M. G. AND E. G. C.—Thanks for problem, which shall have attention.

RESULT OF SOLUTION TOURNEY C.

Avon, A. Bolus, I. M. B., and G. A. A. Walker, are bracketed equal with 81 marks for first prize; 5, Isca and J. Thompson, 71; 7, "——," 67; 8, Link, 65; 9, A Beginner, 63; 10, A. Dean, 59.

The following is the complete award of the *Ottawa Citizen* Problem Tourney. Two-move section: 1, Ottmar Nemo; 2, A. F. Mackenzie; 3, H. D. E. Bettmann. Best 2-er, by a Canadian, E. B. Greenshields. Hon. Men.: C. Planck, B. G. Laws, and A. F. Mackenzie. Three-move section: 1, B. G. Laws; 2, G. J. Slater; 3, J. Jespersen; 4, B. G. Laws. Hon. Men.: J. Jespersen, G. J. Slater, W. Atkinson, E. B. Greenshields, Ottmar Nemo, C. H. Wheeler.—Judge, Mr. Reichhelm.

OUR readers will be glad to learn that there is now in the press a new book by Mr. Clement E. Stretton, entitled "Safe Railway Working," which will be very shortly published by Messrs. Crosby Lockwood and Co., Stationers' Hall-court, London. The work is of a very practical character and well illustrated, and deserves to be in the hands of every railway servant.

ACCORDING to recent statistics, there are 4,570,000 more women than men in Europe at the present time.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 3, and unacknowledged elsewhere:—

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding : No. 613.
Electric machines : Nos. 1,009, 1,025.
Electro-magnets : Nos. 772.
Lacquers : No. 866.
Pattern Making : Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating : Nos. 1,009, 1,010.
Varnishes : Nos. 478, 619, 675, 723, 775.

CROSSLEY BROS.—Sullivan and Co.—H. J. W.—Ajax.—Apprentice Turner.—A. T.—Fixture.—T. S.—Daylight.—Machinist.—W. M.—W. F.—Chatteris.—J. R. Campbell.—Perplexed.—J. R.—Scottie.—C. D. Barker and Co.—Torbay.—Amateur Tinker.—B. B.—E. Conry.

J. I. ISHERWOOD. (Perhaps the best "book" is Prescott's "Telephone and Electric Light," published in this country by E. and F. N. Spon, 125, Strand, W.C. There is also Du Moncel's "Telephone, Microphone, &c.," Kegan Paul and Co.; but if you refer to the back volumes you will find all the information you can require. Begin with the number for Aug. 11, 1876.)—W. B. (Sprague's "Electricity," &c., is published by E. and F. N. Spon, 125, Strand, W.C., or a lower-priced work, "Electricity and Magnetism," by F. Guthrie, Collins, or S. P. Thompson's "Elementary Lessons in Electricity and Magnetism," Macmillan. The other questions are continually receiving answers in our pages. See p. 28, No. 1016, and the indices. But why use an accumulator unless you have a dynamo to charge it? It is otherwise more costly than a primary battery.)—A MECHANIC. (Look through the indices and see if you cannot find something that will suit. It is rather too much to ask correspondents to suggest what will suit, and then tell you how to make it.)—W. J. (We have previously answered you, and referred you to the illustration of a sensitive fire-alarm in No. 1063, p. 495. See indices also. 2. The other question has also been answered many times. See, for instance, pp. 177, 260, Vol. XXXIX.)—MODEL TELEGRAPH. (If you have the instruments, surely by a little experiment you can discover how to connect them up. If you have not back numbers, see Culley's "Practical Telegraphy," which contains diagrams of all sorts of circuits and connections.)—M. NEWMAN. (Yes, it can be done; but it is not suited for the purpose. If you want a dynamo for lighting purposes, better construct one of those described in our columns.)—TRANSPARENCY. (Opinions differ. Replies to such questions would partake too much of the character of advertisements. Any good maker will supply suitable plates, or you can refer to several articles on the subject. See, for instance, No. 1091, p. 510.)—PHOTO. (No.)—J. C. O. (Perhaps it is not put in that way in the textbooks, because it is not the fact.)—W. Q. C. G. (The secretary of the institute will give all particulars.) — LEARNER. (A little gum or sugar-candy might do, but it would tend to make the ink clog in the drawing-pen. 2. For the books consult the Syllabus, or the teacher of the classes attended, or back volumes. 3. Is not the evidence of the Science Directory sufficient? 4. All particulars of the City and Guilds Institute can be obtained from the Director, Sir P. Magnus, Gresham College, London, E.C.)—R. C. H. (Parkes's "Manual of Practical Hygiene," and Guy's "Public Health," will be useful.)—PERPLEXED. (The horse-power of an overshot water-wheel is estimated by the formula $P = \cdot 00128\ Q\ h$, where Q equal the quantity of water in cubic feet per minute, and h the head of water in feet.)—W. C. (The reason is that the watch has never been compensated or regulated. A watchmaker will tell you whether anything can be done to it; but probably it is only a "cheap make," not worth spending money over.)—J. THOMAS. (If you can reduce the temperature of the whole body of water to 30° Fahr. it will freeze; but for ice to bear over water an air temperature of about 24° will be required. Are you going to produce it artificially? 2. Yes, a very large proportion of the nitrogenous matter of pulse, &c., is undigested. 3. Not unlikely. The other questions are matters of personal taste.)—MEANDER. (No room just now. Consult works on mensuration.) — CARBON. (Similar to a gas engine. Procure the patent specification, No. 8411, 1885, price 8d.)—REX. (Obtain one of the guides to Patent Law from agents advertising in our columns. A table of foreign patent fees was given in No. 939, p. 62; but any respectable agent would quote terms.)—S'UMWUN. (Read the ENGLISH MECHANIC and the electrical papers. Sprague's "Electricity" is published by Spon, 125, Strand, W.C. Many publishers issue suitable works in sound, light, and heat. 2. Try again. You have not sufficient pressure, and want a gasometer which can be weighted until a very long flame is produced.)—WILLIAM ROSS. (Write on the glass with a piece of steatite or French chalk.)—ANVIL. (The castings must be scoured quite clean with sand and the molten zinc should be covered with sal-ammoniac.) — JUBILEE. (If you have copied correctly, "Lustres ten he has completed, he reigns hitherto, and he may reign for a long while." The latter phrase no doubt is put in the form of a wish.)—INK STAINS. (If the wood has been polished, the stain can most likely be removed with water and gentle scraping; but if on the wood itself, it must be scraped out and the parts repolished.)—GALVANIZER. (Should appear in the Wanted Column. See Hints No. 4 above.)—W. A. J. (Spelter is the name for hard solder, used for brazing. It is also a commercial name for zinc, which is used for a variety of purposes—notably for lining water cisterns, for covering roofs, and for galvanising iron.)—PHOTO. (They are glazed or burnished. See p. 345, last volume, or any of the handbooks of the art.)—COOPER'S HILL. (It does not necessarily follow, but the subsequent non-appearance of the query in a few weeks would imply that demands for space were too many.)—W. T. (Why not adopt the "blue process," as it is called? See p. 85, No. 1070, and the indices. We have described most of the "graphs," and an answer to your question would open the door to a number of gratuitous advertisements.) R. A. G. (It is not easy to direct in such a matter, especially as you appear to have no documentary evidence. If you have a baptismal certificate, or can search the register of births at Somerset House, you could probably trace the marriage of your father; but when that is accomplished it will be difficult to discover whether he has any relations without making personal inquiries in likely directions. As you have an address, the marriage might have taken place in that neighbourhood, and by searching the registers you might gain some information.)—ONE IN A FOG. (You must give some idea of the construction of the machine, and explain what you mean by "loses its magnetism.")—C. MOORE. (Boil a little yellow resin in linseed oil.)—L. T. (Kindly look through the indices of back volumes. An electric railway has been in use for some years at a mine in Germany. See No. 943, for instance.)—JAS. BRADLEY. (The paint is mixed with copal varnish.)—J. D. N. (Beeswax is bleached on the large scale in a steam-heated vat, by means of water, bichromate of potash, and sulphuric acid. The simplest way is to melt it with water at a low temperature, and boil for a few minutes. Withdraw the heat and sprinkle over the wax, very carefully, a little oil of vitriol, say, 3 or 4 fluid ounces to the cwt. of wax. Cover, and allow to settle; then skim off wax with a warm ladle, and place in shallow vessels so as to obtain thin cakes of the wax. These are exposed to the action of sun and air to bleach, and are remelted two or three times when wanted very white.)—A PUZZLED ONE. (Did you commence without knowing the proportions or anything about the process? See p. 298, No. 949, and the indices generally, or procure a pamphlet from the Greenbank Alkali Company, St. Helen's, Lancashire.)—W. P. (For sketches of detective money till, see pp. 228, 387, Vol. XL., and also pp. 455, 477, 500, 522, for a discussion of the subject.)—AN OLD FRIEND. (Ahn's system, Hamilton's, and many others which you can probably see at a large bookseller's in Belfast.)—W. R. (See indices, or the catalogue of the makers. The amount of fall or head of water must be known, or, in other words, the pressure, before advising about hydraulic motors.)—PYROLOGIST. (We think not; but if so, Messrs. Trübner, Ludgate-hill, or Messrs. Crosby Lockwood and Co., Stationers' Hall-court, E.C., can tell you.)—E. E. M. (The fee for an ordinary search at Heralds' College is 5s., for a general search one guinea. Apply to the Registrar at the College, Queen Victoria-street, E.C.)—BLOWPIPE. (The solder will not run until the metal on which it is placed becomes hot. See indices under head of "Blowpipe, Brazing, &c.," or send a definite question.)—K. M. ROTER. (You can only summon him to the County Court. Bills of sale are registered at the Central Office of the Supreme Court.) —BAHADUR. (Vulcanite, ebonite, &c., are polished with rottenstone and oil on a buff, using a little water occasionally to keep the vulcanite cool. The finish is put on with the hand and dry rottenstone. 2. Any dealer will supply suitable paper. 3. Rather incomprehensible. Practice seems to be all that is wanted. 4. Answered above, except that in the case of "sheet" flat rubbers are used.) — SOUTH COAST. (Any builder of bakers' ovens will supply one. We do not send sketches. See Hints above. 2. How can we give instructions without a plan of the place—without, in fact, doing the work of the engineer? See No. 864, p. 141, and the indices generally. It is always difficult work where the place to be heated is below the level of the boiler.)—C. L. OR N. (Spence's "Geography," published by Crosby Lockwood and Co., Stationers' Hall-court, E.C., 2s. 6d. 2. Oxalic acid will start any iron ink; but see indices. 3. How can anyone say without seeing the tooth? 4. Brush them over with glair. Or do you mean re-cover?)—PHOS. (Prescott's book on the Telephone, &c., is published by E. and F. N. Spon, 125, Strand, W.C.; the International Scientific Series by Kegan Paul and Co., Paternoster-square, E.C.)—ZERO. (See the indices for many replies on dynamos. The dimensions are very much the same as those described in his book. See p. 256, No. 974.)—H. EYRE. (Boil some lime-water in it, and so get a coat of fur. The water you use is soft and probably peaty. If you get a good coat of fur on by boiling hard water in it, that will prevent rust for a time.)—LEARNER, J. P. (We believe we answered you not long ago. The art is described in many books, but has scarcely a special treatise devoted to it. Both hard and soft soldering have been frequently described in back volumes.)—CHICKING REARER. (The incubator was illustrated and described in No. 935.)—W. H. W. (Very little in a properly arranged loco.; but it can be ascertained only by means of the indicator. 2. It has been given so many times, and can be obtained from the makers. The original Willans engine was illustrated in No. 497, p. 61.)—NELLIE. (For some there is no effective remedy, but a toilet vinegar to remove summer freckles is made on the large scale as follows:—6,500 parts of vinegar have 1,350 parts of lemons cut up small into them, and there are then added 850 parts of alcohol, 225 of oil of lavender, 5 of rose oil, 60 of cedar oil, and 850 of water. The mixture should be exposed to the sun for three days; then filter. Apply with a sponge at night and let it dry. Wash with cold water next morning.)—LEARNER, Galashiels. (If received, it was answered in some form. The question is not of general interest. There are the Finsbury College, the School of Telegraphy, and, we think, one good school in Glasgow and Edinburgh. The B.Sc. would be an advantage; but you do not say what you mean by "electrical education.")—F. STRIFFLER. (Thanks for fresh copy of illustration; letter shall appear next week.)—A SOCIALIST (In type).

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 12, 1886.

NOTES ON NEBULÆ.—IV.

G. C. 5030 (A.R = 23h. 49m., Dec. N. 60° 37′).—Very faint nebulous cluster, condensed in centre = 11 mag. star; several small stars near. Very cometary aspect (power, 100 on 10in.). May 1, 1886.

G. C. 4907 (H II. 706. 23h. 7m. Dec. N. 60° 46′).—Described by H. as "very faint, large; two pretty bright stars involved." This is a very fair description. Only, now the nebula seems more on the preceding side of the stars, and there is apparently a *very faint* star near the centre of the nebulosity, i.e., just preceding the double star; several bright stars near, especially a curious combination of 11mag. stars a short distance preceding. May 3, 1886 (10in, 100). D'Arrest says:—"Proxime subsequitur * duplex (12m. = 12m. dist. 33″; △ A.R. 2·7s. seq. bor.), quarum altera nebulæ adhærere videtur, alterum vero manifesto a neb. liberam esse putem. Ejusdem fixæ mentio fit a. 1787. H hæc res quondam duplex major apparent."

G. C. 4487 = 2037 = H III. 743 (19h. 11m., Dec. N. 6° 17′) August 6, 1886, 10in., power 100.—A very curious object. Rather faint and large, ill defined, about 1′ diam. Slightly brighter on the *s.f.* side, and having apparently a darker centre, giving it an annular appearance. An excessively faint star, close (almost in) the *n.f.* edge (D'Arrest says, "Per amplificatio 356 alia * minutissima, 16 mag., apud marginem nebulæ orient. bor. conspicitur"); and a 12 mag. star about a diam. *n.f.* (D'Arrest, "* 13 ord. seq. 6s. ad boream in angul. posit. 37° 3′."). Edges of nebula very ill-defined; will not bear high powers, 80, 100, and 150 only used. The description given in the G.C. is "planetary, faint, large, round, very suddenly brighter to the middle disc; small star *n.f.*," which agrees pretty well excepting as to the brightening to the centre. Without doubt (as also in D'Arrest) the nebula is now *darker* in the centre. Is it possible that the faint star now on the *n.f.* edge can have been in the centre when seen by Herschel?

G.C. 4572. H IV. 16 = *h*. 2075 (20h. 16m., Dec. N. 19° 40′), Aug. 6, 1886 (10in.).—A pretty bright planetary (?) nebula, with appearance of a nucleus (star?) slightly oval, 20″ diameter; edges ill-defined, exactly between two stars (10 mag.) about a diam. south, and same distance north, a 12 mag. star. Power 320. Aug. 25, 1886. Not planetary, but bright compact nebula, very woolly at edges; diameter of nebula 40″—50″. The nucleus is gradually brighter, and is placed more on the following side of the nebulosity; an 11 mag. star follows at a little distance. At times a suspicion of a minute stellar nucleus. Power 320. D'Arrest says: "Lumine satis æquabili cum duobus punctus paullo lucidioribus excentrice insites."

G. C. 4514 = 73 H IV = *h* 2050. (19h. 41. Dec. N. 50° 11′). Aug. 11, 1886. 10in.—A bright quite circular nebula, about 30″ diameter, fading off at edges. A 10 mag. star exactly in the centre. Sharp with low powers; but apparently a little ill-defined with high ones. An excessively faint star on prec. edge of nebula, a little north. (D'Arrest does not mention this star.) A 12 mag. star a little distance south, and a fainter 13 mag. star at a good distance N. Two very faint stars follow at some distance a little S. To me this nebula appears different in character from 37 H IV. Seeming a globular nebulosity, brightening from edges to centre, although D'Arrest says "Gemina est nebulæ planetaris H IV 37, nisi quod fixa in centro clarius elucet." Powers used, 80, 320, and 1,400.

G. C. 4390. Σ 6 = *h* 2000. 18h. 5m. Dec. N. 6° 49′. Aug. 26, 1886. 10in.—A wonderful object. Exceedingly bright. Exactly like an ill-defined star with low powers; with higher ones rather elliptical N. and S. Small, not over 10″ diam. (D'Arrest says 5″—6″), edges a little uncertain; condensed to centre. Almost a star-like nucleus, but lost in the brightness, perhaps a very little haze surrounding the whole. An excessively faint star *n.p.*, the nebula almost in the edge. With a direct-vision prism, the nebula appeared monochromatic, and very different from the bright 9mag. star following at a little distance. The brightness of the nebula = 8mag. star. Powers 100 and 320.

G. C. 4625. H 152 = *h* 2097. (20h. 54m., Dec. N. 15° 38′). Globular, rather compact nebula, bright, with low powers (100); but with 320 apparently resolved, like the nebula near β Androm. It seems to be a feeble distant cluster, a 12 mag. star at some distance *s.p.*, and a 14 mag. star about two diameters of nebula *n.p.*, and the same distance *n.f.*, and a suspicion of an excessively minute star just following the nebula. August 26, 1886; 10in.

G. C. 4678. M 2. (21h. 27m., Dec. S. 1° 22′). A grand, brilliant, compact cluster of very minute stars, a perfect blaze in centre. The stars comprising it are unusually equal in size, and rather more scattered toward the south side. A bright 10 mag. star *n.f.* the cluster. A faint 12 mag. Double (10″ ±) following. Powers 100 and 150. Aug. 30, 1886.

G. C. 4585. H I 103. (20h. 26m., Dec. N. 17° 16′). Brightish nebula about 3′ diam. with low power, but with higher (320) apparently resolvable much brighter to the middle to a granulous nucleus. A bright 9½ mag. star precedes at about 1½ diameter of nebula, and a faint 12 mag. star follows at a greater distance.

A.R. = 19h. 42m. (Dec. N. 11° 17′ ±) a cluster of 12 mag. stars apparently mixed with nebulosity, especially towards the *s.f.* side, abont 2¼′ in diameter. It is easily found on sweeping a little east of π Aquilæ. This, I thought, was new, having found it by sweeping, Sept. 1st, 1886: but I am informed by Mr. Herbert Sadler that he has seen it before.

G. C. 385. 76 M. (1h. 33m., Dec. N. 50° 52′.)—A double nebula (P = 45° ±) nearly equal in size, but the preceding quite twice as bright as the other. An 11 mag. star precedes, and another follows at twice the distance, a faint double star a little north. No nucleus in either nebula. Diameter of each about 60″. They are quite joined by nebulosity. No star very near nebula. Sept. 1st, 1886; 10in. Powers 100 and 150.

G. C. 4561 H IV 72 (20h. 7m. Dec. N. 37° 59′).—This is a most interesting object. An excessively faint wisp or ray involving and extending in a *s.p.* direction from the beautiful double star O Σ 401 (7½ and 10 yellow and purplish). The nebula is *exceedingly faint*, about 8′ long and 1′—1½′ broad. Mr. Sadler mentions this nebula in his interesting letter (ENGLISH MECHANIC, No. 1,109, letter 25881) on one of MM. Henry's photographs of part of Cygnus. He says that Holden did not see the nebula with the 15½in. Washburn refractor, and neither O Σ nor Dembowski mentions it; but this is not surprising, as their object being the observation of the double star, the power used was probably too high. He says that according to the Parsonstown observation the nebula extends on both sides of the double star. On the print of MM. Henry's photograph (which Mr. Sadler most kindly lent me) no trace is seen of the nebula. When I examined the object in July of the present year with the 10in. dialyte and power 100, the nebula was seen to extend certainly only on the *s.p.* side of the double star. This was confirmed by just shutting out the star first on the *s.p.*, and then the *n.f.* edge of the field; some faint stars not shown in the photo-print were seen in the telescope. Why is this placed in Herschel's fourth-class nebulæ? It is quite of the character of 19 H V. Andromedæ, which from its faintness and large size is easily missed with a moderately high-power.

G. C. 1541. H 44 V. (7h. 23m. Dec. N. 66°).—Cometary, large bright, two 10 mag. stars touching the nebula *n.p.* and *s.f.*; brightening towards the centre to a small nucleus = 12 mag. star, a little following the line joining the two stars; the coma extends more to the north of the nucleus. It is described in the G. C. as "considerably bright; exceedingly large; very much elongated; very gradually much brighter to middle to a nucleus 7″." It is a little curious that no mention is made of the two bright stars which are really involved in the outskirts of the nebula. Sept. 30, 1886, 10in. P. 100.

G. C. 463 H I. 112 = *h* 181 (1h. 51m. 39s., Dec. N. 19° 20′).—A very pale and not very bright nebula, slightly elongated (P = 100° ±). About 1′ × 1½′ cometary, an uncertain condensation in centre, but not sharp. Powers used 100 and 200; a 12 mag. star about 5′ S. Sky not quite clear (Oct. 29, 1886).

G. C. 2158. H IV. 60 = *h* 731 (10h. 29m., Dec. N. 54° 14′).—Pretty bright round nebula; not planetary; about 40″ diameter; gradually brightening towards the centre, in which a patch of about 10″—15″ equally bright—forms a sort of nucleus; no star near, the nearest a 12 mag., about 3′ N., and a 13 mag. at a rather greater distance *s.p.* (Sky hazy). Powers used 100 and 200; 10in; October 30, 1886.

Herbert Ingall.

REVIEWS.

A Complete Treatise on the Art of Retouching Photographic Negatives. By ROBERT JOHNSON. London: Marion and Co.

THE arts of negative retouching and of working up photographs in colours or monochrome are not to be acquired without considerable practice; but those who are possessed of the requisite artistic taste will find their labours immensely facilitated by a study of Mr. Johnson's work. The author has had many years' practical experience of his subject in the best photographic establishments in this country, and as he writes in a clear style, and explains what he means by the aid of lithographs, we can recommend this work to all who desire to learn the art of retouching negatives and "finishing" photographs. Almost indispensable to amateurs, it will be welcomed by professionals, for no previous work has treated so thoroughly and so practically the important subjects of retouching and colouring.

Abridgments of the Specifications relating to Velocipedes. By ROBERT EDWARD PHILLIPS, M.I.M.E. London: Iliffe and Son.

PERHAPS the chief complaint made against the establishment known as the Patent Office is the dilatory manner in which the officials look after work that it is of importance to would-be patentees and their agents should be done well and promptly—e.g., the publication of the abridgments of specifications. Mr. Phillips makes a speciality of cycling patents, and has therefore felt the want of a work which would give in a concise form the special features of all patents relating to velocipedes. He has boldly tackled the task himself, and pertinently says that if other agents would make abridgments of the class of patents with which they are most intimately connected, the officials would be put to shame for the disgraceful state into which they have allowed their abridgments to lapse. The present volume contains abridgments

from 1818 to 1883, when the illustrated journal was issued from the Patent Office; but Mr. Phillips intends to issue appendices from time to time, thus keeping the work as far as possible up to date—indeed, the volumes for 1884 and 1885 are "in the press." Makers of machines, inventors, and patent agents are indebted to Mr. Phillips for the trouble he has taken to compile this list and then publish it for the benefit of all concerned.

A Textbook of Steam and Steam-engines. By ANDREW JAMIESON. London: Charles Griffin and Co.

THIS work is the result of gradually improved lectures delivered to the students of the Glasgow College of Science and Arts, and is intended to bring the information step by step within the grasp of its readers. Although not by any means a mere cram book, it is excellently adapted to the wants of those who intend to sit for the examinations of the Science and Art Department, and of the City and Guilds Institute, for while the Lectures themselves contain all that is needed to obtain a thorough knowledge of steam and the steam-engine, the questions appended at the end of each lecture will give an idea of what is required of candidates who go up for the examinations referred to. Students for honours are also advised to consult the works mentioned in notes and the appendix for information which could not be given without unduly augmenting the dimensions of Mr. Jamieson's useful textbook. The examples of boilers, engines, and accessories are, as a rule, well selected, and if students will carefully read the Lectures and endeavour to answer the questions at the end, they need have little fear of not passing any of the examinations for which they can sit.

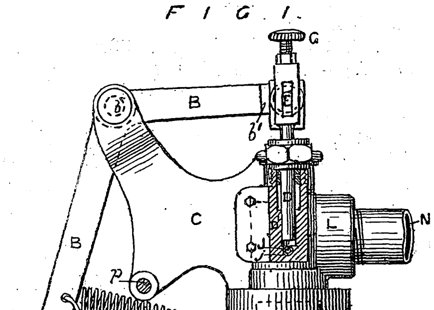
WE have also received *The Watch and Clockmaker's Handbook, Dictionary, and Guide*, by F. J. BRITTEN (London: Kent and Co.), the sixth edition of a work which is almost indispensable to all watch and clockmakers. In this new edition much useful technical information has been added, and several tools and devices of recent invention have been described for the first time.—*Geometrical Drawing for Army Candidates*, by H. T. LILLEY, M.A. (London, Paris, New York, and Melbourne: Cassell and Co.), is a little work in which the problems are classified in groups suggested by an analysis of examination papers, and arranged according to the principles involved in their solution. The author has indicated about 180 problems, which in his experience form a suitable "first course" for the majority of students. —*Lessons in Elementary Dynamics*, by H. G. MADAN, M.A. (London and Edinburgh: W. and R. Chambers), is a valuable little book which will even interest schoolboys in the laws of matter and motion, because the facts are put forward and explained in a simple, straightforward way.—*Ausa Dynamica: Concerning Force, Impulsion, and Energy*, by JOHN O'TOOLE (Dublin: Hodges, Figgis, and Co.), is an improved and enlarged edition of "Mr. O'Toole's" clever book, in which the author insists that none of his strictures can be properly called hypercritical, and respectfully suggests that the dynamicists would do well to revise and rearrange the phraseology of their science. There are many points in Mr. O'Toole's brochure which will interest students and doctors of Dynamics. — *The Practical Manager's Slide-rule Companion*, by JOSEPH HOVELL (Dundee: J. P. Matthew and Co.), is a collection of examples of the use of the slide-rule in making all sorts of calculations.—*Euclid Revised*, Books I. and II., Edited by R. C. J. NIXON, M.A. (Oxford: Clarendon Press; London: H. Frowde), will be welcomed by many teachers, and possibly also by a good many examiners. — *Chemical Arithmetic*, by SYDNEY LUPTON, M.A., F.C.S., F.I.C. (London: Macmillan), is the second edition revised of a useful little work which has been reduced in size and price.—*Cottage Building*, by C. BRUCE ALLEN (London: Crosby Lockwood and Co.), is the 10th edition revised and enlarged of a little treatise in Weale's series which may be useful to those who wish to erect cottages on their property. —*Practical Dynamo Building for Amateurs*, by F. W. WALKER (London: Iliffe and Son), will perhaps be recognised by our readers as a series of papers which appeared in our last volume. — *The Wood Carver*, by J. S. GIBSON (Edinburgh: Scott and Ferguson), is a collection of 34 full-size designs, with instructions for practising the art of wood carving, which are sufficient for anyone determined to succeed. — *The Wayfarer* (London: Chatto and Windus) is the journal of the Society of Cyclists, which, besides information of interest to the members, contains several readable papers on miscellaneous topics.—*Report of the United States Fish Commissioner for* 1883 (Washington) is a ponderous volume of over 1,200 pages containing an "inquiry into the decrease of food-fishes, and the propagation of food-fishes in the waters of the United States." It is full of useful information, including a detailed description of the *Albatross*, the United States Fish Commission steamer.

WE have also to acknowledge the receipt of *Electricity in the Service of Man*, from the German of Dr. VON URBANITZKY, edited by R. WORMELL, D.Sc., M.A. (Cassell and Co.); and the *Gas-Engine*, by DUGALD CLERK (Longmans); *The Modern Practice of Shipbuilding in Iron and Steel*, by SAMUEL J. P. THEARLE (London and Glasgow: W. Collins, Sons, and Co.), Vol. I. (text) and Vol. II. (plates).

SPIEL'S PETROLEUM ENGINE.

ENGINES which work by the explosion of vapours derived from petroleum do not differ much in their general arrangements from gas-engines, but the valve and governor gear are almost of necessity rather complicated. We illustrate in the annexed engravings the

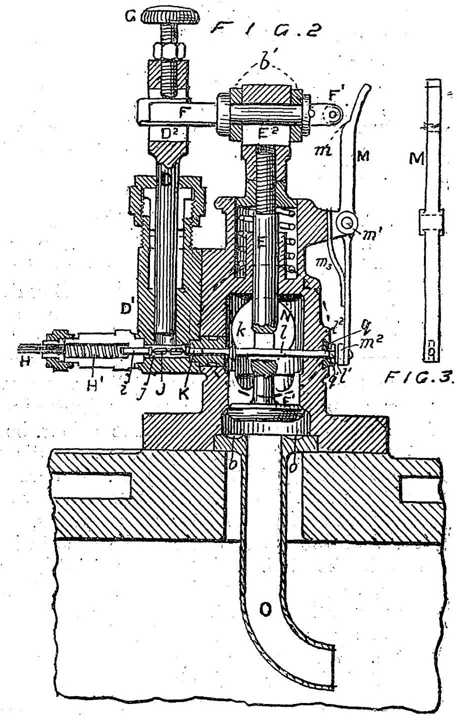
FIG. 1.



principal features of the Spiel petroleum engine, which represents the improvements adopted and recently patented. In these improvements, the action of the governor prevents the engine running too fast, by interposing a slide between the pin whose function it is to open the supply valve controlling the port through which the combustible is injected into the mixing chamber above the cylinder, the thickness of which slide shields the projecting supply valve spindle, and receives the tap of the opening pin. The improvement in the slide-valve consists in fitting it with an adjusting screw, by means of which the narrow port along which the supply of compressed combustible mixture passes from the cylinder to the flame cavity in the slide during the stroke of the latter, may be regulated with respect to its sectional area. Fig. 1 is a front elevation, partly in section. Fig. 2 is a longitudinal section through the axes of the combustible pump and air-valve chamber, from the flywheel side of the engine. Fig. 3 is an elevation of the tappet lever of Fig. 2.

A is the way shaft driven from the crank shaft at half speed, and a the cam for actuating the supply gear. B is a lever having its fulcrum at b, in an extension of a bracket C standing across the engine cylinder. C^1 is a returning spring. The lower (and longer) arm of the lever is fitted with an anti-friction roller to insure a smooth action between the cam and it. The upper (and shorter) arm is split into a fork b^1. D is the ram of the combustible pump D^1, and E the spindle of the air valve E^1. Both of these are connected to the lever B by a crosshead F carried by the lever and passing through a slot in the head of the ram and spindle respectively. G is a screw by means of

FIG. 2. FIG. 3.



which the depth of the slot D^2, and consequently the play of the crosshead therein, may be adjusted for the purpose of regulating the length of the stroke made by the ram D. H is the combustible supply terminating in a short pipe of enlarged bore, in which lies a spiral spring H^1 always bearing against the pin of the suction valve i. J is a pin lying centrally in the port j. K is the delivery valve, k a pin terminating in a conical extension, and l a pin, the end l^1 of which projects beyonds the face of a grooved extension l^2 formed upon the side of the cylinder L in which the air valve works, while the valves i and K are kept in a central position by webs formed upon these spindles. Similar webs are also formed for the same purpose upon the pins J and k. The spring H^1 keeps the aforesaid lines of pins and valves in constant contact, and when free the suction and delivery valves i and K, the former open and the latter shut. The rise of the crosshead F closes the air-valve E^1 and makes the ram D draw in a supply of combustible. The return of the crosshead down the slots D^2 E^2 in the respective heads of the ram D and spindle E, leaves the latter at rest for a short time while the projecting end F^1 of the crosshead engages with the shoulder m of the vibrating leader M having its fulcrum at m^1 in a projection from the cylinder L. The lower extremity or tapper m^2 of the lever is, accordingly, forced against the projecting end l^1 of the pin l which is drawn in, thereby opening the delivery valve K and closing the suction valve i against the spring H^1. While these valves are maintained in this last described position by the continued contact of the crosshead end F^1 with the adjacent face of the lever M, the continued

descent of the crosshead causes the ram to make its down stroke, injecting the charge of combustible through the port j and past the conical extension on the end of the pin K into the cavity above the valve E^1, where it meets with the air supply coming in at the pipe N, with which it is thoroughly incorporated, such incorporation being facilitated and rendered perfect by the comminution to which the combustion is subjected during its passage from the foot of the pump D^1 on to the valve E^1. This latter is opened at the same time that the injection of the combustible is being effected, and the mixed combustible and air pass the valve into the working cylinder of the engine along the pipe O. The gutter o round the top of this pipe gives an upward tendency to the compound vapour passing the valve E^1, and therefore acts as a further intermixing agent upon the particles of air and combustible. A slide is connected to a crank on the end of a rod geared to the governor. The opposite end of the slide works in a groove in an extension, the nose of the spindle passing through a slot formed in the end q^1. Upon part of the face of the end q, there is an outward extension q^1, the projection of which beyond the extension l^2 is not less than that of the spindle end l^1. When the governor begins to race, the crank moves the extension q^1 between the tapper m^2 and the spindle end l^1. The next tap of the tapper will therefore fail to reach the spindle end l^1. The next upstroke of the ram D will draw in a supply of combustible through the pipe H^1, which will be returned along the same by the following down stroke of the ram. The consequence will be a cycle of motion without an explosion in the cylinder. The speed of the engine will then decrease, and the slide P be drawn back, thereby allowing the tapper m^2 to act upon the suction and delivery valves in the normal way as above described. The flexibility of the lower half of the lever M prevents its being distorted when the extension q^1 prevents it making its stroke. The returning spring m^3 needs no detailed explanation.

TRIPLE-EXPANSION MARINE ENGINES.

It is not so many years ago that a considerable number of engineers could have been found who would have asserted that the compound engine could not possibly be more economical than the single type, and that any advantages discovered in actual practice were due entirely to the higher pressures of steam employed. That high pressures tend to economy is well known, because they facilitate expansion; but, so far as the average shipowner is concerned, it is a matter of no importance to him how the economy is effected so long as he can propel his vessel a given number of miles for a lessened consumption of coal. Just as the single engine went out of fashion for marine purposes years ago, so the compound, or the "simple compound" as it is called to distinguish it, is being supplanted by the triple-expansion engine, and it is not unlikely that quadruple expansion will be adopted before long by some of the more adventurous engineers. At the recent meeting of the Institution of Mechanical Engineers at Leeds, only one paper was read—that by the late Robt. Wyllie, of Hartlepool, on triple-expansion engines — which led to so lengthy a discussion that its further consideration was postponed until the next meeting. As a contribution to the literature of this subject Mr. Wyllie's paper is perhaps the most interesting that we have had for some time, and though the theoretical points will be argued pro and con. by engineers, the fact remains that the high-pressure triple-expansion engine is the successful rival of the double-expansion compound, so far as "orders" are concerned, and orders for marine engines always follow a lessened coal consumption, which can be easily understood when it is mentioned that of two sister ships making the voyage to Australia, one consumed 1,200 tons of coal less than the other. As to the position of the three cylinders, considerable difference of opinion prevailed until Mr. Wyllie undertook to construct an engine of 700 I.H.P. which should occupy no more space than an ordinary compound. His experience taught him that to take full advantage of the triple-expansion system, the cylinders must be so placed as to drive three cranks at equal angles, and in his paper he says that the most important conditions are approximate equality in the range of temperature in each cylinder, in the initial stress on each crank, and in the indicated H.P. of each engine. As regards steam jacketing—a vexed question in connection with marine engines—Mr. Wyllie considered that the benefits to be obtained were naturally not so great with a triple-expansion engine as with a single engine having a high ratio of expansion; but he held that the jacketing of the intermediate and low-pressure cylinders is essential to maximum efficiency, while there are mechanical advantages in having the working barrels of all cylinders cast separately —for new liners cost comparatively little. Mr. Wyllie's paper contains several tables of performances of triple-expansion engines, and a number of indicator diagrams, so that it is a valuable contribution to the subject; but although there is no doubt of the economical working of the triple-expansion engine, we must wait awhile before it will be possible to ascertain how it stands when repairs and cost of maintenance can be entered as items in the comparison. Mr. Parker, of Lloyd's, says that from facts gathered from shipowners and marine-engine builders, it has been conclusively shown that the ships in which the highest pressures are carried are the most economical steamers, and so far no one has yet shown us how to utilise high pressures without the three-cylinder expansion. According to Mr. Parker, the consumption of coal has been reduced quite 30 per cent. within the last five years, and he instanced two large P. and O. steamers of exactly the same dimensions, but one having the triple engine working at a pressure of 145lb., and the other an ordinary compound and a pressure of 90lb., where the latter consumed 1,200 tons more coal than the former in completing an identical voyage. Such a fact as that, which is of course known without any chance of error, explains the anxiety of owners to adopt the higher pressures and triple expansion. One of the speakers, indeed, said that he was working engines at 180lb. and even 200lb., and he expressed an opinion that with still higher pressures four and perhaps five cylinders would be required. Prof. A. B. W. Kennedy dealt with the question from a theoretical point of view, and also by calculating the steam consumption of six vessels from indicator diagrams, which he says always make the steam quantities too small. The statements of averages cannot, he says, be trusted entirely, and he hopes it will be possible to secure more accurate data, for he believes that some of the indicator diagrams examined by him do not show more than about 75 per cent. of the steam actually used. In working out some diagrams as much as 16lb. of water per pound of coal was found as the evaporation; but Prof. Kennedy says that is impossible, for with ordinary coal, such as is burnt in marine boilers, only 12 to 14lb. of water per pound of coal could be obtained in a calorimeter, while, owing to imperfect combustion, loss of heat, &c., 10lb. of water evaporated per pound of coal is really very good practice in boiler furnaces. Such advantages as have been obtained by the use of triple-expansion engines are believed by Prof. Kennedy to be due entirely to the use of higher pressures of steam, which enables us to take additional work out of the steam by expanding it from 150lb. down to 45lb. There is no theoretical reason why this additional work should not be obtained in two cylinders; but there are important practical reasons connected with range of temperature and initial condensation which make it difficult to utilise with advantage so high an initial pressure as 150lb. in two cylinders only. The economy of the triple engine being thus due to the increase of steam pressure, it may well be asked where is the limit at which this development will or must stop? If 150lb. gives an economy which is so much appreciated that shipowners take out good engines and replace them with others of the triple-expansion type, will not 200lb. give more economy still? and if three cranks distribute the strains more equally, will it not be better at once to go boldly to a quadruple-expansion engine and have four cranks? These are questions for practical marine engineers and experts, for it is certain that shipowners, knowing and appreciating the economical value of high steam pressures, will insist on having pressures as high as can be carried with safety. If the Perkins system is a practical success, now is the time for those who believe in the possibility of using such high pressures to come forward and take, not merely a step, but a leap in advance. Considering the enormous amount of coal consumed by the latest types of Transatlantic liners, there is a wide field in which to practise any economy that can be devised.

THE AMATEUR WORKSHOP.—XXIX.

Circular Saws.

A CIRCULAR and a band saw must be considered indispensable accompaniments of a modern workshop, the first for ripping and cross-cutting, the second for sweeps. I will describe a circular saw alone in this article, and then in the next illustrate a combined circular and band saw, not because I am much in love with combination machines, but rather on account of their special adaptation to the requirements of an amateur workshop.

First then, in reference to the circular, it is well to remark that for power-driven saws the almost universal practice among the best makers is to adopt what is known as the "solid-box framing," that is, the whole of the standard framework is in one casting instead of being made of separate pieces or frames bolted together, the advantage of this consisting in the superior rigidity and freedom from tremor which this design possesses. But I do not recommend the adoption of this design to the amateur, because of the amount of work involved in the pattern making. Neither is it of much consequence in the case of a light machine, even though driven by power, and certainly is not necessary for a hand machine. The framing which I have chosen as being easy of construction, yet quite rigid, is that shown in Figs. 319 to 321, and details. Almost any common wood will do for the framework excepting those kinds which are given to twist, as elm, for example. Dry beech or birch among the hard woods, red deal or pitch pine among the soft woods will suit equally well; or the frame may be of soft, and the table of a hard wood.

The mode of construction of the bench is apparent on an inspection of the figures. There are, first, the two side frames, or standards A, maintained rigid by the four distance pieces or stretchers B, and sustaining the four cross bars C, upon which the boards forming the table are placed, and to which they are screwed down, the framework itself being steadied, and held with bolts as shown. The table is supposed to be removed from the frame in the plan view (Fig. 320), the better to show the spindle and timbers. The different joints are outlined in detail (Fig. 32?), and the dimensions given are suitable for a saw of moderate size, or not exceeding 12in. The size of the bench could be easily increased or reduced at pleasure, the proportions remaining about the same. The side frames will be first made, and put together, and afterwards united by the stretchers, cross bars, and bolts. The tenons must be a good driving fit, and their shoulders square and straight and closely abutting. Then when the bolts are tightened up there will be no fear of the structure rocking unsteadily. The diagonal braces will prevent alteration of form taking place in the frames themselves, and movement in the transverse direction will be prevented by the good abutment of the stretchers, and by the firm bedding and screwing down of the cross bars on the tops of the frames. The whole structure is bolted down to the floor by bolts passing through the ends of the bottom rails of the frames. The table will be more conveniently described presently.

The common form of saw spindle is shown in place on the timber framing, and also enlarged in Fig. 323. It consists of a shaft running in long bearings, the latter being prevented from becoming improperly set or atwist by being cast on a flat base for bolting down to the framework. A collar is forged in one with the spindle to receive the face of the saw, which is prevented from turning by a stump key, or by a pin standing out from the face of the

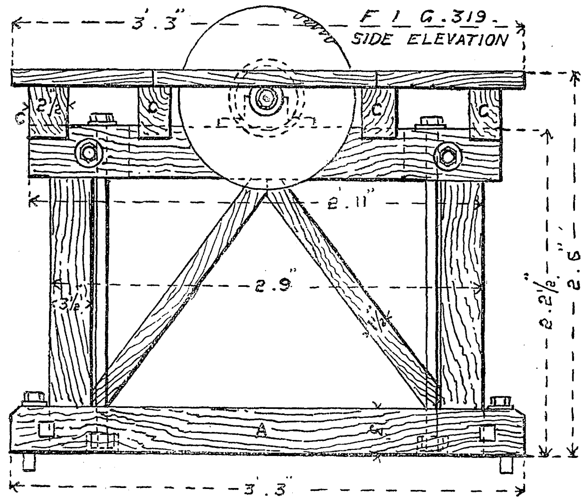


FIG. 319. SIDE ELEVATION

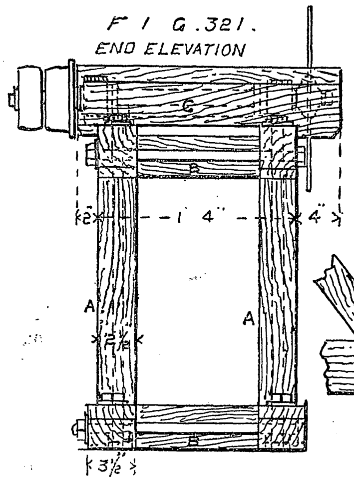


FIG. 321. END ELEVATION

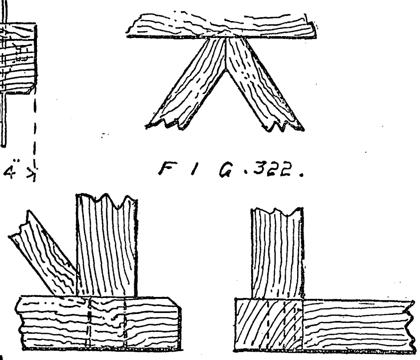


FIG. 322.

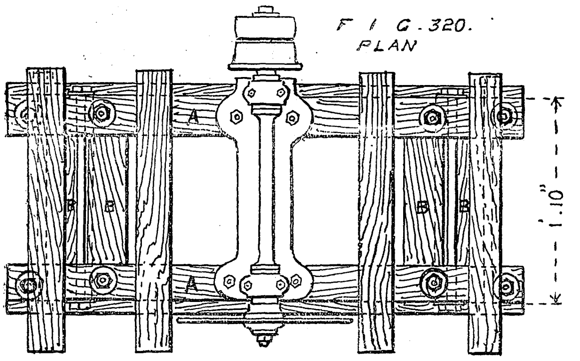


FIG. 320. PLAN

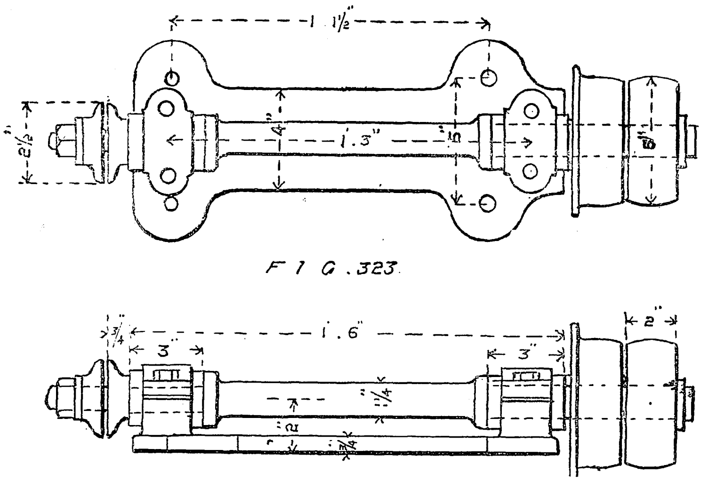


FIG. 323.

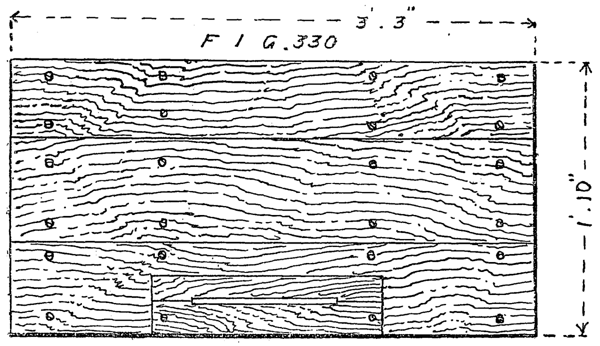


FIG. 330

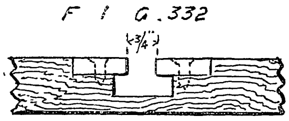


FIG. 332

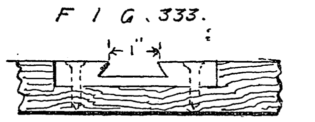


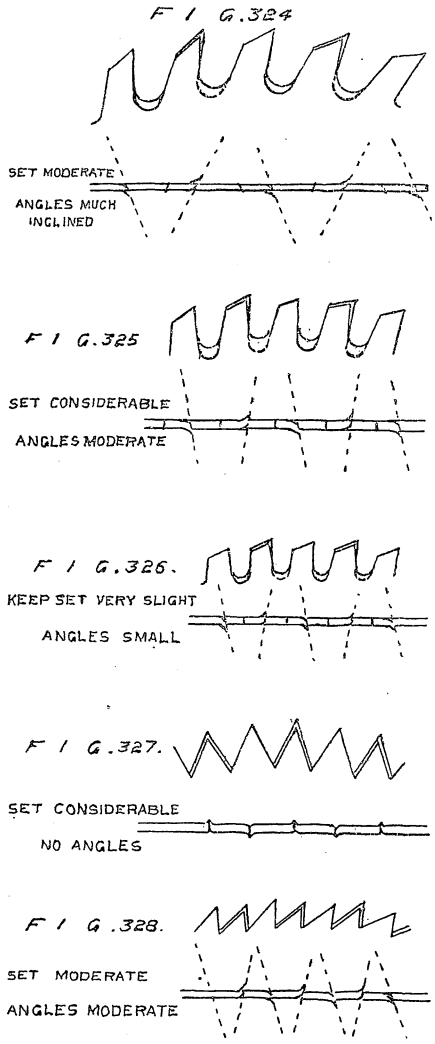
FIG. 333.

collar, and fitting a keyway or a hole in the saw plate. A similar collar or washer bored to slide over the spindle outside the saw acts as a clamp, being pinched in place with a screwed nut or nuts. At the opposite end a fast and loose pulley are attached, the one next the bench—that is, the fast one—being provided with a flange to retain the belt. These spindles ready fitted are sold in various sizes by the makers of wood-working machinery, or they can be made with little trouble.

The shapes of the teeth of circular saws should properly vary with the nature of the work which they have to do, though it would be, of course, much too inconvenient to change saws so often as different qualities of timber or different directions of the grain required cutting. Yet it is well, where much work is being done, to have three or four saws in the shop, and to replace one with another when the quantity of one sort of cutting is sufficient to compensate for the trouble of changing. I have shown five different types of teeth, the first (Fig. 324) for ripping soft wood, the second (Fig. 325) for cross-cutting the same, the third (Fig. 326) for sawing hard wood with, or across the grain, the fourth (Fig. 327) a cross-cut saw pure and simple, suitable for hard or for soft wood, the quantity of set alone varying; the fifth (Fig. 328) a small circular of from 4 to 8in. diameter. In the Fig. 324 the teeth are large and deep, have much rake, and a moderate amount of set. In Fig. 325 they are smaller, and have somewhat less rake, but more set. In Fig. 326 they are smaller still, have still less rake, and very little set. In Fig. 327 the teeth are triangular, and the angles of the face and back may be equal, or the face may have a trifle less inclination than the back, thus approximating to the shape of Fig. 328, which is used indiscriminately on all thin stuff. If the third or fourth examples are used on soft wood they will not cut so quickly, nor remove the sawdust properly, and in wet or resinous wood will become rapidly heated. The first, if used for hard wood, will not cut sweetly, but show a tendency to hitch and make a loud chattering or ringing noise, and probably heat and become buckled if forced to its work, and also sag and show deep grooves. I am, of course, speaking of extreme cases, since it is very often the practice to set and sharpen a saw in a medium fashion and use that indiscriminately for all jobbing work, hence I have presented these chiefly as typical forms to enable the reader the better to understand the principles to be observed in the sharpening of saw teeth. Practical sawyers know that within certain moderate limits, variations in the shapes and angles of saw teeth may be permitted without appearing to affect the capability of the saw. I have sometimes been surprised at the saw mills to find that in the cutting up of even the largest logs the very same saw is used for both hard and soft woods, so that at one moment a log of oak has been cut, and at the next a log of resinous pitch pine has been put on, and then again a piece of cross-cutting has been effected, and with no difference apparently in the readiness with which the tasks were performed. But this does not invalidate by any means the theory that rake and set and pitch should properly vary. The reason why the work is performed so satisfactorily is that the saws in mills are kept in perfect order, both as to set and pitch; they are also well packed, and any buckle in them is promptly hammered out, and last, but not least, they are power driven. Again, it is frequently customary with those who do make a difference in their saws to depend less on rake than on the angle of sharpening, the face of the teeth for soft wood being much more inclined than for hard wood (see Figs. 324, 326), so that while in the first case a point or corner only of the tooth cuts at first, in the latter the thickness, or nearly the whole tooth thickness, is presented at once. One thing in which most men inexperienced in the use of saws will blunder is in giving too much set to the teeth, forgetting that the minimum of set, given with *exact regularity*, is far preferable in any case to a larger amount imparted irregularly. So that the main points to be attended to are the giving of that precise amount of set, and no more, which will enable the plate to clear in the wood, the stoning of the saw to make it truly circular, so that each single tooth shall do its work, none standing above the others, and the sharpening of each tooth point to the same precise angle with the rest, whatever that angle may be; and to these we may add the preservation of the depths of the gullets with as near an approach to uniformity as possible, since on these depends the proper clearance of the sawdust.

Since the sweetness of working of the saws depends mainly on their sharpening and setting, a note or two thereon will not be amiss. The sharpening of the gulleted saws is done by means of a mill saw file, which is flat on the two faces, and rounding in section on the edges. The saw being first topped by running it in place against a piece of hard stone, the teeth are filed from alternate sides, the whole

of the alternate teeth being done from one side first of all, when the saw is reversed in the vice, and the filing of the other alternate set effected. The average angles may be gathered from the diagrams. Frequently the gulleting is done with a separate round parallel file, and only the faces and backs of the teeth with the mill saw file. The gullets should not be allowed to diminish in depth, and in order to lessen the labour of preserving them intact, it is well to have an emery wheel of the proper section for gulleting; then one application of the wheel will deepen the teeth sufficiently to allow of three or four successive sharpenings of the fronts and backs alone, and by this means the labour of gulleting with the file can be avoided. The setting is variously done with a setting block (Fig. 329) held in the vice, and

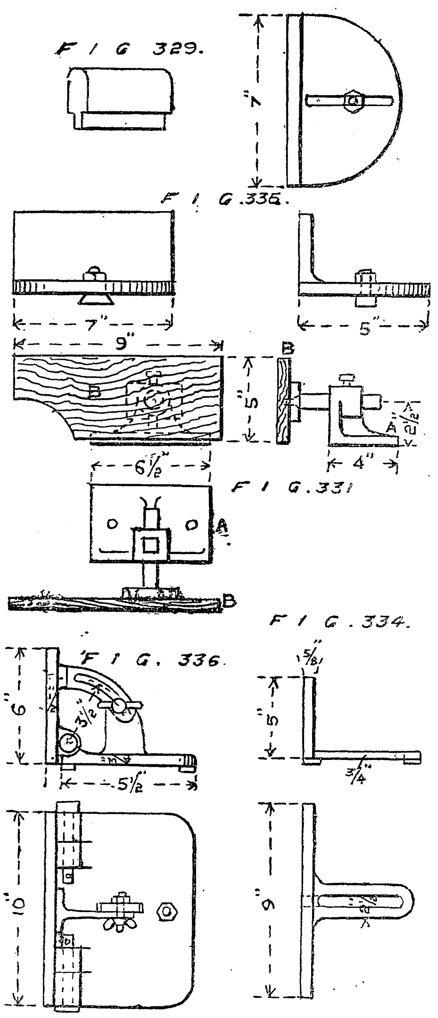


across which the saw is laid at the constant angle required, the teeth being struck with the set hammer; or by means of the common notched saw set, or by means of one of the numerous set-pliers of English or American manufacture.

It is usual and necessary to pack all but the smallest saws with oiled tow or gasket, to prevent them from becoming overheated, and at the same time to generate by the friction of the gasket just that moderate degree of warmth which, being equably diffused through the saw, shall prevent local heating, and consequent tension, which produces vibration or wabbling motion and unpleasant metallic ring. The ringing sound is due to the circumferential portion of the plate expanding more than the central parts, and producing a temporary buckle. The tow is kept in place by a slip of hard wood, mahogany being best, fastened on the bottom of the table on each side of the saw at the front or cutting portion, a rebate or recess being made to take the oiled tow.

A portion of the table must be made loose, for the removal and replacement of the saw on its spindle. To provide for this I have made that part of the table immediately in front of the saw plate loosely fitting upon the cross-bars, on which it is held by common wood screws (Fig. 330). That portion of the table on the opposite face of the saw is made of a corresponding piece in order that, as the saw widens the slit in time by its friction, both sides of the slit may be renewed easily. It is almost needless to say that the slips should be made of some good hard-grained wood, as mahogany, beech, birch, or oak.

It would be instructive to examine the different types of fences or guides used in conjunction with the circular saw bench. One objection to a wooden bench is that it is not readily adaptable to the superior sort of guides; nevertheless, with a little extra trouble, useful guides can be rigged up thereon, both for parallel and angular sawing. About the simplest fence which can be employed is that shown in Fig. 331, in which the bracket A is

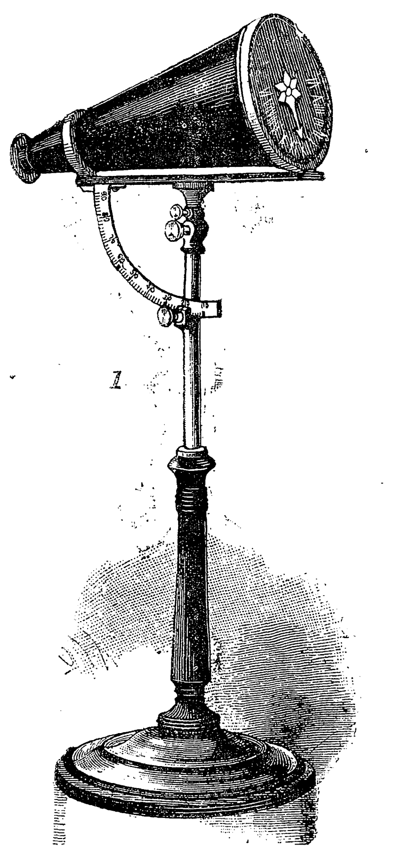


bolted down to the table in one uniform position by means of two coach screws, which are readily removable when the table is wanted clear, while the actual guide itself, B, is slid to and fro by means of the long turned pin moving in the bored hole in the boss of the bracket, and set in any position by the pinching screw. This is for parallel cutting simply.

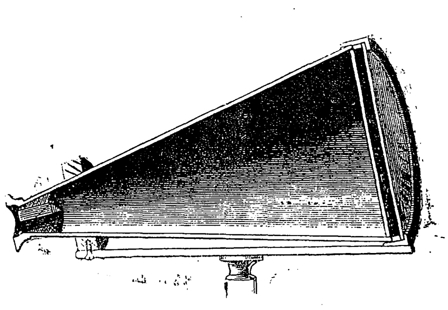
But if we want to rig up something more readily adjustable and truer, we must adopt some other mode of guidance, and the most convenient method in this case is to have a groove or grooves cut in the table. But easily working grooves, and strong enough to resist the strain of a bolt, and the tendency to fray out or become jagged at the edges, are not to be obtained in wood. Hence metal must be introduced. Without, however, making the entire table of metal, there are simple and effective devices which can be adopted. One such is shown in Fig. 332, by which it is seen that the table is grooved across to a certain distance, and two strips of brass or of wrought iron are let in flush, overlapping the groove, to receive the pull of a T-headed bolt. In the other (Fig. 333), a narrow plate of cast iron is sunk into the table, having a groove planed in it for a bolt. In each case also joggles or guide pieces are cast on the under sides of the fences to slide closely in the grooves. Three fences adapted to these grooves and to this particular bench are shown in the remaining figures. All are of cast iron. Fig. 334 is for parallel work simply, Fig. 335 is for turning round to any angle, the face remaining perpendicular. A simple form of fence to angle in the other direction while remaining parallel with the saw plate is drawn in Fig. 336.

PRACTICAL APPLICATIONS OF THE POLARISCOPE.

THE practical applications of the polariscope are few but important. In chemistry, its most prominent use is in the determination of sugars. In medicine, it finds an application in the examination of diabetic urine. In geology and mineralogy, it is of utility in determining the



origin and nature of rocks and minerals. In photometry, it forms the basis of several photometers. In photography, the polariscope, or at least a part of it—the nicol prism—has been employed for reducing the glare of highly illuminated objects. In a similar way, the nicol prism has been used for extending the field of vision in a fog. It forms an important part of the water telescope. It has also been used to some advantage in viewing paintings unfavourably situated in galleries. In the trades,

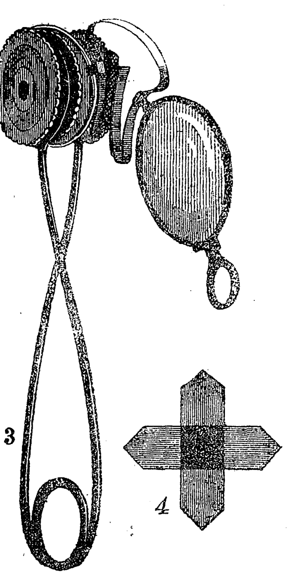


the polariscope has proved useful in detecting strains in glass. By opticians it has for years been recognised as a test for the genuineness of Brazilian pebble lenses for spectacles. It has also proved of great utility to the microscopist in the microscopic examination of structures.

One of the most curious uses of polarised light is the indication of the time of day. Sir Charles Wheatstone devised a polar clock in which a Nicol

* By G. M. HOPKINS, in the *Scientific American.*

prism in connection with atmospheric polarisation is made to indicate the time of day. Several forms of this instrument have been made; one of them is shown in Figs. 1 and 2. Atmospheric polarisation, according to Prof. Tyndall, is due to the



reflection of light from the fine particles of matter floating in the air. By examining the sky on a clear day by means of a Nicol prism and a plate of selenite or other crystal, polarisation will be detected without difficulty. The brightest effects are noticed at a point 90° from the sun. By directing a Nicol prism to the north pole of the heavens—a position always at right angles to the sun, or approximately so—and turning it round, the colours of the crystal plate, viewed through the prism, will change in a definite order, or, if the position of the Nicol be fixed, the movement of the sun will produce similar changes of colour. The polar clock is based upon this principle.

The inventor describes this instrument as follows: "At the extremity of a vertical pillar is fixed, within a brass ring, a glass disc, so inclined that its plane is perpendicular to the polar axis of the earth. On the lower half of this disc is a graduated semicircle, divided into twelve parts (each of which is again subdivided into five or ten parts), and against the divisions the hours of the day are marked, commencing and terminating with VI. Within the fixed brass ring containing the glass dial plate, the broad end of a conical tube is so fitted that it freely moves round it own axis; this broad end is closed by another glass disc, in the centre of which is a small star or other figure formed of thin films of selenite, exhibiting, when examined with polarised light, strongly contrasted colours; and a hand is painted in such a position as to be a prolongation of one of the principal sections of the crystalline films. At the smaller end of the conical tube a nicol prism is fixed so that either of its diagonals shall be 45° from the principal section of the selenite films. The instrument being so fixed that the axis of the conical tube shall coincide with the polar axis of the earth, and the eye of the observer being placed to the Nicol prism, it will be remarked that the selenite star will in general be richly coloured; but as the tube is turned on its axis the colours will vary in intensity, and in two positions will entirely disappear. In one of these positions, a smaller circular disc in the centre of the star will be a certain colour (red for instance), while in the other position it will exhibit the complementary colour. This effect is obtained by placing the principal section of the small central disc 22½° from that of the other films of selenite which form the star. The rule to ascertain the time by this instrument is as follows: The tube must be turned round by the hand of the observer until the coloured star entirely disappears, while the disc in the centre remains red; the hand will then point accurately to the hour. The accuracy with which the solar time may be indicated by this means will depend on the exactness with which the plane of polarisation can be determined. One degree of change in the plane corresponds with four minutes of solar time."

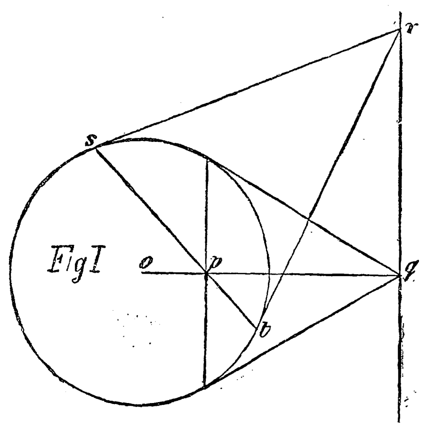
In Fig. 3 is shown the tourmalin tongs, the simplest polariscope known. It consists of two plates of tourmalin, cut parallel to the optic axis of the crystal, and mounted in cells arranged to turn in eyes formed at the extremities of the looped wire. When the plates are parallel light passes through them; but when they are arranged at right angles with each other the light is completely extinguished. If a plate of crystal, a Brazilian pebble spectacle lens for example, be placed between the tourmalins arranged in this way, the light will again pass, showing that it has been depolarised by the rock crystal.

This has been accepted an an infallible test of the genuineness of lenses of this class. In the hands of an expert it is undoubtedly valuable, but glass lenses may be put under strain by heating them and allowing them to cool rather quickly. They will then, to some degree, act on the polarised beam like the true crystal. This form of polariscope is useful in the examination of crystals generally, but on account of the natural dark colour of the tourmalin the utility of the instrument is limited.

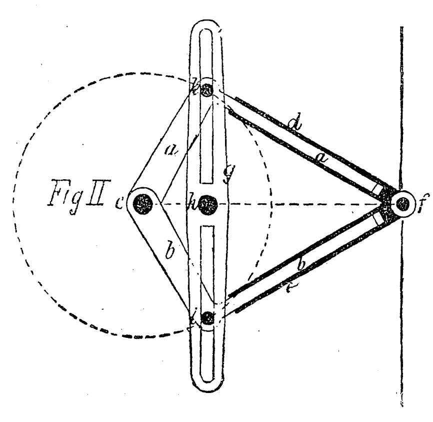
A polariscope designed for the examination of large objects, such as glassware, &c., consists of a bundle of 16 glass glates, about 20in or 24in. square, arranged with reference to the nicol prism employed as an analyser at an angle of 35° 25′. Behind the series of plates is hinged a board covered with black velvet, which may be raised up parallel with the glass plates when it is desired to polarise the beam by reflection. The analyser, a Nicol prism, is mounted in a revolvable tube, supported by a small adjustable standard. Articles to be examined are placed on a table between the polariser and analyser. The light for the polariscope should be taken through either a white paper or cloth screen or a plate of ground glass. Any strain in the article examined will exhibit itself by its depolarising effect on the polarised beam.

CONVERTING CIRCULAR INTO RECTILINEAR MOTION.*

Mechanism for converting circular into rectilinear motion is suggested by the following geometrical construction: Let a point p (Fig. 1) be assumed anywhere within the circumference of a circle. Join the centre o with p by a straight line, and produce it beyond the circumference. On

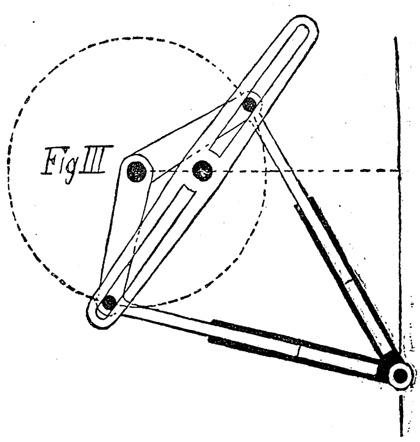


this line lay off a distance $o\,q$ so that the radius of the circle will be a mean proportional to $o\,p$ and $o\,q$. Through q draw $q\,r$ perpendicular to $o\,q$; $q\,r$, the polar of p, is the locus of the intersection of tangents to the circle drawn from the extremities of any chord passing through p. Thus, if we draw a chord $s\,p\,t$, and construct the tangents $s\,r$ and $t\,r$,



they will intersect at r somewhere in the straight line $q\,r$.

The proposed mechanism is shown at Fig. II. Two arms $a\,a$ and $b\,b$, on a common centre c, free to move independently of each other, are fitted with sleeves d and e, which are jointed by the pin f. If now we add a slotted link g, which moves freely around the centre h controlling the positions of the pins k and l, it will be seen that since the pins k, h, and l are always in the same straight line,



the locus of the centre of the pin f will, according to Fig. 1, be a straight line.

Fig. III. shows the mechanism in another position. The above geometrical construction is clearly explained in Prof. Newcomb's "Analytic Geometry." See section: Synthetic Geometry of the Circle, p. 94.

* By F. R. Honey, Instructor in the Sheffield Scientific School, New Haven, Conn.

BITTERS IN DIGESTION.

If any doubt still survived as to the prejudicial action of bitters on the digestive process, Dr. Tschelzoff's recent experiments may be regarded as having given it the *coup de grâce*. He has shown that bitter substances produce effects more hurtful than beneficial on digestion and assimilation, though till quite recently it was an article of popular, if not of professional, belief that these substances, while proving indifferent in the peptonification of albumen, yet hindered fermentation, and were, therefore, useful in certain ailments of the stomach. Experimenting with a great number of bitter substances, chiefly extracts, as being in more general consumption, he dealt with artificial digestion prepared with gastric juice; and in other cases he administered flesh to dogs, to some of which he gave bitter extracts, and, having sacrificed the animals, he weighed the quantity of the meat digested. In still other cases he kept the dogs alive while introducing into their stomachs, through permanent fistulæ, either flesh only, or flesh in union with bitters. He found invariably that in artificial digestion a small amount of bitter extract suffices to retard the digestion of fresh fibrine, and that the same effect, rather less pronounced, is produced in the natural stomach. Turning next to determine in what way bitters can whet the appetite, whether by augmenting the gastric secretion or by irritation of the mucuous membrane, he experimented on dogs in whose stomachs he had made permanent fistulæ. After having introduced flesh only or flesh in union with bitters, he collected the gastric juice, and found that, in these cases also, the bitter extracts diminished the gastric secretion, which underwent only a slight and brief augmentation when the bitters were employed in small doses. In every case the energy of the gastric juice was enfeebled. As a further result of experiment, he ascertained that bitters retarded the pancreatic digestion, while the biliary secretion was enhanced by extracts of absinthe and trefoil. The traditional belief, or rather assumption, that bitter extracts retard fermentation, is further shown by Tschelzoff to be fallacious. Indeed, the stronger the dose of bitters, the greater the intensity of the fermentation; in this case, however, the bitters do not behave in the same manner, and so the extracts of quassia and absinthe do not ferment, while fermentation becomes stronger in presence of powdered rhubarb or quinine. Finally, the putrefaction of organic substances, like blood or urine, he found to be favoured by the presence of bitter extracts, which in the organism also impede the assimilation of nitrogenised compounds.—*Lancet.*

A new central railway station, said to be the largest in the world, is nearing completion at Frankfort-on-the-Main. It has taken six years to construct, and will cost about £150,000, of which the Government has contributed about £100,000 and the Ludwig Railway Company the balance.

The plans for the Paris 1889 Exhibition have been approved. The main building will cover 230,000 square mètres, or 30,000 more than were occupied in 1878.

SCIENTIFIC SOCIETIES.

WESTERN MICROSCOPICAL CLUB.

On Monday week this club met at the house of Mr. Francis P. Pascoe, F.L.S., of Burlington-road, Bayswater. The host gave a *résumé* of what is known in regard to the peculiar crustaceans known as Pycnogons, to which collectors in marine zoology attach some importance. Until 1881 but little was known of these animals. In that year Dr. Anton Dohrn and Dr. Hoek published two very important works. These authors considered the Pycnogonida to form a distinct class of the Arthropoda. In old times they were referred to the Arachnida; Linnæus even placed the few species known to him in the genus Phalangium. In later times they were referred by Johnston, Kroyer, and Milne-Edwards to the Crustacea. Now they are generally classed again with the Arachnida, between the mites and the spiders. Häckel divided the Arachnida into the true and the false, the latter comprising the Pycnogonida and the Arctisca (water bears); he has since, however, referred the latter to the worms. Mr. Pascoe inclines to the view that they are neither crab nor spider forms, but he is unwilling to place them in a sort of no man's land. He has in his "Zoological Classification" included them in the crustacea. They certainly possess eight ambulatory legs, as do spiders, and have a similar arrangement of the eyes; other characteristics appear to approximate them more closely to the Crustacea. Huxley's suggestion that their proboscis is formed, as in the mites, by the coalesced representatives of the Cheliceræ and Pedipalpi is shown by Hoek to be untenable. Of the eight legs which are the main argument to prove that they are Arachnida, the first pair, as well as an accessory pair between them, are attached to a special or independent segment, and this is held to disprove their Arachnidan affinity. The absence of a respiratory apparatus is also a condition of many Crustacea, in which, it must be recollected, the variations of structure are of far higher morphological importance than in the other classes of Arthropoda. And so in the Pycnogonida we find many of them without eyes, some without mandibles and without palpi, the accessory legs sometimes absent in the female—the male only carrying the eggs, and the embryo either resembling the larva of the Copepoda in having three pairs of appendages round the mouth (the ambulatory legs being a subsequent outgrowth from the body), or the young animal when it leaves its larval envelope is already provided with them. The most striking character of the Pycnogonida is the small size of the body, it being in some cases only about one-sixth the length, and even thinner, than one of the legs; the abdomen is reduced to a mere peg-like tubercule. Of the four thoracic segments the anterior is sometimes suturally marked off from the head, but according to Johnston, Savigny has proved that the so-called proboscis is the head, that part behind the proboscis belongs to the thorax, to which the palpi are attached, and, consequently, the latter are only modified legs, which, with the ovigerous legs, would give seven pair, or three more than any Arachnidan. In consequence of the smallness of the body the internal organs are almost entirely placed in the legs, the stomach sending very long cæca into them, and the heart also branching out into them. The eggs formed in the legs are emitted through small openings at their base. The eye is the only organ of sense, but it is frequently absent or rudimentary; when present they are two or four in number, and although simple they have an analogy with the compound eye. The nervous system consists of a brain and four or five ganglia. There are not many known species. We have about thirty, a few being found under stones in tidal pools, but the majority in the open sea. In the *Challenger* expedition, over a course of 69,000 miles, there occurred only thirty-six species—one dredged at 38 fathoms had no eyes, while another at 1,875 fathoms had "two extraordinary large kidney-shaped eyes directed forwards, and two, very small, backwards." From 2,160 to 2,650 fathoms—a trifle over three miles—the eyes in all were rudimentary. Like all long-legged invertebrates they are very sluggish. It is hard to say what they feed on, apparently not vegetable matter. As to size they vary considerably, some are comparatively minute, the largest known (Collossendeis gigas) has legs nearly 12in. long and a body less than 2in. It is doubtful if any are parasitic.

Mr. A. W. Stokes, F.C.S., of Vestry Hall, Paddington, was unanimously re-elected hon. secretary. Any information as to the club may be obtained from him.

No record is kept of the yield in the United States in cubic feet of natural gas. The amount of coal displaced by gas in 1885 was 3,161,600 tons, valued at 4,854,200 dols. In 1884 the coal displaced was valued at 1,460,000 dols. The yield has increased tenfold since 1883.

SCIENTIFIC NEWS.

The elements of Comet Barnard have been computed from observations made at Königsberg, Vienna, and Palermo, by Dr. H. Oppenheim, of Vienna. T = 1886 Dec. 23·5706 Berlin M.T.; $\pi - \Omega$ 79° 44′ 24″; Ω 140° 5′ 53″; i 93° 54′ 7″ mean equinox 1886; log. q 9·90350. Ephemeris for Berlin midnight reads:

	R.A.			N. Dec.	
Nov. 12	12h.	29m.	14s.	10°	8·0′
14	12	38	41	10	55·5
16	12	48	45	11	45·2

Three more minor planets have been recently discovered, thus bringing the total number to 261. The first was discovered by Dr. Peters, of Clinton, New York, on Nov. 1, the position being R.A. 1h. 40m., N.P.D. 85° 30′ 47″; daily motion minus 3m. 36s., plus 4′. The other two were discovered by Dr. Palisa, of Vienna, on Nov. 4. The position of the first was R.A. 2h. 18m. 52s., N.P.D. 75° 57′ 43″, moving slowly N.; of the second, R.A. 2h. 17m. 58s., N.P.D. 76° 13′ 25″ daily motion, minus 3½m., plus 3′.

Part 1, Vol. V. of the *Journal* of the Liverpool Astronomical Society contains a variety of papers on astronomical subjects which will interest its readers, notes, reviews, and correspondence. "The Moon Surveyed in Common Telescopes," by T. G. Elger, is a paper which will be of use to many tiros.

The French Government has granted the funds required for the completion of the observatory of Algiers, which will be in full operation by next spring. Two assistants have been sent to join M. Trépied, and two more are to be selected from the pupils of the School of Astronomy this winter.

The Paris Academy of Sciences propose that an International Conference shall be held in Paris next spring, and make arrangements for a photographic map of the heavens to be simultaneously executed by ten or more observatories in different parts of the globe.

The permanent Committee of the International Geodetic Conference includes Prof. Hirsch, of the Neuchâtel Observatory (sec.), Prof. Förster (Prussia), Sande (Holland), Faye (France), Ferrero (Italy), Ibannez (Spain), Ragel (Saxony), Oppolzer (Austria), Stepnicki (Russia), and Zachariae (Denmark). The next Conference will be held in 1887 at Nice, on the invitation of M. Bischoffsheim, owner of the great Observatory there. Before separating, the Conference passed a resolution requesting the Prussian Government to invite other States to join the International Geodetic Society.

The following is the list of names to be submitted to the Fellows of the Royal Society at the forthcoming anniversary meeting (Nov. 30) for election as the Council for the ensuing session: President, Prof. G. G. Stokes, M.A., D.C.L., L.L.D.; treasurer, J. Evans, D.C.L., LL.D.; secretaries, Prof. M. Foster, M.A., M.D., and Lord Rayleigh, M.A., D.C.L.; foreign secretary, Prof. A. W. Williamson, LL.D.; other members of the Council, Prof. Robert B. Clifton, M.A., Prof. G. H. Darwin, M.A., L.L.D., W. T. Thiselton Dyer, M.A., Prof. D. Ferrier, M.A., E. Frankland, D.C.L., A. Gamgee, M.D., A. Geikie, LL.D., Prof. J. H. Gilbert, M.A., J. Hopkinson, M.A., D.Sc., J. N. Lockyer, F.R.A.S., Sir Lyon Playfair, K.C.B., LL.D., Prof. Bartholomew Price, M.A., Prof. Pritchard, M.A., Admiral Sir G. H. Richards, K.C.B., Prof. Arthur Schüster, Ph.D., and P. L. Sclater, M.A.

The death is announced of William Wakeling Boreham, of Haverhill, Essex, for forty-one years a Fellow of the Royal Astronomical Society. Mr. Boreham was in his 83rd year.

There are signs that at last something will be done about the Gresham lectures; but it is to be hoped that the Mercers' Company will not adopt the suggestion to utilise the funds for the encouragement of students destined for commercial careers, in order that they may acquire a useful knowledge of modern languages. If the Gresham committee do not know how to make the lectures provided for under the will of Sir Thos. Gresham popular and attractive they should resign, or hand over the funds to the Finsbury Technical College. The Gresham lecturer on Astronomy has done his best to attract audiences, and has been fairly successful; but he has been handicapped by the time of delivery being fixed at an hour which is just a little too early for the majority of the young people engaged in the City.

The president of the Geologists' Association, Mr. W. Topley, delivered his address on the erosion of the Coasts of England and Wales last Friday, in the course of which he stated that it was probable the total area of dry land in this country is not less than it was 500 years ago, and may be much more; but although the waste from erosion is not so great as was at one time suspected, there is abundant evidence that the avoidable loss is much greater than it need be, if proper control were exercised, either by the Board of Trade, or by some other board possessing the requisite powers. Some parts of the coast suffer by the removal of shingle from the beach by the action of the sea, which is compensated for—probably more than compensated for—by the filling up of shallow bays and estuaries; but it would be better to prevent the erosion, if possible, for that sometimes involves the ruin of valuable property. The British Association, it will be remembered, has a committee whose duty it is to report on this question, and Mr. Topley is secretary to that committee.

At the meeting of the Edinburgh Geological Society last week, Mr. Ralph Richardson, vice-president, delivered an address on the antiquity of man, in which he pointed out that there was a paucity of "finds" of fossil mammalia in Scotland as compared with those discovered in England, and stated that some of the polished implements of the savage Papuans of to-day resembled those of primeval man which had been found fossilised in Scotland.

Mr. Miles Settle, of the Darcy Lever Collieries, near Bolton, recently exhibited his electric safety-lamp and water cartridge to a number of visitors interested in mining. The "Settle" is an incandescent electric lamp attached to a float suspended to a glass globe and surrounded with water. Fracture of the glass breaks the connection, and the lamp goes out. The lamp is asserted to be perfectly safe, excepting from wilful injury. It was shown of two sizes, large for main roads, powder magazines, &c., and portable, of the weight and size of an ordinary miner's lamp, with a much brighter light. The experiments were successful in firing the water cartridge without flame when placed amid coal dust and gunpowder, and also in breaking the lamp without exploding the gas with which it was surrounded.

We are informed that the success which has attended Professor Silvanus Thompson's lectures on "Electric Bells" at the Finsbury Technical College, is such that the course will be repeated next autumn. The next course of "special lectures" by Professor Thompson is on "Electro-deposition of Metals"—chiefly of nickel—and begins on November 18th. Laboratory instruction is provided to accompany the lectures. Another special course on "Solders and Soldering" will be begun on the same date by Mr. Millis.

It is stated that a factory for working Ramie fibre—the China grass plant (*Boehmeria nivea*)—has been recently established near Gerona by a French company. The plant was introduced to that part of Spain in 1870, and its cultivation having proved successful, three machines are now at work which decorticate nearly 1,000lb. a day, producing a fibre which is much cheaper, finer, and stronger than either jute or hemp, while the refuse can be used for paper making. So far as jute is concerned the statements may be true; but it is not easy to believe that the thread is finer and stronger than hemp.

While great efforts have been made—not without success—to develop the cultivation of cinchona trees in India and Ceylon, there has been an idea that other plants might be found which would be as useful as remedial agents, and it is now asserted that the leaves of a native Ceylon plant, *Michelia niligerica* possess marked antipyretic properties, a decoction of the plant acting, indeed, more powerfully than cinchona. A peculiar, bitter principle, is said to have been extracted from the leaves. Meantime, experiments have been made as to the effect of manure in increasing the yield of quinine from cinchona bark, and according to the Government quinologist at Madras the question is now settled, for comparative

tests show a gain of from 20 to 50 per cent. in favour of manured trees—the increased yield of the valuable alkaloid more than covering the cost of the manure and its application.

In a pamphlet recently issued by Mr. Marvin, entitled "The Coming Deluge of Petroleum," it is stated that there is an oil well in Baku which delivers 11,000 tons of petroleum per day—that is, from a single orifice, "10in. wide," there spouts more oil than from the whole of the wells of America, Galicia, Roumania, Burmah, &c.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

**** In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

SMALL STARS NEAR VEGA—31 M. ANDROMEDÆ.

[26470.]—WITH reference to the estimated values of the small stars near Vega, quoted by Mr. Sadler in his interesting letter (No. 26,441, page 214), it should be borne in mind that they are essentially atmospheric tests, and that any estimates of magnitude are the merest approximations, in consequence of the blaze of the large star. As a matter of fact, the field was examined on some half-dozen nights without a trace of any other stars except A and B being seen, and some of the smaller ones were only visible with the greatest difficulty by using a high power and small field to exclude the light of Vega as far as possible. The fainter stars were only seen on one night.

Regarding the reported change in 31 M. Andromedæ referred to by Mr. I. W. Ward (letter 26455, p. 217), I find from my notes the Nebula was observed on Sept. 15 and 28 without any change being noticed, again on Oct. 19, when the central part appeared bright, but the air was too thick to render the observation of much value, and again on the 5th inst., after the moon had set, when no trace of any star or bright point (other than the usual nucleus) could be detected, and the central condensation did not seem brighter than usual.

I have several times noted apparent fluctuations in the light of the central portion; but it must always be a matter of grave doubt how far atmospheric conditions are responsible for these. I am not aware what aperture was used in the Continental observations recorded in the *Astronomische Nachrichten*, but there is nothing within the grasp of my 10in. reflector.

Kenneth J. Tarrant.

Letchford House, Pinner, Nov. 6.

A SUGGESTION IN STELLAR CHROMATICS.

[26471.]—SOME little time back Mr. Francis Galton suggested in the pages of a contemporary that Roman mosaic was probably the best material for preserving a scale of colours for use by anthropologists. Since I came across that suggestion it has occurred to me that, on account of its imperishable nature, a scale of colours in mosaic would be admirably adapted for use in ascertaining the colours of stars; for it is almost certain that any colour disc printed upon paper must undergo in the course of time a great change, due not only to the colour fading through the action of light and contact with the atmosphere, but also to the paper itself becoming darker by age.

Take, for example, the plate of colours in Admiral Smyth's "Sidereal Chromatics": the difficulty of distinguishing several of the discs from each other, particularly by artificial light (which the present writer and Mr. McCann called attention to in the *Astro. Register*, Vol. XIX.), is probably due, not so much to the colours not having been selected for viewing by lamp-light, but to the colours, especially the fainter ones, having undergone a change since they were printed.

As those interested in this subject are aware, from my previous communications *re* "star colours," I am not in favour of what I have elsewhere termed "the eye-and-memory method" of ascertaining the colour of a star; but until some instrumental means has been devised that will meet with the approval of the majority of astronomers, it is obviously our duty to perfect the present method as far as possible, and the first step to take is to get a standard series of colours. It being undoubtedly desirable that the subject of star colours should be placed upon a more satisfactory footing than it at present holds, it is a pity some scientific body, such as the British Association, for instance, does not take the matter up. What is wanted is a scale of colours selected with reference to certain portions of the spectrum, the colours, when chosen, to be imitated and preserved in some imperishable material, such as mosaic, and a suitable nomenclature for the same.

B. J. Hopkins.

ORGAN WINDCHESTS.

[26472.]—I AM delighted to find your obliging correspondents, Mr. Audsley and "Uranium," are again writing on this very interesting subject. I would ask the favour of their opinion on the windchests illustrated on pages 414, 525, and 597, Vol. XXXII., ENGLISH MECHANIC, as regards their suitability for chamber-organ purposes. They appear an admirable invention in one or two respects, doing away with the "slider" and its attendant danger of leakage of the wind; and the ventil system for admitting wind to separate registers is introduced in a simple manner. I fear, however, that the touch at the keys would be heavy, and perhaps the pipes would not speak readily.

Mr. Landel should, by all means, have three or four stops entirely of wood in his organ, especially if it is in a dry place. There is a roundness of tone consequent on the employment of wood, and low pressure of wind obtainable by no other means.

Guernsey. **C. H. D.**

GRINDING AND POLISHING GLASS SPECULA.

[26473.]—I HAD hoped before this to have given a description of a following altazimuth stand; but I have been hindered, and as Mr. Wigmore's letter (26005) has been so long unanswered, it now demands priority of attention. I still adhere to what I said in letter 25317—viz., that it would not "be fair to the trade to give in public a description of the work of any living maker without his consent," simply because perfection is not often to be found, and if I were to take the worst specimens of anyone's work, I could speak ill of it. The fact is, each maker excels in certain points, and is liable to a slip as well as anyone else, and of the four English makers now before the public—Mr. With, Mr. Calver, Mr. Linscott, and Mr. Jones—each has produced good specula. I am upon very friendly terms with them all, and wish to remain so. If I can do any of them good, I will. I wish to do neither of them any harm. At the same time I constantly keep in view the duty I have to perform to the large number of users of the telescope, and to the science of astronomy as far as it can be aided by improving the telescope, and I have every reason to believe that I have improved the character of specula even in the trade, and that this improvement will be more felt in years to come than just now. This I have done by calling attention to certain defects and their remedy, publicly and privately, and these are gradually being eliminated, and I hope will ultimately disappear. It would be very ungracious, yea very unfair of me, to blaze abroad defects of makers, when no one professes to be perfect. This might answer a selfish motive in me if I were a public maker, or intended to become one. I desire the position of a helper of all without mentioning names, and that for their sakes and the telescope's, for I believe the reflecting telescope has never had justice done to it yet. There are defects that have never had proper attention, but which I hope one by one to call attention to, which defects have been marring the finer definition of the reflector. I would just observe that these defects do not occur in all specula of any particular maker—each maker can boast of specula that are perfect, at least practically so. While upon this subject I may just state that since my last letter I have had two interviews with Mr. With, and very pleasant times we had together. Talking over the whole range of speculum-making, he very kindly volunteered to describe the whole of his process, telling me to ask any questions I liked as he proceeded, only saying that he could trust me not to make any improper use of the information to his or anyone else's injury who may be concerned. I should, therefore, not think of making public any of his processes, or anything that he told me that specially belonged to his process. Therefore no further questions need be asked me about what I know of Mr. With's process. I hope he will see his way clear, and I think he will ultimately, to write a description of his process for the benefit of all, as full as he gave me verbally. He commenced with the rough grinding, went on to the polishing, then came the interesting part—his mode of figuring, and then his mode of testing. One thing I noticed particularly, and which he pointed out to me towards the last—viz., his thorough knowledge of flexure, and the careful means he adopted to avoid it, only corroborating my testings of his specula that they are singularly free from flexure, and flexure is a terrible enemy to the finer definition. He showed me his stock of specula which he is now selling at about half their original price through Mr. Browning, and which are his latest and best productions.

And now as to the work of these makers. I need not give the figures of the aberration for five or any other number of those that are said to perform well; but state generally that specula that are only three-quarters corrected are said to perform well, and those that are one quarter over-corrected are said to perform well. One person will say under-correction is best, and ask for it in his particular speculum; another thinks over-correction is best, and asks for it in his particular speculum. I often pity the makers. The sensible view of the matter corroborated by my own experiments is that the nearer we get to the parabolic figure, the better for definition; and here Mr. Jones, who makes for Horne, Thornthwaite, and Wood, has adopted a very good plan of supplying a table of the zonal aberrations of each speculum he supplies, and warrants them to be within 1-100in. of the figures, thus the purchaser has some guarantee that he can understand and feel sure about. If this were demanded it would lead to permanent improvement in the figure of all future makers, as they would have to come up to a certain standard before they could get a name. Mr. Jones I know, having had two very interesting interviews with him; he has described to me his process, which is very different to Mr. With's and Mr. Linscott's. I am very careful not to divulge any of the secrets of either to the other makers, but if I can help either in his particular line it is my pleasure to do so. I have tested specula of Mr. Jones's and of Mr. Linscott's that have been exceedingly near to the parabolic curve, quite within the limits of the possible error of testing—i.e., the 1-100in. which in the telescope would be only 1-400 in., which no one could detect. Mr. Wigmore wishes me to give the aberrations of specula that have been considered good. Now, this I need not do, but will illustrate the matter in figures of zonal aberration at centre of curvature of a 12in. speculum whose aberration for the No. 1 zone (outside zone) ought to be, say, ·12. I have found specula whose aberration has been as low as ·08, and all other numbers up to ·16 have been said to be good; but I have detected a difference in the definition of specula that have been one-third under-corrected from one exactly right, as well as in specula that have been one-third over-corrected, but when the departure from the proper aberration is only $\frac{1}{6}$—i.e., taking a 12in. speculum, whose aberration ought to be, say, ·12 as above; if the aberration is ·1 or ·14, then I cannot tell the difference, in the telescope, between it and one that is exactly ·12; so that I call a speculum practically perfect that is not more than $\frac{1}{6}$ wrong. I mean this only to apply to specula whose foci are about nine times their diameter. I hope this will meet Mr. Wigmore's wishes, as it is the result not of five, but of scores of testings and observations.

And now as to Mr. Wigmore's own speculum. It is regular in figure; this is an important achievement, and shows that his polish is all right, and that he only wants to carry the correction a little further, as he has not carried it as near as I should. I always try to get the correction to within $\frac{1}{100}$in. of the required amount. Now, all his polisher wanted was a little more, say, $\frac{1}{50}$in. cut off the outside facets, bringing it to nothing at the centre; then polish again till the polisher gets nearly dry, which would be perhaps twenty or thirty minutes. Then test—the correction would almost be bound to be nearer; if not exactly right, then take a little more off the outside, bringing it to nothing at the centre. I sometimes find that one half-hour's polishing or figuring, as it is called, does not exhaust the amount of correction that the last cutting of the facets will give: this I know when a rapid correction is going on from working to working; in that case I work another half-hour without altering the polisher, and the correction will probably be carried a little further, but not so much as before, showing that the correction for that form of polisher is exhausted, and will allow a little more graduation of the outside of the polisher coming off to nothing at the centre, if the proper correction has not been already reached; by this means we can always come within $\frac{1}{100}$in. of the calculated correction above or below, and this is near enough for all practical purposes. I always, after I have polished enough to get the surface sufficiently bright to test with certainty, begin to graduate my polisher

to the shape that produces the parabola, and thus I utilise the time of polishing in getting the proper shaped polisher, and generally many half hour's polishing before I have got all the emery marks out. I have got the parabola, which I keep pretty near to by testing after each half-hour's polishing, and altering my polisher if needed to bring up to the parabola, or reduce the correction if I have overstepped it, and thus I go on polishing out the emery marks till they are all gone, when I have the parabola to the $\frac{1}{100}$in.

I may give Mr. Wigmore and others the hint that I have been trying successfully a polisher with two square inch facets instead of one square inch facets, and putting them on the tool upon exactly the same principle—viz., the groove nearest the centre $\frac{1}{8}$th of two inches from the centre, i.e., $\frac{1}{4}$in., and the other groove that crosses this and is nearest to the centre I put $\frac{3}{4}$in. from the centre, filling up the polisher from these with the two inch facets. I cast my facets $\frac{3}{8}$in. thick to begin with, and cast upon Mr. Tweedale's plan, which is a great improvement; thus this polisher is easier made, there being only a quarter the number of facets to put on. But I find I have to make two small grooves at right-angles to one another on each facet, dividing each facet into four smaller ones. These grooves are about $\frac{1}{8}$in. wide and $\frac{1}{16}$in. deep; they prevent the suction of such large facets being too great—in fact, I cannot work without these cross grooves. This plan is a great saving of time and trouble. I hope to more fully describe this plan, with details of working, at some future time. I mention it here that all may take the hint at once.

I give below an extract from a letter I received from an amateur in New South Wales. He requested me to order for him a $12\frac{1}{2}$in. speculum from Chance Brothers and Co., thinking the order would receive more attention from me than from an unknown individual. Of course, I got the speculum for him, and got Chance Brothers to pack it and send it off. They say that they shall be happy to supply amateurs in any part of the world, with specula at the same rate and with the same care in packing, as they should for any regular maker, so that to trouble me about this matter is now unnecessary. They have a scale of charges which I consider very reasonable, and any inquiry will receive prompt attention. Their full address is "Chance Brothers and Co., Glass Works, near Birmingham."

I now give the extract that will interest all amateurs at home, knowing as they do that our amateur brothers in New South Wales have to get all their information from the ENGLISH MECHANIC. He says, after he has done with asking me to get a glass disc for him, that "in addition to which it is my great desire to convey to you my humble appreciation of your excellent directions as given from time to time in that most useful journal, the ENGLISH MECHANIC, instructions that have been in Sydney the means of setting several to work in earnest. One friend has completed mirrors up to 19in. diameter, with which aperture I have had some magnificent views of the planets and our great clusters, whilst half-second double stars are beautifully defined. Another amateur has finished four specula, the largest of 10in., which have proved satisfactory. Spurred on by the success of these gentlemen, although then in my teens, I managed to successfully finish a reflector of 7in. aperture, which is so interesting that I am anxious to try a larger size, and with that object in view, would trespass upon your kindness and ask you to procure the disc."

All this is very encouraging to us all, and especially so to me, who feels that if amateurs can make and accurately test by the shadow and zonal test their specula, this will lead to a steady improvement in the trade, and thus the mass of users of the telescope who cannot make their own telescopes, will have at their command, at convenient prices, improved instruments. Now, it is the shadow and zonal tests combined that reveal to us the real nature of the curve. Let every amateur, and all in the trade, too, remember that they must not divorce these two tests. The amateur is apt to think "Oh, if I can but get the zones to answer to the calculated values as described by Mr. Wassell, and thus get the parabola, I shall be all right, and shall be sure to have good definition." Yes, and those in the trade when first adopting the zonal test, are apt to think the same. Now, let me not disparage the zonal test. Anyone using it will be bound to get a near approach to the parabola, nearer than ever he got before, and all the rays will be brought to a focus nearer to one distance from the speculum, at the eyepiece when in the telescope, than before the use of the zonal test. So far, there will be a vast improvement. Now the zonal test helps us no further than this—viz., it most accurately enables us to detect longitudinal aberration. Now, before the adoption of the zonal test, this correction for longitudinal aberration was a matter of guess-work, proved by the fact that mirrors have been turned out as being perfect which were only half-corrected, while others had double the amount of correction they ought to have. Now the zonal test puts a stop to all this by pointing out the error at once. But this longitudinal aberration is not the only error that a speculum is liable to, for the rays from the various parts of a speculum ought, not only to cross in the same plane, but to cross in the same point in that plane. Now, this the zonal test will not tell us anything about. To illustrate what I mean, suppose the rays from a star are all brought to cross at the same distance from the speculum; but the rays from one part of the speculum are crossing on one side of the rays from another part of the speculum, but yet at the same distance from the speculum. Now, further suppose that these various foci from different parts of the speculum cover an area of a circle at the eyepiece of $\frac{1}{10}$in. diameter, now magnify this by the eyepiece, and what kind of an image of a star would the amateur get? Why, like Jupiter in a fog. Of course I know this is an exaggeration; but the principle I wish to explain is there—viz., that we must avoid lateral as well as longitudinal aberration.

Now, the shadow test deals with lateral aberration, and does not touch longitudinal aberration, while the zonal test deals with longitudinal aberration, and does not touch lateral. There are two insidious sources of error causing lateral aberration that require great care to avoid, and most careful and patient testing to detect. One I have already dealt with—viz., flexure. I am sorry to say I have not only detected this in amateur's work, but in good makers' work; some error in supporting while polishing is the cause. Let all look to this. The other cause of lateral aberration is a small waviness in the surface. This is very insidious. I will narrate one of my own experiences in testing to illustrate its insidiousness, and as a warning to testers as well as to workers. I had sent to me a speculum, that its present owner could not get to define well on a star. Its previous owner praised it much—had even written a testimonial that was printed, and upon this testimonial it was bought. I was rather interested to find out how this discrepancy of testimony arose: its present owner so described its performance on a star, that I saw he knew what he was writing about. I tested the speculum the first day it came to me, for I felt deeply interested. I found it about three-quarters- corrected by the zonal test, and there seemed to be no flexure; but much as I was puzzled at finding no more wrong, for I knew that the quarter under-correction would not account for the defects so well described by its owner, I did not there and then condemn its owner's judgment, for I never depend on a testing till after the speculum has been allowed to remain in the same atmosphere for many hours, so I waited till the next day, tested it again, with exactly similar results—i.e., with only about one-quarter-under-correction. I was now really puzzled, and could not get it off my mind all day. I began to think that there was something seriously wrong in its owner's mind, and that perhaps its first owner was right. I tested it again the next day, for I could not get this puzzle off my mind; but with the same result. I may add that I carefully tested it for flexure each day; but could find nothing to account for the defect. A time or two I thought I saw a little indication of flexure; but upon more careful scrutiny found it was only the mind perplexed grasping at a straw that I could not support the charge of flexure upon when more carefully examined. I now thought of writing to its owner, telling him he must have made some mistake, and that the speculum was a pretty good one, and that the only defect I could find was that it was not quite enough corrected, but that this would not account for its defect in the telescope; but I thought I would wait till the next day and think it over again—the fact was, I did not like to give it up. Well, the next day, I felt myself irresistibly drawn down the cellar again; with a kind of forlorn-hope feeling I lit my lamp and put my eye to the shutter, and began to pass it across the shadows with rays at different points, watching the shadows with a feeling of despair, when I thought I saw on one part of the speculum a mottled appearance; this gradually spread all over the surface. Is it possible, I said to myself, that the surface is uneven? I went to the speculum and wiped it carefully to make sure that the appearance was not caused by dew, or a kind of film that comes over glass surfaces that are left exposed to the open air; but still there were the small irregularities. This appearance I was well acquainted with in my early speculum working, but never expected to find it in a speculum of this maker. This blinded my perception before; but now this mottled appearance I could not get rid of, for every time I looked at the speculum, for days after, and until it went out of my possession, there they were easily to be seen, being an illustration of the well-known fact that what will easily escape observation till once seen will then become most easily seen. I was not prepared to find this defect in this maker's work, for I had often spoken of his work as free from this defect; yet here was a slip that accounted for the very defects complained of by its owner. I passed the speculum on to another who is very apt at testing, and told him to look for the mottled appearance, and he saw it at once, corroborating all my description of it. Now, this uneven surface would cause the rays reflected from the sides of the undulations to be scattered over a small area at the eyepiece, instead of being brought to a point. I have dwelt thus much on this experience of mine to impress upon all the importance of keeping in mind every possible error while testing, and testing carefully for each, and taking nothing for granted. Now, at the risk of making this letter too long, I think I ought to mention some of the principal causes of this unevenness of surface, which is so fatal to fine definition, and yet may exist on what is as a whole a parabolic surface, and will therefore pass the zonal testing. The cause of this unevenness of surface is unevenness of cut on the facets of the polisher; in other words, one part cutting more than another, and these, in their passage across the face of the speculum, making a number of irregular grooves, which, being crossed by the revolution of the speculum, and altered in their position by the revolution of the polisher, leave irregular hills and vales. If we apply rouge during the polishing it will increase the cut around the edges of the facets, where it can easily get, leaving the centres but poorly supplied, thus causing irregularity of cut on the face of the polisher, and irregular valleys on the face of the speculum. When the polisher has been used too long the rouge gets irregularly imbedded in the face of the pitch, and irregularity of cut ensues, with the mottled appearance under testing. When the pitch is too thin on the polisher, say from $\frac{1}{16}$in. downwards, the pitch cannot yield regularly, and the irregular resistance causes irregular cut. I find about $\frac{1}{4}$ to $\frac{1}{8}$ thick work very well; the thicker the pitch the more even the surface. I have been trying $\frac{3}{8}$ thick, and it works very well. A polisher that has been laid by for a week or two, and thus got out of shape, if used without allowing time for its forming itself to the shape of the speculum, will, of course, only cut in the high points of the facets, and thus cause the undulating surface, with its mottled appearance under testing. The above are some of the causes which have come under my own notice, and which I have noted, and are sufficient to put us on our guard against every cause of unequal cut in the polisher.

The shadow test when carefully used detects any irregularity in the surface, whether caused by flexure or undulations; therefore the shadow test ought never to be divorced from the zonal test in the examination of a speculum.

I wish to further add that in the future I do not undertake to test specula previous to their being purchased, and only purchased subject to my giving a good report. I will only undertake to test specula that have some peculiarity that cannot otherwise be explained, and the discovery of the cause of which may lead to some useful information or results. I am forced to this restriction because the number of specula sent to me to test has greatly increased and become a burden without leading to results that aid the improvement of the telescope. There comes a period in the history of us all when our labour and time are of more value than to be spent on mere routine work.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

"HAS ENGLAND GONE UP-HILL OR DOWN DURING THE LAST FIFTY YEARS?"

[26474.]—My capitalistic opponents are evidently badly hurt. I have struck home. Only a blow that "made itself felt" could have produced three such ludicrous howls as the letters of "U., Birmingham," "H. G. E.," and "B. R." (26373-4-5, Oct. 15). As for the last-named, mine ancient enemy, he fairly evacuates his position, and leaves me master of the field. He is wise in his generation. Albeit, even his short note, emanating as it does from a member of the upper or the middle class (he does not deny the soft impeachment), could not be entirely free from misrepresentation. I did not say, as he asserts I did, that I believed "increased deposits [in savings banks] indicate greater poverty." What I did say, as anyone may see by referring to my letter, was that "as a rule, the darker, not the brighter, a man's *prospects* are [not his position] the more he saves"—a distinction and a difference.

"U., Birmingham," "rushes in" to the rescue of "B. R." just as the latter throws down his arms and flies. I sympathise with "U., Birmingham," in the unfortunate predicament in which "B. R." leaves him. I am also sorry to disillusionise "U., Birmingham." He evidently takes the flattering unction to his soul that he makes a good point when he says that Socialists, believing it to be "unfair to accept dividends," would "only invest in concerns which would be unable to declare

them." Now, "would 'U.' be surprised to hear" that Socialists, in the case given, regarding *interest* and *plunder* as interchangeable terms, would, voluntarily, *not invest at all?* "How goes the game now?" I am sadly afraid "U." has the laugh against him, which, I need not add, I mournfully deplore. But he has the consolation of knowing he provoked it himself.

I am glad to learn from this correspondent that some of the tramway companies of his town have "lately reduced the hours of working to twelve per diem." So "late," evidently, has this been done, that few outside "U.'s" native place have as yet heard of it. That the reform has been effected at all may be placed to the credit of the wholesome lessons Socialists are teaching the community. From 16 hours to 12 per day is a reduction, certainly; and it shows what even tramway shareholders will sacrifice out of their plundered hoard to stave off for an hour longer the evil "day of reckoning" with the awakened workers. But this reduction, let it be understood, is anything but enough. Another will have to be made—this time to 8 hours or less. And what about wages under this precious Brummagem plan? Are they reduced too? "U." says, "The men receive a fair remuneration." Pray, what is meant by "fair"? "Fair" happens to be a relative term, and a very elastic one into the bargain. It may mean anything between eighteen and eighty shillings per week, just according to the ideas of fairness held by the person using it. "U.'s" idea of fairness and cognate matters may be inferred from his remark concerning the practice of certain other victims of capitalist greed, which practice I described as "pawning their Sunday coats and petticoats on Monday and redeeming them again on Saturday." This "U." is "fair" enough to say is "in many cases caused rather from bad management than extreme poverty." "Bad management"! How can their management be either good or bad when they have (so to speak) nothing to manage? "Bad management," forsooth! One would like to witness the superior management with which "U." would keep himself, a wife, and family, pay rack-rent and frequent doctor's bills, and be out of employment about three months or more of the twelve—all with the wages received by those who are compelled to resort to such practices as the one described, said wages ranging from sixteen to eighteen shillings per week. "Bad management, indeed! When will these impudent capitalistic libellers, whose luxury is purchased at the price of the producers' misery, cease to insult as well as injure? Not, I am more and more afraid every day, until the terrible upheaval of a bloody revolution shall wrest from their grasp their power to do either. They are apparently as incapable of learning from the past as they are of preparing for the future. Like the Church of Rome, they "learn nothing": but, unlike it, they forget everything. They are sowing—what? They are drifting—whither?

"H. G. E." is the next to take up the cudgels on behalf of "B. R." In "replying" to me he talks as capitalists and their apologists usually do—in the words of Artemus Ward, "with an imagination untrammelled by the slightest knowledge of the subject." He confesses his inability to make "head or tail" of the paragraph in my letter on the Savings Bank question. "Open confession is good for the soul." It is also, in this case, good for me, as well as for the soul of the confessary—if he has one. It is always as well to know the sort of opponent with whom you have to deal. It may, e.g., prevent your being guilty of that regrettable blunder crystallised into the saying *re* "throwing pearls." I admit, now, that I have been so guilty. But my guilt, I hope, is venial, for I sinned in ignorance. I was unaware of the retarded mental condition of "H. G. E." I did not know that he was incapable of estimating at its proper value the trite truism expressed in the formula: $2 \times 2 = 4$. I am sorry he is unable to perceive that if the deposits in the Post Office Savings Bank since 1861 have averaged about £2 14s. 8d. each, while in 1885 they only amounted to £2 6s. 5d., the corollary is that a decrease is shown of 8s. 3d. per deposit. I regret he fails to comprehend the statement that the total amount of the deficiency thus shown amounted last year to £2,670,000. I condole with him on his inability to draw from this the deduction that the assertion about deposits increasing in all savings banks is false, and that, on the contrary, they are materially decreasing. I lament these things, I say. At the same time, whether he can grasp them or not, there are the facts.

From bad "H. G. E." goes to worse. He asserts that I "talk of the 'real worker' as if the man who puts on an apron and stands at a bench is the only being who does any work." I would mildly venture to hint, and in the gentlest way imaginable, that this is a deliberate—well, misapprehension. Socialists are for ever iterating and reiterating that they include all who truly labour, no matter how, in the term "workers"; and what, in my letter, I did say, was the "real '*people*,' the workers." Who, however, out of Bedlam, expects fair play from capitalists and their hacks? Certainly not Socialists. We expect misrepresentation, and misrepresentation we get with a vengeance. The only characteristic exceptionable about "H. G. E.'s" experiment at the business is its extraordinary comparative insignificance. I am not surprised that he deliberately misrepresents—I am astounded that he deliberately misrepresents so little. There is, doubtless, every excuse for his leniency, though. This is probably his first try at the game. He is, as yet, merely a tyro at it, and is only just "getting his hand in." Judging from his present effort, however, I anticipate great things from him in this direction. I will even dare to prophesy in the matter. All uninured as he is to the fashionable pastime of baiting Socialists, he has already, in addition to shining in the small performance I have mentioned, unearthed the fact that Socialists, to adopt his own classic phraseology, "want to reverse things, so that they can occupy the places of employers and capitalists; and they are prepared to go any length to achieve the object, even to driving the capital [*sic*] out of the country" (!!) Yes, certainly "H. G. E." has a brilliant future before him. Practice makes perfect. In a very short time, if he continues his present rate of progress, he may reasonably be expected to discover that Socialists also yearn continually day and night to capture the Flying Devil of Fleet-street, and to run off with the Monument!

"H. G. E." next objects to the two examples I brought forward to prove that the condition of the English workers has not been ameliorated all round. He apparently did not trouble to read the letter which I attacked. In that letter the assertion was made that "*all classes* . . . . are better paid for labour, and work shorter hours." "*All* classes," observe! Could any statement contain less ambiguity? And yet I am accused of irrelevancy because I named as examples *two* classes, at random, out of *all!* And those two, moreover, by no means the worst! Why, I might have instanced, among a score of others, the matchbox makers, slaving all day and nearly all night for 2½d. per gross! Perhaps my opponents can discern some improvement, as regards hours and remuneration, in the condition of *this* specimen "class"! Really, there is no pleasing these capitalistic cavillers. They only pretend to show fight at all because they find themselves driven like rats into a corner. The factitious and fatuous objections I have indicated will serve to show the uninitiated and the unsophisticated to what desperate expedients the upholders of the present capitalist want of system have to resort in order to find any answer whatever to the unanswerable arguments Socialists hurl against them.

It is fortunate for "H. G. E." and "B. R." that my space in these columns is not unrestricted. I could go on exposing their fallacies and absurdities almost indefinitely. For the present, one more point must suffice. "H. G. E." heroically undertakes to show "how worthless are my facts." "One example," he bravely prefaces, will be sufficient (*sic*). What is the example? He tells us he finds that "B. R.'s" figures relating to population in 1871 and 1881 "include Ireland." Well? With all due deference to "H. G. E.'s" superior information as to what my letter contained, I was not aware that I disputed the accuracy of this statement. On the contrary, I was under the impression that I assumed the statistics on the subject of population to include all four divisions of the British Isles; and, what is more, I admitted their accuracy. What I objected to, and what neither "B. R." nor "H. G. E." has a word to say in defence of, was the "lumping together" by "B. R." of the figures relating to Ireland with those of England, Scotland, and Wales, and then his crowing over the fact that an increase was still shown. In that increase, I contended, Ireland did not participate. "H. G. E." endorses my contention, and proceeds to prove that not only did Ireland's population not increase during, for instance, 1871-81, but that it really *decreased*. Furthermore, he actually quotes figures, and puts the decrease during that time at "about 240,000"! Where, now, does the point of the "so much for Socialistic facts" remark come in? Out of his own mouth is he judged. Certes, when these capitalists and their hacks do venture into print in support of their preposterous claims, they make our task of refutation *too* easy.

In addition, however, to all this, "H. G. E." wilfully evades the real issue. I referred to the decrease in the population of Ireland "*during the last few years*." "H. G. E." disputes the accuracy of my general estimate, and gives me the figures, not for the "last few years," but for "1871-81": It must be as difficult for "H. G. E." to understand correct English as it is for him to write it. What, pray, have the figures quoted to do with the "last few years"? What have they to do with the point I raised. And how do they injuriously affect my contention? I have to inform "H. G. E.," as he appears ignorant of the fact, that we are living, not in 1881, but in 1886, and that, therefore, except to the fervid imagination possessed by himself, it is somewhat hard to suppose the phrase "last few years" implies the period "1871-81." The terrible years for the Irish people which immediately preceded and followed 1880, and which saw evictions alone at the rate of *one thousand per week*, are the years to which I referred. During the fearful winters and redemptionless summers of the years I name, those two effective clearing agencies, starvation and emigration—euphemisms for the rack-renting landlord and the speculating colonial capitalist—between them managed to slay or deport unnumbered thousands of one of the noblest races that ever inhabited this globe. Unnumbered, did I say? Unnumbered, perhaps, in the cold-blooded official statistics among which "H. G. E." grubs and gropes; but I at least am content to believe that the All-Father who numbers the very hairs of the heads of His children, will not see thus dealt with, impunibly, the lives of the innocent, the helpless, and the wronged. **A Socialist.**

POLARISATION OF LIGHT—BATTERIES—THE OPTICAL LANTERN—SILVERING GLASS.

[26475.]—It is much to be wished that Mr. W. G. Penny would make his exact meaning more clear by some elementary diagrams, without which I cannot be sure that I really understand him. And it is also to be desired that he would make himself absolutely sure of his facts and statements. As it is (and with the saving clause above) it appears to me that he is very seriously wrong in the facts and statements upon which he bases his conclusions. It is at least certain that some of his statements are gravely in error, and he appears also to have overlooked the fact that Professor Stokes and other mathematicians *have* taken into consideration the existence of vibrations in the ether in the longitudinal direction of the ray, as possibly or probably affecting certain phenomena.

There is a cardinal error in the very first paragraph of letter 26466; for the angle of polarisation is *not* that at which the loss of light in either reflection or refraction is "the greatest possible." It is simply the angle at which all the *reflected* light is perfectly polarised, and at which this quantity of reflected polarised light, and of the quantity of transmitted or refracted light *which is polarised*, are equal. The angle at which the "loss of brightness" is greatest is a perpendicular incidence for reflected light, and an incidence grazing the surface for refracted light.

Secondly, in these cases of reflection and refraction, it is a cardinal error to speak at all of brightness being "destroyed" as though it had vanished. It is nothing of the kind. Excepting the very small quantity *absorbed* by the medium—say, glass—or lost by scattered dispersion owing to imperfect polish, no "brightness" is "destroyed" at all. The incident light is simply divided into two portions. What is not reflected is transmitted or refracted, and *vice-versâ*.

So much is certain, and I believe Mr. Penny to be equally wrong in what follows; but not desiring to place any limits to discovery, await a diagram to explain precisely what he means. At present I will only say that, in my opinion, when by *any* possible polarising arrangement light is made incapable of passing the surface of a refracting substance, which really means (in other words) that it is *wholly reflected* therefrom, or wholly *absorbed therein* (as in a tourmaline) it is not "latent," and cannot be restored in any way. I do not possess a pair of prisms cut at the polarising angle; but I suspect Mr. Penny has been misled by some appearance he has not fully traced home to its real cause. Because I am certain of this one point at least: that the brightness he speaks of as "destroyed" is no such thing; it is simply, as regards all polarising arrangements depending on reflection and refraction (the case of a ray stopped by a crystal is somewhat different, but the principle still holds good) *gone somewhere else*. No one speaks or thinks of "non-existence" as he seems to suppose. I have made all the experiments I can think of with three plates of glass, which I suppose him to mean by "mirrors," and am so utterly unable to get any such effects as described that I await further explanation with some curiosity. At the same time, it is well to remark that *prisms* do sometimes produce phenomena apparently anomalous, till they have been properly investigated.

I have read "Cato's" letter on "A good Battery" (26463) with more than interest. Surely he does not need to be told, that if his statements are borne out by facts, there is a moderate fortune for him—sure. The battery he describes at the close—63 volts and 12½ ampères—it is hardly necessary to state, is amply sufficient to run an arc light of over 1,000 candles in an optical lantern. At present this requires 50 to 60 Grove or Bunsen cells at a cost of, say, 30s. per evening of three hours—that is what it really costs in practice. If he can *really* give for the same sum 126 hours, and it is not merely another battery puff, then, unless his battery is fearfully bulky, or expensive, or deleterious, or

dangerous to use, or has some other fatal defect, he has only to get it protected and put on the market, and customers must come in a rush for all sorts of purposes.

While on optical lanterns I may recall a short note in the spring, explaining the difficulty I had found in procuring limes to stand the powerful jets we now have without splitting across. I am glad to find that the well-known "Excelsior" limes sent out this season are from an entirely new source, and so far appear to stand all I have applied to them. I am told the lime is from a foreign quarry; anyway, it is very hard, fine in grain, and is turned beautifully, true as ever, with no signs of splintering out in cavities. As long as this supply may last I would wish for no better, and shall work with much greater comfort this winter.

Can any reader tell me the brightest burner I can get—either oil or gas—within about ⅝in. square as regards flame. I do not expect any *great* light, of course. I hope for perhaps 10 to 20 candles. There is no reason why I should not say that my real object is to get as bright a *simple* light as I can, *the size of a lime-spot* in the lantern, to work out without dazzling the course of the rays in some arrangements I have in hand.

Lastly, can any reader give me and others the formula for silvering glass *with a brush*. I know that small work is done this way—no trough work, but laid on with a brush like paint; and it would be a great convenience to be able to silver a small bit of micro-glass at pleasure. Or can the solution be bought anywhere?

Nov. 8. **Lewis Wright.**

EGYPTOLOGY.

[26476.]—THE point raised by "Memnon" (26418 and previous letters) respects the testimony of the Bible regarding dates, &c. He admits the value of its testimony; but puts it at "rough approximations." On my part, I contend that, while its testimony has some imperfections inseparable from human agency, it is of the very highest kind—not only equal, but greatly superior to all similar testimony which is regarded as sufficient to establish facts of the highest importance.

I adduced evidence sufficient to establish the authenticity of the Pentateuch. "Memnon" has not been quite fair to me here: he says, "The main defence offered by 'Ramases' is that of traditions of the Apostolic age." Now, I have given the earliest Jewish writings back to the days of Moses and earliest Jewish historians, which go back long before the Apostolic age, and are history, not tradition.

In the book of Joshua, for instance, the Law of Moses, the Book of the Law, which had been written and was to be read, is continually spoken of. In the first chapter the very words of Deuteronomy are twice quoted at length by Joshua. There are numerous other connecting links too numerous to mention here. The same holds good of the fragmentary Book of Judges, and of the history of Samuel, of the times and the writings of David and Solomon. And it has been shown that the architecture of Solomon's temple, notwithstanding its splendour and expanded proportions, shows itself, after the image of the tabernacle of the wilderness and Shiloh, to be only a tent no longer portable.

"Memnon" has no counter-testimony, either traditional or historical, to adduce, that Moses did not write the Pentateuch, and so he relies on objections as follows:—

1. Moses's date for the Deluge does not agree with that of Egyptian history. "Memnon" gives a number of authorities for dates, who base their opinions on Manetho and his reference to Menes. Of Manetho I may speak plainly. He pretended to derive his information from certain pillars in the Siraidic land, which had been inscribed in the secret dialect of Thoth before the Flood. Their contents translated into Greek were said to have been laid up in the Egyptian temples by the 2nd Thoth. Now the Greek language was unknown in Egypt at the time alleged. No classical historian condescended to notice this book.

The Christian author from whom we have the little that remains of it introduces Manetho as "a High Priest of the detestable Egyptian mysteries, and as great a liar as Berosus himself." Manetho obviously wrote with a view of astonishing the Greeks by an antiquity exceeding their own, and of which Herodotus, who preceded him, heard nothing from the earlier priests. Touching the dynasty of Menes, we have nothing save in the catalogue of Manetho's Monuments, it has none—its names are found only in the tradition of later days, and the escutcheon containing the name of Menes was the production not of his age, but of that of Ramases. An objection founded on such testimony as this, is worthless, especially as against the honest, straightforward testimony of the Bible.

2. The Scripture referred to by me (Deuteronomy xviii. 11), in reference to the life of the soul beyond death is in no sense doubtful. What could be plainer?

3. The omission of the names of the three Pharaohs is perfectly in harmony with archaic usages of writing. Anyhow, the objection is worth nothing, because it can very well consist with either view, and, therefore, proves or disproves neither.

4. This is a poor objection, and unworthy of "Memnon." The death and burial of a man like Moses would surely be recorded. Such a record would likely be added to his own writings, and before the days of putting a space even between words, it would naturally be joined on to his writings.

5. This objection is of no value, because it may harmonise with either view, and, therefore, proves or disproves neither. Copyists may have added to the margin of MS. a word or a sentence here and there, which afterwards was put into the text. These passages are not numerous. The jarring sects of the Jews, which held different views, forbade such. The one cited by "Memnon" is not one of them; in the original it is, "before the reigning of a king, to the sons of Israel." In the previous chapter a promise is made to Jacob that "kings should come out of his loins."

I am able to refer to Gesenius's words in a friend's Hebrew lexicon; like Memnon, I have no library to refer to, being at the seaside. Gesenius says, "*An age, a generation* of men, in the times of the patriarchs, was reckoned at a hundred years. See Genesis xv. 16, compare verse 13, and Exodus xii. 40. So among the Romans, the word *seculum* originally signified *age* or *generation* of men, and was later transferred." Rightly understood, they do not conflict with the Bible, or invalidate its testimony: to me they vastly support it.

Ramases.

[26477.]—I AM glad "E. L. G." (26446) agrees with me that the Pentateuch is *not* of Moses' age or by his hand. He thinks it is of the time of Saul, and probably by Samuel or his school. I consider that part of it is so; but not nearly all, and that the general editor was Ezra. "E. L. G." says it is a "single work"; but shortly after says it is compiled from older books. That it is a single work is flatly contradicted by itself, as can be easily seen by comparing Exodus vi. 3, where it is explicitly stated that God was not known by the name of Jehovah to Abraham, Isaac, and Jacob, with Genesis xiv. 25, and a multitude of other somewhat similar passages, where we find that word placed in the patriarchs' mouths. To be sure, the translators, with the usual clerical subtlety and daring, render the word Jehovah as "the Lord"; but, as "E. L. G." says about the age of the Pentateuch, "every decently-educated man" knows it is not so.

The ascription of the same story to Abram and Isaac, Gen. xii. and xxvi.; the order in Gen. vi. to take of every living flesh *two* into the ark, with Gen. vii., when all clean beasts are to be taken by *sevens;* the wet or first description of Creation, with the second or dry one; the generations of Adam in Gen. v., where Cain and Abel are omitted, with the previous statements, all bear out the fact that the book is a sort of mosaic, or patchwork, and *not* a single book; especially when one set of these stories are known to be by a writer who always uses the word Jehovah for God, and the other uses the word Elohim.

"E. L. G.'s" remark about Moses' Coptic is funny, as there is no proof he wrote a line for the Jews in that language. If he and the Jews spoke and used Coptic on leaving Egypt, that language would enter deeply into their later language; but notoriously it does not. The few instances that occur are explainable by the intercourse known to have existed in later times, the result of the immediate neighbourhood of the two peoples.

It is well known that the base of the Hebrew is *not* Egyptian; but, as the learned Mr. Sayce says, "The close resemblance between the Phœnico-Hebrew and Assyro-Babylonian languages proves that the speakers of them must have lived together for some time after their separation from the rest of their Semitic kindred." And, again: "The Hebrews themselves, if we may trust the evidence of language, physiognomy, and character, had the same ancestors as the Phœnicians, and at the time of the conquest of Canaan only differed from the people they expelled in being rude nomads instead of cultivated citizens." I am afraid the Coptic books written by Moses for the Jews only exist in the fertile imagination of "E. L. G."

That he is fanciful, arbitrary, and imaginative his letter proves most plainly; but his references to particular subjects are curiously inaccurate. Thus he says the Greek and Samaritan text adds the words, "*and their fathers*, which they had sojourned in Egypt and *Canaan* was 430 years" to Exodus xii. 40, and says the Hebrew Rabbis left them out and otherwise altered the text (the text that "Ramases" would so fully rely on) for some bad purpose. Possibly so; but who is to prove what the original text was? Perhaps the Greeks and Samaritans altered theirs. "E. L. G." has a grand proof that he is right, and refers to the prediction in Genesis xv. 13, which, as far as I can judge, *disproves* his assertions as far as it goes. It says: "And he said unto Abram, know of a surety that thy seed shall be a stranger in a land that is not theirs, and shall serve them, and they will afflict them four hundred years." This certainly does *not* prove they were to spend half the time comfortably in Canaan. Again, Isaac was directly ordered not to go to Egypt (Gen. xxvi.) and everything he could want was promised him. Yet, according to "E. L. G.," he must have been suffering sadly. The reference to Ishmael mocking Isaac is really comical, and the curious assertion that Abraham "set up" Hagar "as a Bedouin princess" is painfully opposed by the text, as is also his statement that the Jews had not (according to the Bible) 600,000 men "able to go forth to war." This is flatly contradicted by the text and by Numbers i. 46, and by Exodus xxxviii. 26, which says that the 603,500 men who were paid for were *above* 20 years of age, and *not* every soul above a month old, as "E. L. G." so fancifully asserts. Again, his reading of Joshua's miracle is plainly opposed to the text, which was always accepted till astronomers proved it to be wrong. In the revised version the translation is not at all like "E. L. G.'s," and we know it would soften it as much as possible.

I never said Manetho's assertions were fully to be relied on. We have no pure copy of his text; but all eminent Egyptologists place the accession of Menes before the date of the Flood, and I think the great antiquity of Egypt is better proved than the historical reliability of the Flood or its date.

Why "E. L. G." approves so much of the Hindoo, Chinese, and Babylonian records, and declines the Egyptian ones, I do not know, especially as the former claims an immense antiquity for that nation, and to them the date of the Flood would be nothing—indeed, they claim too much. I suppose "E. L. G." will fall back on the miserable plea that the Flood is not mythic, and was local. As the Bible says it covered the whole earth, and professes that Noah repeopled the world, I decline to admit any such loophole, or to alter the plain statements simply because they are ascertained to be wrong.

As Osiris plainly is a sun myth, it would be safer for "E. L. G." to assert (though equally wrongly) that Menes was Noah. If "E. L. G." will take up any one or two points I shall be glad to discuss them with him; but his present letter touches on so many points that it is not possible to deal with them all in a letter of reasonable length.

Memnon.

ANALYSIS OF SUGAR—SWEETNESS OF SUGAR OF DIFFERENT KINDS—DETECTION OF GRAPE SUGAR—ANALYSIS OF SILVER ALLOYS.

[26478.]—THE "Analysis of Sugar," so far as required by querist No. 60835, page 227, is not a very difficult matter. Certainly loaf-sugar ought to be wholly soluble in water—at least, when any reasonably small quantity, such as an ounce or two, is dissolved, and the residue should not have an appreciable weight. If any residue is left on dissolving the sample in cold water, "A.W.W." should filter it off, wash it thoroughly with cold water, and dry it at a gentle heat. On then boiling a portion with water, cooling the solution, and testing it with a solution of iodine, a blue coloration will be produced if starch be present. On igniting the remainder of the residue insoluble in water, any insoluble inorganic impurity will remain, and the querist's experience in inorganic analysis will enable him to ascertain its nature. For animal impurities generally it will be sufficient to ignite a weighed quantity of the sugar and weigh the ash. The complete combustion of sugar is difficult, and the ash is often light and easily blown away. Hence it is very desirable before igniting to moisten the powdered sugar slightly with water, and then add a little pure concentrated sulphuric acid. On heating the whole gently the mixture froths and subsequently forms a dry cinder. This is ignited at a dull red heat, and when the carbon is nearly burnt off the residue is again moistened with sulphuric acid and ignited till white. By this treatment the readily volatile, fusible, deliquescent potassium carbonate is converted into the less volatile and fusible potassium sulphate. A deduction of one-tenth is made from the weight obtained, as a correction for the increase due to the use of sulphuric acid.

The querist's statement that the sugar in question is not nearly so sweet as loaf-sugar usually is suggests that the sample is one of starch sugar or glucose. If so, he will find it will give a dark-brown coloration when boiled with a solution of caustic potash or soda. If he dissolves the sample in water, and adds a few drops of solution of naphtha of copper and sufficient caustic potash or soda to produce a clear, deep-blue solution, and then heats the liquid to boiling, little or no

change will result if he be dealing with genuine loaf-sugar; but an abundant yellow or red precipitate will be formed if glucose be present. In the latter case he will probably find the ash, and, perhaps, the residue insoluble in water, to consist chiefly of calcium sulphate. If, by the tests described, "A. W. W." concludes that glucose is present in quantity, while the sugar has the general appearance of ordinary loaf-sugar, I shall be glad if he will send me a specimen.

I may here remark that the statements made respecting the relative sweetness of different samples of sugar are often very misleading. They generally mean that, having tried two or more samples in succession by chewing a lump of each in the mouth, the observer concludes that the latter are the less sweet. But this conclusion may be vitiated by the partial insensibility to a sweet taste caused by the previously-tasted sample. It is similar to the necessity of adding more sugar to a cup of tea drunk after eating marmalade or honey. How often are we told that the sugar used in France is far let sweet than that employed in England; and the statement is generally capped by the assertion that the cause is that the former is made from beetroot and the latter from the sugar cane. This description of their origin is not very exact; but, even assuming it to be true, it is a fact that chemists are not able to recognise any difference between the pure crystallised sugar made from beetroot and that derived from the sugar-cane. In all their properties, both physical and chemical, they are generally regarded as absolutely identical; but occasionally the suggestion is made that a further investigation may establish differences. The sceptics prefer to speak of the two sugars as "beetose" and "cannose." Now, if there really be an essential difference in the sweetening power of the two products, it will go far in the indicated direction. My own impression is that the casual observer is deceived by the fact that the French sugar is commonly very porous, and hence a lump of given size does not weigh so much as an apparently equal one of a denser sugar. Hence the supposed inferior sweetening power. How often we are told that crystal sugar and sugar-candy are less sweet than powdered sugar and loaf-sugar, the fact being that they are all absolutely equal in sweetening power, and are convertible one into the other; but owing to the slow rate of solution of the denser forms they rarely have the opportunity of exercising their full effect on the palate. Crush all to powder, dissolve equal weights of each powder in similar measures of water, and employ equal measures of the solutions to sweeten your tea on consecutive evenings, avoiding a previous use of sweet edibles, and you will have a means of judging fairly of the relative sweetening powers of the specimens. It is an experiment nearly anyone can make, and if extended to glucose, levulose, beet sugar, glycerine, and other sweet bodies, and the results recorded, would be of considerable interest, and would confirm or refute the very questionable statements respecting relative degrees of sweetness which have too long been copied from one textbook to another.

The tests already given for glucose will suffice for the detection of "Grape Sugar" (unanswered query, No. 60278, page 588). The proportion present can be ascertained from the amount of copper reduced from the cupric to the cuprous state by a given weight of the sample. The process is known as Fehling's method, and is described in all books treating of sugar or of organic analysis. There are some other substances which also reduce alkaline cupric solutions, and hence the indication must not be relied on too absolutely.

The method given by the apparatus dealer to "G. E." (see letter 26419, p. 191) for the "Analysis of Silver Alloys" is perfectly good; but the querist does not seem to have sufficient knowledge of chemistry or chemical manipulation to make any analysis by him trustworthy. A little more knowledge would have told him that he ought not to evaporate the nitric acid so completely as to get a blue residue insoluble in water; and if on adding sodium carbonate he got a blue precipitate he should have added nitric acid cautiously, drop by drop, with stirring, till it was redissolved. I did not intend my statement that the "textbooks do not lay sufficient stress on the solubility of silver chloride in saline solutions" to be construed as a verification of the querist's conclusion that "small particles of silver chloride were dissolved by the hot nitrate of soda solution." On the contrary, I believe silver chloride to be absolutely insoluble in aqueous solutions of nitrates only, and in water containing any reasonable proportion of free nitric acid; but to be very sensibly soluble, on the other hand, in aqueous liquids containing metallic chlorides or free hydrochloric acid, even in very moderate quantity, and especially if hot; and to be not absolutely insoluble in pure water.

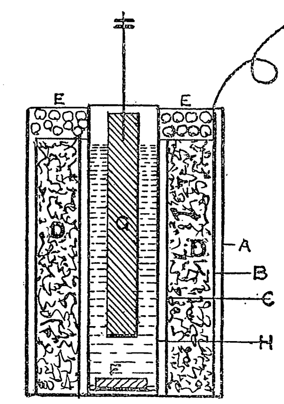
If "G. E." wishes to use the neutral process of determining silver, I should recommend him to put a definite quantity of standard salt solution into a white basin, and add a few drops of a strong solution of neutral potassium chromate. The neutralised solution is then dropped in from a burette, until the red colouration due to the formation of silver chromate ceases to disappear on stirring. If he then makes a precisely similar experiment with a solution of pure silver of the same strength as that of the sample, the relative amounts of the two solutions decolorised by equal measures of the salt solution will give the means of calculating the proportion of silver in the alloy. He can check the result by weighing the chloride of silver precipitated.

I did not intend my reference to the compilation of textbooks on chemistry to apply to Sutton's "Handbook of Volumetric Analysis." That work is decidedly the best on the subject, is in most cases thoroughly reliable, and is written by a practical analyst. If any statement made in it is not borne out by the experience of the querist, in all probability it is because the experience of "G. E." is deficient. Silver chloride should be collected on a paper filter, washed, dried, brushed from the filter into a porcelain crucible, and then heated till just fused. It may be removed from the crucible by means of strong ammonia; but the use of dilute sulphuric acid and a fragment of zinc is in some respects a preferable plan.

Sheffield, Nov. 8th. **Alfred H. Allen.**

THE DANIELL CELL FOR ELECTRIC LIGHTING — THE SCRAP COPPER CELL.

[26479.]—Having been very busy of late, I had quite overlooked "Nemo's" query (60523) *re* above. I should specify six 10-volt 5c.p. Woodhouse and Rawson lamps (I know these to be good from actual use), to be run up to about 7 or 8c.p. each. Although this shortens the life of the lamps, yet this is of secondary importance when such costly fuel as zinc furnishes the electrical energy to light them. These six would light the room very well; four would do it fairly. From experiments with the Daniell for large current, I should recommend "Nemo" to construct his cell according to the inclosed sketch, showing the cell in section.



A is the outer jar of well-glazed earthenware, 12in. high, 8in. in diameter. B, cylinder of very thin sheet copper, with a strip soldered to it for connection. C, another cylinder of sheet copper perforated. The space between B and C is filled with copper scrap. D, cuttings from sheet, &c., any shape, and packed closely to a height of 10in.; upon this is laid a sheet of copper, perforated, to hold the supply of crystals, E, of sulphate of copper, which must be replaced as they dissolve in the solution, which they will do in proportion to the amount of current passing. After the solution is saturated, these crystals do not dissolve when the battery is idle. F is the piece of zinc (unamalgamated) not in contact with G, to reduce any copper which comes through the porous pot H; this may be omitted if only a short run is required.

The solution of sulphate of copper in the outer cell should be about ½in. or so above the crystal shelf.

About fifteen cells would be required to light six lamps. The scrap copper can be bought at the price of old stuff—about 4d. per pound. The copper cylinders made of No. 30 B.W.G. copper sheet; this is ·012in. thick; it is made in sheets 24in. by 48in., weighing about 4lb. per sheet. The glazed outer cell can be dispensed with, and the copper cylinder itself made to take its place, with a bottom soldered in. Canvas porous cells can be used, but not so satisfactorily as the proper porous pots prepared according to my previous instructions—use 75 parts weight of paraffin wax, and 25 parts tallow. If "Nemo" requires any more information he may communicate privately with me—that is, if he wants prompt attention, and he decides to go on with this affair, especially as the dark nights are on us already.

I suppose the "wonderful" lamps are exploded. This is my experience with two—one called a 2½c.p., the other 5c.p. R. *cold*, of one (2½) 4·7 ohms, the other (5) 4·5 ohms. E.M.F. on lamp (on the ticket sent by makers) six volts. The R., hot, would be about one-half, or about 2·5 ohms, requiring, therefore, about 2·4 ampères. With this current they give a good light—probably 5c.p., not more; therefore, three watts per candle-power is the value of their efficiency. They are cheap and good, but certainly not "wonderful."

Middleton, Lancs. **F. L. Striffler.**

CALCIUM PYROBORATE.

[26480.]—I have been in communication with Col. Ross on the subject of Blowpipe Analysis, but he having gone abroad, and a letter I sent him, hoping that it would be forwarded, having been returned to me, I write to the "E.M.," hoping that the penetrative power of "our" paper may bring this to his notice.

This explanation will, I hope, relieve me from the charge of egotism, if I quote from a paper of mine on Calcium Borate which appeared in the *Chemical News* of October 22nd, and refer those interested to the paper itself.

It will there be seen that taking pure caustic lime or its carbonate as a starting point, and treating it with excess of boric oxide in a Fletcher's gas furnace, I obtained a fused glassy mass, which remained perfectly distinct from the surrounding boric oxide, and was of precisely similar appearance to the calcium borate balls obtained before the blowpipe.

Synthesis and analysis of this substance showed its composition to correspond closely with that of the calcium analogue of borax—i.e., CaB_4O_7. This body is fairly well known, and is also found native, hydrated and crystalline, in Peru; but its formation under the conditions described and its characteristic appearance I do not find mentioned. A possibility exists that the compound formed pyrologically may contain a larger proportion of boric oxide, for it is a characteristic of boric oxide to combine with bases in different proportions according to the relative quantities present and the temperature to which it is subjected. This is borne out by the observation that a large excess of boric oxide and prolonged heating had a tendency to form compounds containing less lime than is demanded by the formula CaB_4O_7, and coming nearer to the composition put forward by Col. Ross—viz., CaO 25 per cent. and B_2O_3 75 per cent.

B. B.

ORIGINAL ELECTRIC EXPERIMENTS — A NEW ARRANGEMENT OF ELECTRIC MACHINE.

[26481.]—In following out these experiments, I discovered what appears to me to be a new feature in frictional electrical machines. Thus, if we lay a piece of tinfoil upon a sheet of glass, and apply a rubber underneath the same, then, similarly to the manipulation of an electrophorus, if a finger be applied to the foil whilst the rubber is underneath it, much more electricity will be given off from the aforesaid foil upon the withdrawal of the rubber. This showed me that the ordinary disc electric, as seen in the shops, is wrongly constructed, there being a pair of rubbers opposite to each other at the opposite sides of the diameter of the disc. Now any rubber will only develop electricity proportionately to its area, and, as I have found, it possibly develops more, and that also in a greater state of tension, upon the opposite face of the glass to that upon which the friction is applied. Now, as electricity cannot be accumulated upon any rubber by continued rubbing beyond the quantity normal to its area, it follows that if one rubber be applied opposite to another, the electricity formed upon the opposite face escapes away through each cushion. In accordance with these considerations I have constructed the machine as figured, and it gives off a large quantity of electricity. It occurs to me that I may here state that, upon a careful study of the molecular theory, as explained in "Sigma's" (Mr. Sprague's) book upon electricity, it seems to meet the necessities of the case better than any other of which I am aware.

Fig. 1 is a back elevation; the disc is 26in. diameter, carefully selected, and only $\frac{1}{16}$in. full in thickness. The face was covered entirely with tinfoil pasted on, and to lay this on smoothly I used a rubber of flannel upon a piece of, say 6in. by 2½in., and kept wet whilst gently pressing out the superfluous paste; then, with a sharp-pointed knife and straight-edge, it was divided into 16 sectors divided from each other by ½in. spaces of glass, and when mounted *in situ* we must strike a circle of 5¾in. towards the centre of same, to insulate it from the boss upon the opposite side. This boss is made of two pieces of mahogany with grain reversed, and measures 3¾in. by 1in., and is affixed by means of the cement I have already mentioned in these pages, and could only be removed by smashing all in bits with a hammer. The spindle to which it

FIG. 1

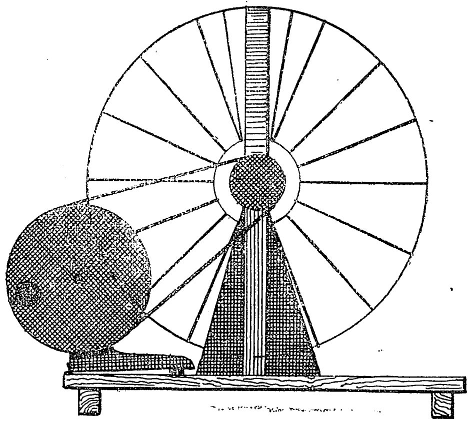


FIG. 2

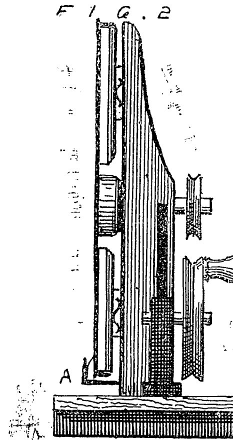


FIG. 3

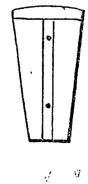
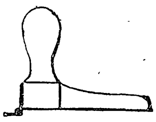


FIG. 4.



is attached by means of a brass faceplate and four woodscrews is a piece of brass tube ½in. diameter and 5¼in. long; this carries the mahogany driving-pulley, which is 3½in. by ¾in., and tightly fitted on same. This spindle fits accurately into a piece of iron gaspipe 4in. by ⅝in. rymered out and driven moderately tight into the standard at 15in. from the baseboard, which latter measures 29in. by 11in. by 1in., with two stiffening pieces, one under each end. The standard measures, including 1in. for mortice, 29½in. by 4in. by 1¼; it is better to divide the foot into two tenons, so as not to weaken the baseboard too much. In order to stiffen this against the strain of the band, it is well to glue and sprig on the two triangular pieces, as shown, say ½in. back from the edge of standard, and made out of ⅜in. timber. A shows the piece of small tube bent to a right-angle, one end tapped to screw into the standard, and having a couple of inches of the wire off a violin bass string fixed by a little peg, so as to touch each sector as it travels over the rubber. Fig. 3 shows the back of one of these. They are made of pine ¼in. thick, stiffened, as shown, by slips of, say, ¾in. square glued on to keep them flat. A piece of ordinary drugget is cut to same size, and kept in position by a piece of lining paper, which overlaps and is glued for, say, ½in. upon the back, which is in view. The tinfoil ought only to be cut and pasted so as to cover the front face, and not to communicate directly with the wood. Two French wire nails, with the heads cut off, form steady pins when driven into the standard to carry the cushion; and springs to keep them gently pressing the glass may be either of indiarubber, or thin sheet steel, such as that in the dresses of the ladies of the period. The glass can be slightly lubricated with ordinary paraffin oil as required, both to lessen friction, and to counteract the effects of a damp atmosphere. Fig. 4 is the piece of wood which carries the driving-wheel, being fixed to a well-made hinge, as shown, 2½in. long, so as to enable the band to be tightened by means of a wedge, and slackened when not in use. This measures 8½in. by 2in., and with its lever, 8½in. by ½in., and stud to carry driving-wheel, and this with a corresponding V-groove and handle, as well as a band of gut, or leather, or sash-line, completes the machine so far as experimental purposes require; but the framing may be ornamented, if so desired, to suit the requirements of the owner. It will be well to give all exposed glass upon the front face, say, two coats of shellac varnish, also all around the outside diameter and edge of the glass and tinfoil, but, of course, not upon the rubber side of same, nor under the foil sectors. The framing may have two coats of mahogany varnish, or else the shellac. I use a Leyden jar, or a conductor, as required, standing in front of the machine, each being provided with a piece of tubing with a single fine wire, as before mentioned, at each end, and curved so as to all but touch the sectors upon both sides of front face.

Nov. 5th. **A., Liverpool.**

GRAVITY.

[26482.]—THE question raised in this journal a few numbers back, respecting the behaviour of a body falling through a hole through the centre of the earth to the Antipodes branched off into some side issues, but was not satisfactorily answered. What shape the hole must be, or what course the body would take, may be left to be discussed. One correspondent affirmed that it would traverse the distance in about an hour, and would pass and repass the centre until it finally settled there. This is assuming that the rate of fall would increase in the same proportion as it does from above the earth to its surface, up to the centre, and then diminish in the same proportion, until it nearly reached the Antipodes. But that is just what requires proof. Is there any peculiar virtue, so to speak, in the centre? If the attraction which a body exercises is due to the sum of its parts, the matter nearest the falling body must exert the greatest influence, and that furthest from it the least. The centre then would be in the exact middle position, and the nearer the body approached it the less would be its velocity. This is assuming the density of the earth to be the same through its whole mass. Two pieces of cork floating in a glass of water will attract one another. Is the attraction due to the size of each or the weight? A pendulum vibrates at a certain rate on the surface of the earth. Is its rate due to its length or its weight? It is said to vibrate quicker in a deep mine. Is this because its weight is increased? Is its weight increased?

In the experiments that have been made has the question of the density of the surrounding strata been taken into consideration? Have the results always been identical? The theory has been lately advanced that the surface of the earth is solid up to a certain distance, then liquid, and then solid again of a much greater density. Does not this seem to bear its own refutation? If there be no weight at the centre there can be no specific gravity; the words have the same meaning. Is not matter that has the least specific gravity of a gaseous form, at least so far as we know? Would not the natural change be solid to liquid, liquid to gaseous, gaseous to what?—the ether that surrounds the world and fills space—if there be ether.

It has always been a subject of wonder that gravity has not more attracted the attention of science. Its law of attraction has seemed the only point of consideration. What is gravity? What is this wondrous force that molecules so small that human skill has never been able to isolate them, exert over each other? What is centripetal force that is always drawing the earth to the sun, and centrifugal force that is always resisting it? What is attraction of cohesion and attraction of repulsion? Is it chemical affinity, or motion, or supernatural force? Can it be increased and diminished at will? A core of soft iron with a certain current passing round it has its attraction increased, so that it attracts with more power certain substances. Can anything like it be done with other substances? The imagination may wander off into endless speculations as to the results that would follow could we neutralise the force of gravity in bodies, or increase it at will.

Has anything ever been attempted or done with gravity, save ascertaining the fact that it exists everywhere and in everything? **Angulus.**

THERMO-BATTERIES.

[26483.]—IN the *Minutes of Proceedings* of the Institute of Civil Engineers," issued July, 1886, there is an abstract of a paper by Wilhelm Penkert, on the "Transformation of Heat into Electrical Energy, and the cost of the latter in the case of Galvanic and Thermo-Batteries and Dynamo Machines," in which the following table is given as to the cost of 500 Watts per hour by the several methods mentioned:—

	Shillings.
Daniell's element	1·06
Bunsen element	1·51
Thermo-Batteries:—	
Rebeick's star form	5·65
Rebeick's straight form	7·17
Clamond's, heated by gas	16·03
Clamond's, heated by coal	0·42
Dynamo driven by steam	0·10
Dynamo driven by gas	0·25

From this it appears that Clamond's thermo-battery heated by coal is a very efficient and cheap source of electrical energy, and if it can be made cheaply, I should think it would make a good substitute for the dynamo and gas-engine for charging accumulators used in household electric lighting, and the current might also be used direct to drive motors.

In looking through my back numbers, I find that little has been said in "Ours" on the subject of thermo-batteries since 1876, when a letter appeared describing Clamond's battery heated by gas. The E.M.F. of the elements, which are sheet iron for the positive and an alloy of two parts of antimony and one of zinc for the negative metal, is stated to be $\frac{1}{20}$th of a volt with a difference of temperature of 200° Fahr. This, I think, must be a mistake, as, according to Dr. Stone's experiments (ENGLISH MECHANIC, Nov. 26, 1875), the E.M.F. of a pair composed of German silver and the antimony-zinc alloy was only the $\frac{1}{108}$th of a Daniell cell, with a difference of temperature of 80° C., and the iron and antimony-zinc couple has a less E.M.F. than that of the German silver and antimony-zinc couple just mentioned.

From the information that I have been able to get so far, it seems that 155 iron and antimony-zinc pairs would be required to give an E.M.F. of 1 volt, with a difference of temperature of 80° C.; and 44 bismuth and antimony pairs would not give more than 1 volt under the same circumstances, although Fleeming Jenkin (chap. 12, p. 183) speaks of a bismuth antimony pair being prepared "having, say, an E.M.F. of 100,000 micro-volts, or about $\frac{1}{10}$th the E.M.F. of a Daniell cell, while the resistance might be reduced to almost any desired extent by increasing the section of each element."

There must have been many improvements made in thermo-batteries within the last ten yeass, and letters on the subject from your scientific correspondents would, I am sure, be very instructive to many of us. An account of Clamond's improved thermo-battery, or of any new thermo-electric combinations and their comparative powers, would, I am sure, be most interesting.

I believe that it is only a question of time when thermo-batteries will take the place of all galvanic apparatus for the production of powerful currents at a constant potential. **J. G. H. B.**

A NEW (?) ELLIPSOGRAPH.

[26484.]—THAT the arrangement described in the ENGLISH MECHANIC of Oct. 22 produces a correct ellipse may be mathematically proved as follows:—

Referring to the figure already given, and considering each link as a rigid line, let $ad = bc = m$, and $ab = cd = n$. Join bd. Then in the triangles adb, dbc we have $ad = cb$, $ab = dc$, and bd common to both. The triangles are therefore equal, and the angle adb = angle dbc. Hence $ed = eb$, and therefore $ae + eb = ad = m$. The sum of the distance of the point e from two fixed points, a and b, being a constant quantity, it follows that the locus of e is an ellipse of which a and b are the foci. The major axis is m, and the minor axis $\sqrt{m^2 - n^2}$.

Charing, Kent. **J. R. Campbell.**

CHAMBER MUSIC AND MUSICAL INSTRUMENTS.

[26485.]—YOUR correspondent, "Musik Freund," will find a useful series of four papers on "How to Play Beethoven's Sonata's," by Lady Benedict, in the *Girl's Own Paper*, Vol. III.

After reading the fifth part of Mr. Audsley's notes on the chamber organ, it must be, I think, clear to all your musical readers that the chamber organ of the future will hold a very different position to that which it has held hitherto, and I, for one, am delighted that it should be so. Simply as a means of producing music, pipe against reed, argument on their respective merits is impossible, and were it even possible, would be ridiculous. It is simply for its marvellous power and beauty of expression and admirable adaptability in so many ways for home music in comparatively small and unpretentious homes that I place the Mustel organ so high, although, indeed, it is in place amid the highest art surroundings, and would be a worthy companion for such an instrument as Mr. Audsley describes. Gladly do I accept his invitation, conveyed through these columns, to see his organ, and I thank Mr. Editor for opening up to me such a vista of delight. I shall be glad to oblige our friend "Unanium" by giving to your readers the result of my visit, if you, Mr. Editor, care that I should do so. I hope that before many days are over Mr. Audsley will see my Mustel. I will ask him to give in your columns what he thinks concerning it. The views thereon of such an authority upon chamber music would, I think, be very acceptable to your readers, and must carry with them very great weight.

Country Solicitor.

MIDLAND EXPRESSES AND GRADIENTS.

[26486.]—SOME interesting accounts were given lately by "P." and "Kappa" of five runs with the Midland expresses. They have expressed surprise at the high speed of down trains between Radlett and St. Alban's, as the gradient is stated, in Mr. Foxwell's book, to be 1 in 176 up "past St.

Alban's." I think there is a slight misunderstanding here. I cannot lay my hands at this moment on the Midland section map, but, speaking from memory, I believe the ascent of 1 in 176 does not begin until about the 18th milepost, whence it passes St. Alban's to about the 23 m.p. It is succeeded by a fall of 1 in 200 for nearly three miles from Elstree summit, and it is down this bank that that high speed is generated which is gradually reduced while ascending the subsequent 1 in 176. A glance at the speed table given by your correspondents will show this very plainly, as after the 18th mile there is a prompt diminution of velocity.

I frequently timed the special at 65 miles an hour for two or three miles after Radlett, with down trains of twelve to fifteen coaches; and on one occasion, with No. 1567 and seven coaches, a speed of 70 miles was attained on the 16th mile.

"Kappa" quotes a good run with the 3.40 p.m. down train (engines 1477 and 1741, and 21 coaches); but, good as it was, there was nothing exceptional for that line. I have been in the 3.40 with 15 coaches and only one engine—No. 1478, the sister engine to the one which acted pilot in "Kappa's" trip—and the run from St. Pancras to Bedford (49¾ miles) was done in exactly one hour, the following length to Leicester occupying 63 minutes. The last three miles of the Sharnbrook bank were run up without a pilot, in five minutes, and the 17 miles from Leagrave to Bedford, stopping at the latter place, were descended in 16½ minutes, the highest speed being 73 miles an hour.

"Kappa" asks, "Is 75 miles an hour often done down the bank of 1 in 90 between Park Forest and Merfle, and if not, why not?" In my experience it is not often done, because of the curves, junctions, and necessity for being always prepared to slacken. When the trains are in good time, which I found to be generally the case, there is no need to run fast down-hill, and they go down at a steady pace of 50 or 55 miles an hour. When late I have known speeds of very nearly 75 miles an hour run down that branch; but this is quite exceptional.

Much has been said lately about the Midland, Leeds, and Scotch expresses losing time. I am able to say, from large experience, that time is very seldom, if ever, lost in the running, unless through slackening for signals. On the contrary, my experience has rather been that of your correspondents "P." and E. A. Speed, with Nos. 1337 and 1,741. I have known the 12.20 down make up nine minutes between Kentish Town and Nottingham. The conditional stop at Chesterfield often causes loss of time with the up trains, as they cannot run from Sheffield to Nottingham in 52 minutes, and stop at Chesterfield out of it.

The 1740 class engines have come out since I left England last year. Have they 19in. or 18in. cylinders? Both have been attributed to them in these columns. Also, what is their heating surface as compared with classes 1327, 1562, and 1667?

Charles Rous-Marten.

Wellington, N.Z., Sept. 22nd.

CARBONATE OF MANGANESE.

[26487.]—In reference to the paragraph in yours Nov. 5th, page 212, the discovery of this ore in North Wales is not of recent date. I have farmed large quantities of this same mineral from the same neighbourhood for fully ten years past, and am prepared to supply almost any quantity.

Geo. G. Blackwell.

BODY FALLING FROM A TRAIN IN MOTION.

[26488.]—Laying aside the resistance of the air (see letter 26448), the falling body will describe a parabola relatively to a fixed surface, or a straight vertical line relatively to a vertical plane carried by the train. Mr. Potts is confusing the fixed with the movable planes. **Glatton.**

ADJUSTABLE SPANNER.

[26489.]—Is this not an unnecessary complication of a well-known form of spanner—Bauer's patent? **H. S.**

An Ice Cavern.—It is reported from Vienna that a great ice cavern has been discovered on the southern slope of the Dachstein, or Schneeberg, the very conspicuous lofty mountain in Lower Austria which is visible from the ramparts of the capital. The general direction of the cavern runs from south to north, and it has been explored for a distance of 600 mètres, a sharp precipice seemingly 14 mètres deep having stopped for the time further progress. The cavern is from 5 to 6 mètres broad, and very lofty, giving the impression that the ice is enormously thick. The explorers are of opinion that a subterranean lake will be found in the cavern.

REPLIES TO QUERIES.

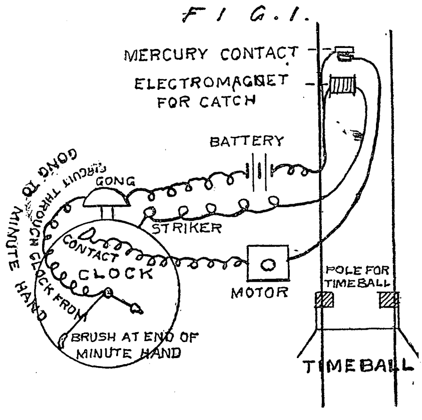
*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60137.]—**Marking Ink.**—To Mr. Saml. Ray.—I have lately tried the marking ink for which you gave a recipe in the "E.M." of 20th August last, and found it too light in colour, and so thin that it ran when used on long-cloth. I therefore doubled the quantity of gelatine, bichromate of potash, and nigrosine, adding only very little water; but the same defects—want of blackness and too great liquidity—prevent me from using the ink. Perhaps Mr. Ray can kindly tell me how to correct these. I find that the nigrosine—i.e., aniline black obtained from an unexceptionable source—is not a good black, being too brown. Chloride of lime (so-called) removes the ink.—L.

[60275.]—**New Banjo.**—The great difficulty in making a brass Dobson banjo is this: you cannot heave down the vellum without having to remove the pan (and in your case the staff), which would be very inconvenient when about to perform. If you turn the bolts upside down, it means a very thick flush hoop, independent of the unpleasantness in having the ends of the bolts digging into your wrist while playing, and when made it would be very heavy. My advice is: If you must have a Dobson, make it of wood; if a metal one, make a modern silver one. It will cost less, have a better tone, look better, and be saleable.—Sam Koe.

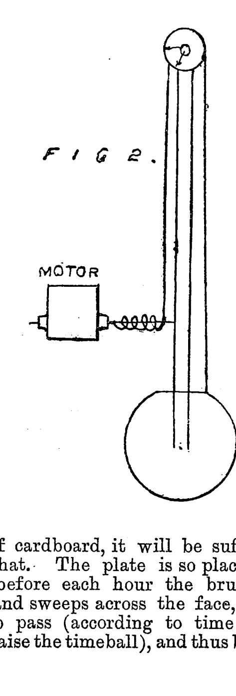
[60316.]—**Electric Time Ball.**—To "Original Querist" and "Watchmaker."—The accompanying sketch gives circuits, further developed.

FIG. 1.



On second thoughts I have dispensed with relay. The gong is connected electrically either through framework of clock or by a special wire to the minute hand, which carries a little brush at the point composed of a few short pieces of fine platinum wire, like the connections of incandescent lamps are made of. The contact piece to which one battery wire is attached is also a little platinum plate, mounted on a small block of wood or vulcanite to insulate it from clock face. If the

FIG. 2.



latter is of cardboard, it will be sufficiently insulated by that. The plate is so placed that a few minutes before each hour the brush at end of minute hand sweeps across the face, taking, say, a minute to pass (according to time required by motor to raise the timeball), and thus by completing the motor circuit, for a time raises the ball. The time ball having risen breaks the circuit by the mercury contact; the slot in the brass guide sliding on the pole; being long enough to allow the ball to continue rising for half an inch or so after the catch has fallen into the slot, so as not to require too precise an adjustment of the mercury contact. Then when the hour strikes the clapper or hammer of the clock (which must be insulated from the clock, as by a wooden stem, to the metal head of which another battery line is attached, as by means of a very small slack coil of the battery wire, so as not to interfere with the striking movement), closes the other circuit through the electro-magnet at the top of the pole, which works the catch as explained in my two previous replies, and the ball sinks. The gong is connected, as shown, to the battery, and the minute hand by wires soldered to it. The actual mechanism of raising the ball is shown in Fig. 2, being a cord passing through a small pulley in the head of the pole, and carried (if necessary, through one or two small pulleys) to the shaft of the motor armature, which should be made specially long for this purpose, so as to project, say, 4in. beyond the standard, on the side remote from the commutator. All pulleys beyond the one at the head of the pole should, however, be dispensed with if possible, as they put a greatly increased load on the motor. If you are resident in London, and intend putting up one of these timeballs, I should be pleased, if you care to advertise your address, to help you personally in the construction of the apparatus, as I am interested in the matter myself. I should use No. 16 for the wires, well covered for the out-of-doors portions.—E. Conry.

[60334.]—**Falling Bodies.**—The violin string, as cited by "Dubliniensis," illustrates well that a force directed to a centre, and varying directly as the simple distance therefrom, makes a body revolve always in an equal period, whatever the ellipticity or whatever the size of the orbit. In the case of a non-resisting interior of a homogeneous earth, this period would be the same as that of a satellite revolving just above the surface—namely, somewhat under 84 minutes. How I came to make it two hours I cannot tell. It must be to a month of 27·32 days, as the square root of cube of earth's radius to the square root of cube of moon's mean distance, or as $1 : \sqrt{60{\cdot}27^3}$. Whether the motion were round a circle, or to and fro in a straight line, and the path 25,000 miles, or 25in., the period would be the same. "Puck" was able to fly almost exactly twice as fast as a gravitating satellite.—E. L. G.

[60334.]—**Falling Bodies.**—Although "Vulcan" has dismissed my reply to a late question, while coolly declaring himself incapable of discussing it, and though the question that he now puts directly to me is accompanied by a sneer, I will answer it for the sake of some other readers. He asks my authority for saying that every (central) ellipse, described under the action of a given central force varying directly as the distance, will be described in the same time; and he considers that this statement is fit for a work on astrology. This very familiar principle is not a matter for authority any more than a proposition in Euclid is so; but if we must treat it as such, let us refer to one out of the host of authorities on this point —viz., Newton's "Principia," Book I. Prop. X. Cor. 2. There is, however, no astrology in that work. As one reader, at least, "M. York," prefers "Vulcan's" acknowledgedly uninformed opinion to my at least professed mathematical calculation, both of us writing anonymously, I beg leave to mention that the mathematical formula I have given for the axis minor, of which there has been so much to say, follows at once and most easily from the first of the pair of equations marked (5) in p. 160 of Williamson and Tarleton's "Dynamics"; and anyone can make out for himself whether my arithmetical calculation from said formula is correct or not. I repeat that if the earth were spherical and homogeneous, and if a stone could be dropped from the Equator and fall freely through the body of the earth, it would describe, in about 80 minutes, an ellipse whose centre would be at the centre of the earth, whose axis major would be the diameter of the earth, and whose axis minor would be about 520 miles; the stone would miss the centre of the earth by about 260 miles. The earth, however, increases in density in descending, so that the central part must be something about 10, water at the surface being 1. This would prevent the orbit of the stone being an ellipse, and would make the stone pass much nearer to the centre of the earth, probably as near as about 170 miles. It is impossible to calculate this, since the law of the increase of density is not known. Laplace's proposed law of this is believed by Thomson and Tait to be not very wide of the mark; but that is all that can be said of it. There is much of "Vulcan's" last communication that I do not understand; it seems to me to be ironical. I happen to know all about Airy's pendulum experiments in Harton Coal Pit, near South Shields, having read

the original account in *Phil. Trans.* 1856, p. 341; but as "Vulcan" only laughs at anything I say, I will pass it by now. He considers that the pressure at the centre of the earth must be "slight"; in this he differs from the mathematicians. Taking the mean density of the earth at Cornu's figure—viz., 5·56, which is unquestionably the nearest to the truth, and must be exceedingly close to it; it requires only the simplest integration to see that the pressure at the centre of the earth would be, for a homogeneous earth, just about 11,000 tons to the square inch; the actual pressure may be safely estimated, as it is by some, at about 17,000 tons per sq. in.—DUBLINIENSIS.

[60428.]—**Silvering Glass.**—Does it matter if I use finish in the place of alcohol stated in Mr. Brashear's letter, Vol. XXXI. p. 27? Also, is the process good when glass is laid and solutions poured on? Thanking you for the reference, will it be troubling you too much to ask you to state the Rochelle salts process.—G. H. H.

[60455.]—**Chemical.**—I am exceedingly obliged to "Nun. Dor." for noticing my query, and with the following explanations hope it will no longer remain a puzzle to him or any other kind friend who can assist. The mark is to be raised—i.e., in relief—so as to be felt, the pencil to be used dry. I do not require the marks to stand pressure.—W. R. L. R. N.

[60506.]—**L.T. and S.E. Side Tank Engines.**—I believe these engines weigh about 40 to 42 tons.—SCALES.

[60516.]—**Railway Locomotive Returns.**—I think this querist can obtain what he wants in the Continuous Brake Return for June, 1886. It is sold by the Queen's printers.—SELF HELP.

[60524.]—**Hide and Feather Press for China.**—Any of our hydraulic engineers can supply a suitable press.—NUN. DOR.

[60534.]—**Dynamo.**—The best thing "Anxious" can do is to call in an "electrical engineer," who, if he cannot put matters right, will be able at least to put the query in some more definite shape than it appears at present.—C. KERR.

[60538.]—**Formula for Train Speed and Brake.**—In Molesworth's Pocket-book "Goods Fireman" will find some formula which will enable him to calculate what he wants. If he will refer to your back volumes, I think he will find some tables about the action of brakes.—J. P. C.

[60540.]—**Tricycling Matters.**—I agree with "Gamma Sigma" that spade handles are preferable to the cross handle in steering in many ways. There is need for improvement in them, however. For instance, the small chain wheels attached by means of a sunk "feather" to the steering rod, have a tendency to work loose, giving a certain amount of play where there ought to be none at all. I am referring to the new Rudge Rotary tandems. If these small chain wheels could be rigidly fixed to the steering handles, the steering of these tricycles would be excellent, as they are fitted with stuffing boxes; but, with my machine, after a few hundred miles the feather which keys the chain-wheel has worked quite loose. As regards gear, I should much like to know the general opinion held by riders, and gained by experience as to the best-sized driving wheel to be geared to. My machine was furnished with a 48in. wheel geared to 52in. This was very well for ease and speed on the level and downhill, and my wife and I could, by much exertion, climb up most hills we came across. But after a long day with a stiff wind, a moderate hill became a teaser, and I altered the gearing wheels, and my machine is now geared level—viz., to 48in. My opinion, however, is that this is too high. Many journeys are full of steep hills, and to me there is no pleasure in dismounting and pushing, and I think this should only be necessary under exceptional circumstances. I may add that it is not the "personal equation" of the partner in my journeys that is in fault, for that would, in truth, tell the other way.—JOHN BELL.

[60542.]—**Photography.**—What advantage does the querist expect to gain by the use of citrate of silver? Or, to put it in another way, where did he find any mention of its use in photography?—E. G. M.

[60546.]—**Phantasmagoria.**—The oleographs must be transferred to glass for use in the lantern, unless the querist intends to use the reflecting lantern.—E. K.

[60547.]—**Letters on Glass.**—Why not silver first and paint afterwards? The question is rather an incomprehensible one.—J. T. M.

[60555.]—**Sardines.**—It would be altogether unprofitable to guess how the modern sardines are put up; but the true sardine (*Clupea sardina*) is a small fish found in the Mediterranean off the coast of Provence and along the shores of Italy. The fish are washed in sea-water, sprinkled with salt, and hung up in the sun to dry, as may be readily guessed from the fact that the eggs of flies can often be found in them. The fish are then boiled in oil, the high temperature thoroughly cooking them, and are then packed in tin boxes, which are filled with olive oil (should be), and immersed in a bath of brine which is hot enough to drive out the air from the tin, which is then soldered up hermetically. Thyme, bay, tarragon, and other herbs are used to flavour; but the majority of sardines which reach this country come from the Bay of Biscay, and are simply small fish.—SAML. RAY.

[60591.]—**Tempering Springs.**—I am sorry if my fun has given poor "F. G. F." pain. He is quite right as to my knowing nothing of getting the temper of springs with a stick. The plan of using the end of a hammer handle to see if the plate is hot enough to work is, of course, familiar to me; its object is simply to avoid working the steel at a temperature at which it would be injured in quality, and has nothing to do with tempering *per se.*—SPRINGEE.

[60622.]—**Astronomical.**—"D. D., Youghal," cannot have given very much attention to his planisphere, if fancying that with your eye placed "at the South Pole" of a transparent globe, any circle thereon will appear "an oval or ellipse." Your eye must be away from its surface, either within or outside the globe, to see either the horizon or any other circle projected as an oval. With your eye in the surface, every circle thereon that appears not as a straight line becomes a circular one; and the kind of planisphere thus formed (called stereographic) may doubtless solve many problems, and be as useful as he says. But none with elliptic lines will do so.—E. L. G.

[60623.]—**Dynamo.**—TO S. AND E., COVENTRY.—Thanks for your kind information on this head. Could you also inform me (1) if there is any scale by which one can ascertain, on procuring the gauge of wire on the armature of an absolutely strange dynamo, how much current that armature will bear without burning, so that a man having to use a dynamo about the capacity of which he has no statistics, can judge how far he may venture to decrease the external resistance by adding more lamps in parallel, without risking burning the armature, in case the machine should be capable of producing more current than the armature coils will actually bear, as I understand is the case with some good dynamos? I have been told by friends of machines having been burnt by switching on too many lamps at once, and I wish to obtain such information or scale as will enable me to avoid this contingency while working a strange machine up to the maximum capacity short of this. (2) Can you recommend me to any book in which I can find clear directions and tables for calculating the gauge and amount of wire necessary to produce required currents and electromotive forces with various speeds? I am working through Prof. Thompson's "Dynamo-Electric Machinery" in the hopes of finding the information I want; but it seems to my limited faculties terribly complicated and intricate; and as for the long articles with algebraical formulæ published at times in the electrical journals, I cannot make head or tail of them, though tolerably versed in algebra and arithmetic. It seems to me that every formula cited depends on two or three other formulæ or unknown quantities, the means of obtaining which are not shown. I am much interested in electrical science, and having the necessary leisure and means should like to feel myself able to construct a machine to a required power, or at all events make the necessary calculations for the purpose.—TORBAY.

[60638.]—**Mechanics—Compound Wheel and Axle.**—"Novice" is not quite correct in the ratio of the velocity of the handle to that of the weight raised. Circumference of largest axle = 18·8496in. (as he states); circumference of smallest axle = 12·5664in.; difference, 6·2832in. As the rope forms a loop it will be double, therefore height-weight raised in 1 revolution $= \frac{6 \cdot 2832\text{in.}}{2} = 3 \cdot 1416\text{in.}$; circumference or distance through which the handle will travel in 1 revolution = 124·5664in. Ratio of velocity $= \frac{124 \cdot 5664\text{in.}}{3 \cdot 1416} = 40$. Therefore, ratio of velocity of handle to weight raised is as 40 to 1. The power or advantage gained will be, as he states, as 40 to 1—that is to say, 1lb. applied at handle will raise 40lb. by the rope—neglecting friction. This could be obtained by using radii in each case, not circumferences. Ratio of handle to weight $= 20 \div \frac{3-2}{2} = 20 \times \frac{2}{1} = 40$, or 40 to 1.—DUD DUDLEY.

[60690.]—**Wood Carving.**—TO "W. A. S. T."—The meaning that I attach to the term "common ornaments" in this case is, ornaments which are employed to relieve the heaviness of a piece of work, but do not contain any considerable amount of artistic value. Are there not peculiar shaped chisels for marking out the form of the carving? If so, please give their names, as I have to pencil it at present, and when I begin to remove the superfluous wood I lose the marks.—G. H. H.

[60700.]—**To Draughtsmen, &c.**—Take a piece of tinned iron or slate. Draw a circle (as large as convenient) carefully with fine point compasses. Draw a diameter, and starting from diameter, step out circle into as many divisions as you have time and patience for, or use two circles, one inside the other, one for even, the other for uneven divisions, then join the first of each division with the centre, marking what part of a circle each line represents, and you have an apparatus for all time. To find, say, the eleventh of a given circle (smaller than your diagram), describe this circle from the centre of diagram and touching the diameter and line marked 11, and you have your eleventh between these points. Should like to know how you managed with trig. hitherto.—HENDON.

[60700.]—**To Draughtsmen, &c.**—The sector that seems unaccountably so gone out of use, that I have not seen one in any of the instrument shops for years, is merely a single-jointed, broad, folding rule, with the two limbs exactly alike, each having a scale of equal parts and some other scales, all on lines radiating from the centre of the joint. The other scales are usually one of chords to every degree up to 60° or 90°, and one of tangents up to 45°. But very large and good ones, of ivory, or even metal, I think, were made for navigators, with some other lines. The fault of any such tool, with no means of fixing the opening, must always be like that of unstrutted compasses, that the joint is either too easy to be trustworthy, or too stiff to admit of accurate adjusting. There should always be struts adjustable with a screw. The sketch I gave of angle-divider like lazy-tongs was by memory from a patent specification, about three years old. I see how it might be greatly improved, but need not say, as "Workman" only speaks of dividing circles, not angles. But though the former is a far more likely operation to need than the latter, I greatly doubt the remunerativeness of any patent invention for it, however perfect.—E. L. G.

[60700.]—**To Draughtsmen, &c.**—May I be allowed a word in extension of my reply on p. 182, which seems to be not exactly acceptable to "Workman"? It is an old workshop motto that the practical man will do his job while the scheme-a-jack is fiddling with his protractors, &c. Now, first, as to dividing straight lines: Most odd numbers come reasonably near to some number compounded of powers of three and two, and a line can be always roughly divided into these fractions by the eye alone. Thus, given a line to divide into, say, 13 parts, down goes one finger in the middle, and another at half again; this quarter can now be divided by eye into three, giving 12ths of the whole. Now set the dividers at about $\frac{1}{13}$th less than that length, and take 13 steps along the line. Say we do not reach the end by $\frac{1}{2}$in.; open the dividers (at a close guess) $\frac{1}{13}$th that quantity. We shall probably, on re-stepping, find we are "out" by a quantity so small as to require only the minutest touch either way to correct $\frac{1}{13}$th of the error, and give a practically perfect setting. To divide a circle into 19ths (say): if we can get at the radius—i.e., put one leg of dividers into centre, and one on circumference, we can now put both legs on circumference, and get $\frac{1}{6}$th of same. Divide this by eye into 3, and we get 18ths. Now set dividers about $\frac{1}{19}$th less than this; and after stepping round, alter same, not more than $\frac{1}{19}$th of the error: when we are within the slightest touch of the truth. When we have to take more than two steppings before the final correct one, it shows that we have failed to bear in mind that we have only to correct a fraction of the accumulated error dependent on the number of steps taken. And this final tentative process is not eliminated, even though we are able to

> "Declare by lines and tangents straight,
> If bread or butter wanted weight:
> Or wisely tell what hour o' th' day
> The clock did strike, by algebray!"

If the centre of the circle be not accessible, we may caliper the diameter, and halve it by laying off equal distances from both ends, and dividing by eye any small space left in the middle; or if the outside (of a column) is all we have to work upon, we may wrap a piece of paper round it, then divide that at the bench. Even when a small portion only of a circle is available we may lay it out on the board by taking two straight-edges, secured at a suitable angle, and marking where these touch the circle (tangentially). Lay down on the board, and trace perpendiculars from the marked points. These will be radii of the circle, and will cross at the centre, from which the circle can now be struck. There is a simple instrument for enlarging drawings, &c., dependent on the even stretching of an indiarubber cord. Possibly a graduated band might be available for rough dividing purposes by stretching as required. In conclusion, it has been the painful experience of many who, like the writer, once thought themselves very clever, to find that a practical man will do his

work while the theorist is thinking about it, and he remembers, with a sigh, how Mark Twain took a Latinist up the Riffelberg, and yet boiled his barometers for altitude — and for soup! (An allegory.)—NEPHESH.

[60726.]—**Engine Flywheel.**—Many thanks to "T. C., Bristol," for his kind reply. I was thinking of purchasing a 6 or 7-horse second-hand vertical boiler, as the one I have is too small, and working it to say 50lb. pressure, do you think that would do? The pipe that supplies the steam to the engine is $1\frac{3}{8}$in. in diameter. I shall be glad of any information on the subject.—STEAM-ENGINE.

[60728.]—**Steel and Iron Tubes.**—I am much obliged for the reply given to above query by "Engineering, Manchester"; but he does not say if the formula he gives is a safe working pressure for "riveted" tubes, or whether any allowance is to be made afterwards for rivets. Perhaps he will kindly enlighten me.—PERPLEXED.

[60741.]—**Mensuration.**—Turn empty vessel on its side and hold a board against open end so as to half-close it. Fill with sand or grain to the level of the board, and set the vessel upright again. Mark where the sand then stands as "half full," or weigh the water nearly to fill vessel, and pour in half the quantity. Mark as before.—GLATTON.

[60744.]—**Question in Dynamics.**—According to "M.I.C.E., Bath," the monkey raises *m*, and *m* raises the monkey. Will he explain how the monkey can ascend while the rope, which it must continue to grasp, is descending? Surely, when "M.I.C.E." uses the word "bounds," he does not imagine the monkey springing up through the air. Such springs could only be given, if at all, by using the rope to "take off" from—i.e., by increasing the downward pull on it, which, as I said last week, would set the system in motion in rising and the monkey falling. So far as first starting the motion goes, the case is precisely the same as that of a man standing on one scale of a balance and trying to pull himself up by his arms to the end of the beam above him: the more vigorously he tries to raise himself the faster will his end of the beam go down; the beam will right itself when the man simply lets his dead weight hang from it, but the motion of the rope once started must continue and be uniform, there being no force available to stop it. Any fresh effort, if it were possible, on the monkey's part would accelerate it. If, instead of pulling at the beam with our arms, we raised our body by pushing against the scale with our legs, the result would be the same; we should practically increase our weight for the moment and give the scale a downward motion. The experiment may be tried on the new weighing machine at any railway station. Bend your knees before you drop your penny through the slit, and when the index is stationary at your true weight, raise your body by straightening them.—W. A. S.

[60744.] — **Question in Dynamics.** — If "W. A. S." will read again my answer on this question, perhaps he may be induced to reconsider his opinion somewhat. I do not see myself that there is so very much difference between our answers, save as to whether the motion would be accelerating or regular. Mine was that "in practice the jerking of the string would probably add to his weight a slight momentum sufficient to start the other mass, when slow motion would result, accelerating gradually through momentum"—i.e., the weight would go up and the monkey down. His answer is, "on the least contraction of the monkey's muscles in the effort to rise, up goes *m* and down goes the monkey as far as the rope will allow." The problem is not of much importance, as weightless strings and disregard of friction do not come within the range of practical mechanics; but as regards the motion "accelerating through momentum," I reason thusly. We are told by the original query to "disregard friction." Presuming this to include friction of air as well as of pulley (as it seems to me from the tenor of the original question we are intended to do), there would be nothing to stop the weight from rising till the pulley was reached, if the weight had been set in motion by a single impulse, for the force of gravity on the weight would equal the ditto on the monkey (producing the normal equilibrium); and this having been disturbed by the first bound of the monkey, motion would ensue, and would continue (there being no counteracting force, as weight of string and friction are to be disregarded); that is to say, there would ensue motion of mass and monkey respectively upwards and downwards, and both at a regular speed. But our quadruped continues his aspiring course ("begins to run up the string"), and every successive bound of his upward progress adds a fresh impulse to that which has already set the weight in motion; consequently, the latter travels upwards faster and faster, or, in other words, accelerating motion is produced. Even if the resistance of the air were not disregarded, the continual impulse of the monkey's successive bounds would probably more than counterbalance the slight resistance of this, and if so, the surplus force of this continual impulse, however small, would suffice to produce accelerating motion. What does "M. I. C. E." say? He has worked out the matter much further than either of us. I do not quite see what "W. A. S." means by there being a trap in "Humbugged's" query. It seems to me straightforward enough; but if "W. A. S." is right, then "Humbugged" is a very wicked man to set traps at all. There are quite stumbling-blocks enough in this sad world without his adding to them.—E. CONRY.

[60753.]—**Light.**—TO W. G. PENNY.—I am sorry Mr. W. G. Penny has misunderstood my meaning, for I don't *really* think that to say a ray falls obliquely on a surface is to imply that the surface is flat. But what I intended to imply was, that the retina is curved so that the rays *shall be* more nearly perpendicular to it, when one does look to the side of a star; and, secondly, that the vision is formed by a cone of rays of which only *one* is perpendicular. And, lastly, that the looking to the side of a star does not alter the angle of the ray as regards the retina sufficiently to account for the improved vision, in my opinion. Hence my query.—M., York.

[60762.]—**Flywheel.**—If the piston speed is the same, the length of the stroke will not alter the power of any engine. The exact power of your engine depends on the piston speed per minute and the mean pressure in the cylinder; but $6\frac{1}{2}$in. cylinder will give about 4-horse nominal. You can drive direct from flywheel; but as the width of face is only 4in., you cannot use the fast-and-loose pulleys which are on saw spindle so as to stop saw without stopping the engine every time you require to sharpen or change a saw, which will be very often if you are cutting anything over a 6in. batten with such a small engine. The distance between flywheel and saw pulley should not be less than 10ft., or as much more as possible. But I should strongly recommend you to put a small countershaft between engine and saw, so that you can get about 1,100 revs. per minute, and also you can then get a wide pulley to drive your fast-and-loose pulleys on saw spindle, as it is not safe to run a saw-bench without it is possible for the sawyer to stop his saw without having to leave the bench, as a new saw would be completely spoilt if it got hot in the middle of a long cut before the man could get to the engine to stop it, as he could not leave the log without lifting it off the bench or running it back, both of which take time, and in the mean time the saw would have got so hot the temper would have been spoilt, which means throwing away the saw, as a burnt saw is not like one simply sprung, which hammering will put to rights. —MACHINIST.

[60765.] — **Area of Sewer.** — None of the answers to this query are correct, as no allowance is made for the increased velocity of flow in the larger sewers. "Student" does not state the rate of fall; but, for illustration, let us suppose it to be 1 in 500, and that the larger sewers are to be laid at the same fall. The velocity in the 2ft. 0in. sewer running full would be 189ft. per minute. In a 2ft. 6in. sewer it would be 213ft., and in a 3ft. 0in. one 234ft. Therefore, if "Student's" 2ft. sewer carries the sewage of 5,500 persons, a 2ft. 7in. sewer would do for 10,000, and a 3in. 0ft. one for 15,000. I can hardly understand though, if the fall is anything like what I suggest, how so large a sewer as 2in. 0ft. can be necessary for 5,500 persons.—W. W.

[60765.]—**Area of Sewer.**—Let it be *granted* that a sewer 2ft. in diameter *is* sufficient to remove the sewage from a population of 5,500 (and, as a matter of fact, is large enough to discharge 1,205 gallons per minute, or 1,735,200 gallons per day of 24 hours r unning half-full, sufficient for a population of 34,704, allowing 50 gallons per head, at the very low gradient of 1 in 1,056). It is asked, 'What size sewer would be required for a population of, say, 10,000 or 15,000. (In finding the size of a sewer, it is necessary that the amount to be discharged should be first obtained; then the gradient should be fixed so as to enable the sewer to be self-cleansing—that is, the velocity should not be less than 3ft. per second. It will be seen that even a sewer 2ft. in diameter is much too large for even a population of 34,704.) The following formula, which was adopted by the late Mr. Beardmore, will be found very useful in arriving at the velocity—

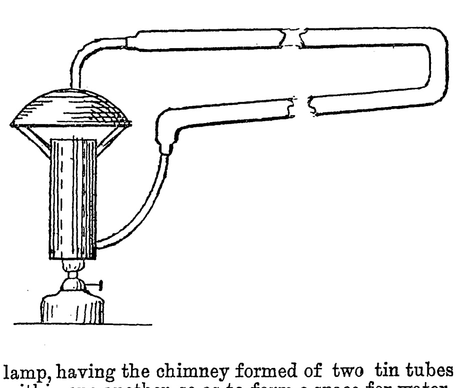
$$V = 55\sqrt{R \times 2H.}$$

R = hydraulic mean depth in feet.
= (in circular pipes) $\frac{1}{4}$ of diameter.
H = fall in feet per mile.
V = velocity in feet per minute.

—FRANK G. COLES, Southampton.

[60776.]—**Boiler.**—Your boiler is very small to drive a 6-horse engine with any amount of success, as you require about 6ft., or better still 8ft., of grate surface, and about 80 sq. ft. of flue surface, which you cannot get in such a boiler without you build side flues. If you do succeed in getting it in your boiler, the only one that will be satisfied will be your coal merchant, as the old dish-end boiler is at the best very wasteful, and when too small for its work, will burn any amount of coal.—MACHINIST.

[60774.] — **Heating Conservatory.** — I send the sketch requested. It consists of a paraffin



lamp, having the chimney formed of two tin tubes within one another, so as to form a space for water. This space is connected to a dome-shaped top, having a flat bottom, the connection being two small tubes. The flow is from top of this, and return to bottom of stem of T.—T. C., Bristol.

[60784.]—**Locomotives.**—I send the following details, which I think will be found accurate:—The Liverpool had cylinders 18in. diameter by 24in. stroke; 292 tubes $2\frac{3}{16}$in. external diameter and 8 tubes $1\frac{3}{4}$in. diameter, all 12ft. 6in. long. Heating surface of tubes 2,136 square feet; of firebox 154 square feet; total, 2,290 square feet. Grate area $21\frac{1}{2}$ square feet; 1 pair driving-wheels 8ft. diameter; 3 pairs carrying-wheels 4ft. diameter; wheel base 18ft. 6in.; length of frames 27ft. Weight of engine, in working order, on four leading wheels 17 tons, intermediate wheels 6 tons, driving-wheels (behind firebox) 12 tons; total, 35 tons. Weight of tender 21 tons. This engine conveyed express trains between London and Wolverton for some time, and in one case took forty carriages within time; but its weight and length proved too great for the permanent way, and it was withdrawn. The principal features in the design of the "Folkstone" were described as consisting in the boiler resting upon three points; one on the centre of a cross-spring, which bears upon the axle-boxes of the driving-wheels, and one on each side in front, on compensating springs, each of which bears upon the two axle-boxes of the supporting wheels. The other principal features consist in communicating the power from the inside cylinders to a crank-axle attached to the frame, and thence by means of coupling rods to the driving-wheels behind the firebox, the rods being arranged to act as "counterweights." The boiler was 4ft. 1in. diameter, 10ft. 8in. long, 184 tubes 2in. outside diameter, 11ft. long, cylinders 15in. diameter, 22in. stroke; driving-wheels 6ft., and carrying wheels 3ft. 6in. diameter, wheel base 16ft.; length over all 24ft. The whistles of the new Caledonian engines are organ whistles. I regret that I can give no information about the North British Railway.—A. W. B.

[60784.]—**Locomotives.**—I am sorry to say I cannot answer the first part of your query, as I have never been down there. The following description of the Liverpool is to be found in D. K. Clark's "Locomotive Engine":—Cylinders, 18in. by 24in.; 292 tubes, $2\frac{3}{16}$in. external diameter, and 8 of $1\frac{3}{4}$in., 12ft. 6in. long; surface of firebox 154·434ft., of grate $21\frac{1}{2}$ft., of tubes 2136·117ft.; total heating surface 2·290ft.; two driving wheels, 8ft. diam.; six carrying wheels, 4ft. diam.; length between centres of extreme wheels, 18ft. 6in.; total length of engine, 27ft.; weight of engine, charged, 35 tons, or 12 tons on driving wheels, 17 tons on four leading wheels, and 6 tons on the two intermediate wheels; weight of tender, 21 tons; total weight, 56 tons. This engine conveyed the express trains between London and Wolverton for some time, and in one case took 40 carriages within time, thus exceeding the combined duty of three ordinary engines. Its excessive weight and length, however, quickly threatened the stability of the permanent way, and induced its retirement from active duty, without impugning its title to be regarded as the "most powerful locomotive in the world." The Folkstone was one of eight engines built on the same plan by Messrs. R. Stephenson and Co. for the S.E.R. The principal features in the arrangement of these engines were described as consisting "in the boiler resting upon three points, one on the centre of a cross spring, which bears upon the axle boxes of the driving wheels at the back of the firebox, and one on each side in the front, on compensating springs, each of which springs bears upon the two axle-boxes of the small supporting wheels. The distribution of weight is for the purpose of preventing oscillation, and at the same time to insure, under all circumstances,

a uniform weight upon each wheel, producing a greater amount of adhesion upon the driving wheels with a given weight than with ordinary engines. The other principal feature consists in communicating the power from the inside cylinders to a cranked axle attached to the frame, the same as in ordinary engines, and thence by means of coupling rods to the driving wheels behind the firebox, the rods being arranged to act as counter weights to the inside connecting-rods, &c., the proper balancing of which is of much importance. In the Folkstone the boiler is 4ft. 1in. diameter, and 10ft. 8in. long; two driving wheels, 6ft. in diam.; and four bearing wheels, 3ft. 6in. diam. The cylinders were 15in. by 22in.; 184 tubes, 2in. external diam., and 11ft. long; extreme length of engine frame, 24ft.; between extreme wheel centres, 16ft.—A. T., Queen's College, Cambridge.

[60799.]—**Screw-Cutting.**—The figures given by "T. C., Bristol," and "Dynamite," are incorrect. The height of a Whitworth thread is ·64 the pitch, therefore, the hole in nut must be smaller than the tap by 1·28 the pitch, not 1⅝ p. A reliable rule for finding screwing size of a nut is to take 1·28in. as a constant, and divide by the pitch to be screwed, subtracting product from diam. of tap. This would make screwing size of 1¼in. Whitworth 1·068in. or 1$\frac{1}{16}$in. full. I gave this rule on Aug. 20-27, pp. 561, 583, and it is easily proved correct. Perhaps the readiest means of finding sizes required by the querist is to take them from a steel rule marked for the purpose, one of which I have. —H. O., Glasgow.

[60801.]—**Mechanical.**—I thank Mr. S. Bottone for answering above query. Will he still further favour me by stating how I may know the resistance of plating bath, &c.?—T. L. H.

[60804.]—**Burgin Armatures.**—The heating is due to heating of the cores, or to an injuriously large current. This excess of current may be due to a partial short-circuit in the machine or leads. Perhaps the machine is running too fast. If the brushes are in wrong positions the E.M.F. and current will be diminished. The heating cannot be due to this cause. In a series machine, if the current through the armature is greater than that through the lamps, it is certain that there is a short circuit somewhere.—G. Bowron.

[60804.]—**Burgin Armatures.**—We have seen a machine called the Franklin (which is a Burgin not made by Crompton and Co.) go on as you describe. The fault, primarily, was excess of current due to bad regulation of the arc lamps; but when the insulation once becomes defective the coils may give way at any minute. You are probably overworking the machine. Take one lamp off and drive slower.—C. D. Barker and Co.

[60805.] — **Accumulators.**— The E.M.F. of each cell rises to 2½ volts when gas is given off. The E.M.F. of 26 cells is therefore 65 volts. The E.M.F. of the dynamo will not be much above this. As the current is proportionate to the difference of these electro-motive forces, it will be much smaller. The power required to drive a dynamo is proportionate to the strength of the magnetic field due to the field-magnets, multiplied by the current in the armature. When the cells are fully charged there is a slight rise in the strength of the field-magnets; but the current in the armature is much smaller than before. The load is, therefore, less.—G. Bowron.

[60806.]—**Storage Battery.**—If I remember rightly, last winter a number of E.P.S. accumulators were fully charged in London, then emptied of the acid and sent to Edinburgh. They were there refilled, and the charge was used to light a large hall one night for a meeting at which Mr. Gladstone delivered a speech. You would want eighteen or twenty accumulators for the arc, and they should have a capacity of at least 30 ampère-hours. A considerable time might elapse between charging and using the current, if the cells were well insulated and the acid left in. Without the acid I cannot say how long, never having tried it. —W. A. W.

[60806.]—**Storage Battery.**—The E.P.S. Co.'s (of Millwall) portable cells will do all you require, and as they are completely closed in at the top like wooden boxes, you could take them from London to Edinburgh, or further, fully charged, taking the precaution of bringing a couple of cells more than the number you actually require to use, in case of one or two short-circuiting themselves and running out (electrically) on the journey. They are rather apt to do this when carried about, especially if jolted, as by trains shunting, and they are very dear in price; but for portability and power within a small space they are the best as yet in the market, and the E.P.S. Co. claim for them a higher percentage of efficiency (i.e., of charge returned in proportion to charge put in) than any other. The sawdust or paper-pulp cells are safe, and do not readily short-circuit, but their percentage of efficiency is very low, owing to their high internal resistance, caused by there being between the plates only about one-tenth or less of the battery acid that there is in even a non-portable cell with felt insulation, to say nothing of cells with "grid" and indiarubber button insulators. If, however, you wish to construct a set of these dry or semi-dry cells for the arc-lamp you mention, I can send you details of construction if you will give address, but it would take up too much space for the columns of "Ours." If you make the cells well and keep them dry and well insulated, you can leave them charged for weeks without any material loss. Accumulators have been thus left for nine months without perceptible loss; but all depends on make and circumstances.—E. Conry.

[60809.]—**Electricity Accumulator.**—Electricity can undoubtedly be stored so as to be commercially practicable, and is so stored every day; but your proposal, taking the minimum even, would be commercially quite impracticable, owing to the enormous cost. To give you an idea, a set were recently made for lighting a station; size of each about 1 yard square by 2ft. deep, containing some 30 plates apiece. It was anticipated that they would give 1,000 ampère hours each. As a matter of fact, they did not; but even had they done so, you would require about 400 such cells, at a cost of about £30 apiece. 10H.P. for 100 hours = 746,000 watts, and even if you had 50 cells in series—i.e., 100 volts (and that is a large number to have in series, owing to practical difficulties that occur with the connections)—you would then require 7,460 ampère hours, which would necessitate eight rows of such cells as those above—i.e., 400 cells—costing £12,000! For very large and long-continued currents like the one you mention, accumulators are quite impracticable, and if you wanted to get 10H.P. available for mechanical purposes, you would have to add on to the above figures 20 per cent. for loss through your motor. The size of accumulator I have quoted may seem large; but in actual practice it is certainly no larger than would be required for a yield of 1,000 ampère hours. There are no doubt cells in the market that profess a greater capacity for the same size; but they simply won't do it.—E. Conry.

[60813.]—**Narrow-Gauge Railways.**—If the chairs and fastenings are in proportion to the rails and sleepers, a speed of 40 miles per hour might be attained with safety.—Libra.

[60815.]—**The Sun's Radiation.**—The thermometer you speak of is a vacuum solar radiation thermometer, and consists essentially of two parts. First, a blackened bulb thermometer; and, secondly, an hermetically sealed and exhausted glass tube, in which the above thermometer is fixed before exhaustion. The difference between an air thermometer and the one in vacuo is the maximum solar radiation you have exemplified from the tables issued at the Meteorological Office. You suppose that if "the sun shines for any lengthened time, the modicum of air confined in the glass containing the vacuum thermometer becomes more heated, and so gives a higher record, &c." Now, this is entirely wrong, and in fact ridiculous, because how can you have "confined air" and an absolute vacuum in the same glass tube? Perhaps you are not acquainted with the fact that terrestrial radiation has an immense amount of influence upon an ordinary blackened bulb thermometer; but when isolated in an exhausted tube from this terrene radiation, the difference between its registration and an air thermometer in the shade at the same moment of time gives the absolute maximum of solar radiance, existing at that specific time. The bulb is blackened because in this condition it is capable of absorbing all the sun's rays. You can prove this by sprinkling some lampblack upon snow when the sun is shining, and watching it sink in whilst the white snow remains *in situ*. The use of the solar radiation thermometer may be employed where large crops and fruit trees are dealt with, to study the amplitude of radiant heat expended in fructifying and bringing organic life to luxuriance and maturity.—A. Treyer Evans, Newport, Monmouthshire.

[60816.]—**Gas-Engine.**—"Engine Driver" does not say who is the maker of his engine. If a Tangye, the explosion is due to too much gas, which causes the mixture to continue burning till the fresh charge is drawn in, which is fired by the still burning gases. If an Otto, it may be caused in two ways: 1st. The charge fails to light, and is exhausted down the exhaust pipe; the next charge explodes, and is exhausted on the top of the unexploded charge, which fills the exhaust pipe; the consequence is, that the charge in the pipe is fired too. 2nd. The cylinder becomes coated with a deposit of carbon, which gets red hot, and fires the gases before the proper time, some firing down the exhaust. As far as I know, there is no danger whatever. "Engine Driver's" explosions are probably due to the latter cause, as the cylinder had to be cleaned out. Could he not get some one to show him how to clean the cylinder?—then he could do it himself. About once in three months is the proper time, or oftener if necessary. I think "Invicta," in Vol. XL., mentioned some way he cured these explosions: would he let us have it, as it would be a boon, for I must say the explosions are rather startling, especially to the uninitiated?—A. Ricardo.

[60820.]—**Chamber Organ.**—I would advise "Taube" to have the following list of stops, as they would form a very complete little organ:—

Great Organ.

Compass C C to A in alt. = 58 notes.

1. Open diapason .... 8ft.
2. Stopped diapason .... 8ft. tone.
3. Flute harmonic .... 4ft.
4. Vox angelica .... 8ft.
5. Clarionet .... 8ft.

Swell Organ.

6. Lieblich gedact .... 8ft. tone.
7. Salcional .... 8ft.
8. Voix celeste .... 8ft.
9. Flute .... 4ft.
10. Oboe .... 8ft.

Pedal Organ.

11. Bourdon .... 16ft.
12. Violoncello .... 8ft.

Couplers.

Swell to great.
Great to pedal.
Swell to pedal.
Octave on great—upwards.
Octave swell to great—downwards.

3 composition pedals to each organ.
Great ventil. Choir ventil.

The materials I should advise you to make the pipes of are as follows:—Nos. 1, 3, 4, of plain metal; Nos. 5 and 10, of spotted metal; Nos. 7 and 8, of tin; No. 2, of oak, with clarabel treble; No. 6, of white wood, selected, and spotted metal treble, from middle C; No. 9, with circular mouths, the blocks, lips, and caps of pear tree, or triangular pipes with inverted mouths; No. 11, of yellow pine; No. 12, if of metal, zinc in low octave, and plain metal upwards, or if of wood, red wood bodies, box wood lips and caps. The vox angelica and clarionet are inclosed in a separate swell box, and form a small choir organ. The vox angelica is carried down from tenor C, with a small stopped wood bass, so is the salcional in the swell organ. Do not borrow basses if possible. The oboe should go through; the clarionet may stop at tenor C. As to cost, you may calculate the whole complete, bought of a builder, at £20 per stop, roughly speaking. As to space it would take up, that depends upon the situation the organ is to be put in. The metal pipes would cost about £30, and the keys £6. This is for the best material and workmanship, not the rubbish amateurs generally get. As to scales, the great op. diapason may be 2½ at tenor C; vox angelica, 1¾in.; salcional, 2in.; vox celeste, 1¾in.; violoncello, 2¼ at 4ft. C.; st. diap., 3½ at C C; gedact, 3in.; bourdon, 7in. at C C C. You will see I do not agree with Mr. Audsley in two matters—viz., the stop nomenclature and having a voix celeste. I consider for a chamber organ a voix celeste very desirable and very useful. The swells should have vertical shutters. If you advertise your address, I will tell you where you may get your pipes as they should be.—Uranium.

[60821.]—**Battery Work.**—To S. Bottone.—Aqua regia or nitro-hydrochloric acid for gilt, and pure nitric acid for silvered articles. Dynamo is much the best for the work. See my advertisements in "Sale Column." Refer to Sprague's work for recipes for plating solutions.—S. Bottone.

[60821.]—**Battery Work.**—To strip gold from a gold-gilt article, and to recover the gold, put the article in strong nitric acid mixed with a little common salt till the gold is removed. The moment the gold is stripped remove the article, then evaporate the solution to dryness, and melt the residuum with potash or soda. The quality is improved by melting three or four times, adding a little nitric each time. Roll out to the required thickness for anode. To strip and recover the silver from plated articles, get an enamelled pot and put strong sulphuric acid and a little nitrate of potash (saltpetre) into it. Place the pot on the fire and boil, then immerse the articles in the solution till the silver is stripped. Add nitrate of potash till the silver is quite off. Then dilute the solution very much with cold water, and place a sheet of zinc in it. This will throw down the silver in a metallic state. When it is all thrown down, pour off the liquid and wash the silver three or four times, then melt and roll out for anode. It will be seen that great care is required in stripping gold or silver, because if the article is kept in the solutions a moment after the gold or silver is stripped, the solutions become deteriorated with the base metal below; but of course this can easily be rectified by refining in the ordinary way if a chemically pure anode of gold or silver is wanted. The question as to whether a dynamo or a battery is best for plating cannot be definitely answered. It really

depends on circumstances. Operations on a large scale are mostly performed with the dynamo; but the battery does equally well if powerful enough for the work on hand.—BOBADIL.

[60823.]—**Electric Star Lamp.**—To MR. BOTTONE.—A small hand dynamo shunt-wound would be best for your purpose. Four 4c.p. lamps in series would have about the same resistance as one 16c.p. lamp; and if thus arranged, could be worked off the same lead. The others had better be used separately.—S. BOTTONE.

[60824.]—**Dynamo.**—To MR. BOTTONE.—To heighten the E.M.F., wind the entire machine with finer wire. To lower the ampères, insert the resistance in the circuit.—S. BOTTONE.

[60826.]—**Small Dynamo.**—To MR. BOTTONE.—Put about 1lb. No. 20 on the armature, 1lb. No. 16 on fields for the series, and 8lb. No. 22 for the shunt circuit. Drive at about 1,800 revs. per minute.—S. BOTTONE.

[60827.]—**Photography.**—No doubt any of the zincographic processes could be utilised for the republication of a book, but the cost would be much more than that of ordinary type reprinting.—B.SC., Plymouth.

[60827.]—**Photography.**—It would be very difficult, and perhaps almost impossible, to reproduce the diagrams you speak of by means of a photo-mechanical printing process, because a clear negative has first to be produced, which would be very difficult from an old diagram. You do not expect to reproduce the text as well? The negatives of the illustrations might be of some guidance to a wood-engraver, who could transfer them to wood blocks, which would serve him as a faithful representation.—A. TREYER EVANS, Newport, Monmouthshire.

[60828.]—**Knife Board.**—Both kamptulicon and linoleum are stuck to the boards by means of ordinary glue, and weighted down.—T. C., Bristol.

[60829.] — **Electric Star Lamps.** — "Stage Fairy" may use for her lamps a small portable battery of eight cells—price £2—which will run 5-candle-power and 2½-candle-power lamps very well. A flexible wire is not easily detected running from the battery to the fairy's batôn, and the lamp in her hair may be lighted by her standing on two small copper discs in connection with the battery.—BATTERY.

[60829.]—**Electric Star Lamps.**—A hand-dynamo should suit your purpose; a 20c.p. dynamo would weigh from 10lb. to 15lb. complete. The 16c.p. lamp should be of low resistance. I should recommend a Bernstein 20c.p. lamp requiring 7 volts 10 ampères, and four 4c.p. lamps of 8 volts 1½ ampère, each to be worked in parallel; the fairy lamps, if requiring 8 volts, can be worked with the 4c.p. lamps. If the voltage is less, a suitable resistance should be attached to the holders of the fairy lamps. The lamps can be arranged to work in series with a suitable dynamo, but an accident to one lamp would put them all out. The voltages and currents are given as examples, though I think they are the most suitable unless the leads are of great length.—G. BOWRON.

[60830.]—**Jaw Chucks.**—I think "A. L. K." will find all the information he requires in the articles on "Amateur Workshop" in the same number in which his query appears.—T. C., Bristol.

[60831.] — **Photography.** — The Dallmeyer R.R. and the Ross R.S. lenses are practically the same in angle, focus, and price; the Dallmeyer wide angle rectilinear takes in a larger field than the Ross portable symmetrical. Of the lenses mentioned I would recommend "Hazir Im" to buy the Ross R.S. and the Dallmeyer W.A.R. I do not think that anyone has as yet succeeded in making the gelatine emulsion, travelling about with it and coating the plates as required—the difficulties are too great; but for this style of thing why not use the old wet collodion process?—it is far superior in these circumstances. I will refer you to a book which you can purchase in Turkey, Egypt, or Russia, in the French language—Dr. Monckhoven's "Manual of Photography." You can also purchase his dry plates in most European countries. I bought and used them in Africa, and found them very good.—B.SC., Plymouth.

[60832.]—**Diatoms.**—In separating them from the mud on the slide, do not use the microscope, but a magnifying glass, a watchmaker's eyeglass, or the microscope condenser will do. The usual way to separate diatoms from the surrounding mud is to shake up well in water and pour off. The diatoms and the mud are of different sp. g., and can be thus separated.—B.SC., Plymouth.

[60832.]—**Diatoms.** — Diatoms are selected, transferred, and arranged by means of a single bristle, which must be fine, and taper suddenly at the end to a very fine point. There is no need whatever for two hairs or a split bristle, which, to my mind, would simply be barbarous tools to work with; moreover, I do not believe anyone ever did work successfully with such tools, although recommended in the early days of "selected" diatoms in textbooks on mounting, but probably at that time only the largest and coarsest diatoms were ever taken in hand. If "No Sig." will advertise his address, I shall be happy to forward him a suitable bristle, and to reply to other questions he may put on this subject.—DIATOM MOUNTER.

[60833.]—**Micro. Objectives.**—You can tell the angular aperture and also the magnifying power by using a ruled micrometer slide (sold by Watson, Holborn).—B.SC., Plymouth.

[60833.]—**Micro. Objective.**—To test the aperture of an objective, take a semicircular piece of wood perfectly flat, say, 24in. by 12in., and mark it in degrees as if making a protractor. Make a sort of carriage to carry the tube of a microscope detached from its stand, and put a wire through one end and into the board at the centre of the flat side, so that the carriage will move round the semicircle. Place a candle a few feet away on a level with the tube in a line with the degree marked 90, and swivel the carriage to first one side and then the other until the flame only shows a small crescent, and add together the angles through which it has been moved. "No Name" should get Mr. James Swift's little book, which will show him this and other tests of the quality of objectives. It was recently advertised in the MECHANIC, price 1s.—R. GILL.

[60834.]—**Noise in Boiler.**—I should think that the rising-pipe projects inside top of boiler, and so allows room for formation of steam. The pipe should be flush inside.—T. C., Bristol.

[60834.]—**Noise in Boiler.**—Perhaps you have fixed the flow pipe on the return pipe of the boiler, or the flow pipe projects through the top of the boiler and causes the steam to accumulate, which would account for the noise. Give more particulars. Did you fix it yourself, or a plumber?—W. W. E.

[60834.]—**Noise in Boiler.**—No doubt it is one of two things—either the flow-pipe (that is, the ascending pipe) is screwed too far through the top of the boiler instead of being quite flush, or the horizontal pipes fall from instead of to the boiler. If this is looked to, I have no doubt it will go right. —F. G. F.

[60834.]—**Noise in Boiler.**—This is due to the temperature of the boiling water rising a few degrees above the boiling point, and every time steam is formed it escapes with a sudden jerk like a slight explosion, and the temperature falling to 212° F., again rising and falling at each bump. Strew the bottom of the boiler with clean iron borings, which will break up that sudden rush of steam and make it keep at a constant temperature of 212° F. Failing this, repeat Faraday's experiment, only on a larger scale; fill the boiler with water, pour over the surface of it a layer of turpentine, so as to cut the atmosphere off; make up your fire, leave your house, and return in an hour's time after the water has "once boiled."—A. TREYER EVANS, Newport, Monmouthshire.

[60836.] — **Electric Light.** — Four portable household cells—price £4 4s.—would light "A. B.'s" room, 12ft. square, for some 20 hours with three low-resistance 8-volt 5-candle-power lamps. Six cells would run lamps of high resistance for a much longer period.—BATTERY.

[60836.]—**Electric Light.**—This applies to query 60848. A room 12ft. square would be well lit by two gas jets of 6 to 8c.p.; three 5c.p. lamps would be ample. I should myself prefer one 10c.p. incandescent lamp with flexible connections, which would allow the lamp to be fixed where I was working, or I should use two lamps with switches, only one being burned at one time. A 20-candle power dynamo would require from 2¾lb. to 4lb. of wire, according to the design; a ¼ H.P. engine will be large enough.—G. BOWRON.

[60836 & 60848.]—**Electric Light.**—To MR. BOTTONE.—To light a room 12ft. by 12ft., four 10c.p. or eight 5c.p. lamps would be ample. A dynamo, such as described in my book, but with a laminated armature 5in. by 2in., and fields 5in. wide, 7in. high, and ⅜in. thick, the armature wound with about ⅜lb. No. 20, the fields with 10lb. No. 16 (if in series) or about 6lb. of No. 22 if shunt wound, would do the work effectually. It would take about a ¼H.P. to drive it, at 2,500 revolutions.—S. BOTTONE.

[60837.]—**Steam.**—As regards model boilers, more depends on the method of heating than on actual cubical contents of boiler; but if it is, say, five times the length and five times the diameter of cylinder, it may be large enough. The rule you allude to is applicable to compound engines, in which case the low-pressure cylinder must be taken. But you hardly need telling that nominal horse-power is a mere trade term.—T. C., Bristol.

[60837.]—**Boilers for Model Steam-Engines.** —I have not had much to do with these; but the following extracts from back volumes may serve your purpose:—

Let D = diameter of cylinder in inches
L = stroke in inches
x = proportion of stroke passed by the piston before steam is cut off
n = number of cylinders to be fed by boiler
C = a constant = 15

Then, heating surface in square inches—

$$= D^2 \times L \times x \times n \times C$$

The thickness of a copper boiler should not be less than 20 B.W.G. or ·035in. If working pressure is 20lb., thickness of copper = $\cdot035 + [\cdot01\,(B - 3\tfrac{1}{2})]$ where B = diameter of boiler in inches. Or, simply $\frac{B}{100}$, remembering not to make it less than ·035. For any other pressure, subject to the same limit make thickness

$$= \frac{\text{Pressure} \times \text{diameter in inches}}{2000}$$

Of course, the converse is: Working pressure of a well-brazed copper boiler

$$= \frac{2000 \times \text{thickness}}{\text{diameter}} \text{ both in inches}$$

Always test to fully double the working pressure by pumping in cold water. The mode of staying the ends, &c., will depend upon the general design of boiler. The above rules only apply to the best brazed work. "Nominal" H.P. is now practically meaningless.—GLATTON.

[60838.]—**Mechanics.**—The whole apparatus is equivalent to a handle 20in. long, and an axle of 2in. diameter—that is, as 20 to 1; but as a loose pulley is used, this doubles the power, and gives 40 to 1, as you suppose.—T. C., Bristol.

[60838.]—**Mechanics.**—Each revolution of axle shortens loop of string by 6in., and therefore each side of loop by 3in. only. Weight would therefore rise only 3in., while power travelled though 125. Ratio of P to W = 1 : 40. Loop of string, of course, passes through pulley attached to weight. —E. F. S.

[60839.]—**Mounting Plates of Wimshurst Machine.**—To "SODIUM." — I have a pair of discs of 3ft. diameter, and only ⅛in. thick, and, after much consideration, adopted the following plan, which is eminently successful. The boss is composed of two pieces of mahogany, grain reversed, glued and screwed, 5in. × 1¼in. I first attach a disc of fine canvas or Drogheda linen, same size as boss, to the glass by means of the cement I have several times described in these pages, and next day I apply the same to the boss and the coarse linen. Support the glass carefully under the centre upon a flat table, upon a piece of drugget; place boss central by means of a lath and pencil mark, and place a heavy weight on same. If in warm room it will be firm next morning. I use a spindle of ⅝in. iron gaspipe, running in brass bearings, and find that, as the glass seems always to have been cooled unequally, and is under a strain or strains, it is much better, if possible, to avoid making any hole in same. I omitted to state that on spindle is a cast-iron faceplate, 4¼ diam., plate ¼ when turned up, and, with neck, measures 1¼ on the spindle, on which it is tightly shrunk, and end of spindle slightly riveted. In this are four wood screws so as to adjust the plates, which are never quite flat, which I do by means of a soft leather washer.—A., Liverpool.

[60839.]—**Mounting Plates of the Wimshurst Machine.**—"Sodium" will find the chief objection to mounting plates by simply cementing the glass without a hole flatly upon the end of the boss, is, that when so mounted they must be suspended at the extremity of the spindle, hence the driving band, and many other causes, set up vibration. A lesser difficulty will be found in getting the two plates to run parallel to each other; besides these mechanical difficulties, there always is the danger of the cement yielding while the plates are rotating, and thus allowing the plate to fly loose. Cementing a disc of hard fibre to the glass and afterwards securing this disc to the wooden boss with screws, certainly seems the best and the safest method. Breaking the glass, by screwing up roughly, only indicates the absence of a proper sense of touch in the final adjustment of the screws: practice will correct this. I certainly use the method frequently, and, — whether by good fortune or by good management I don't know, but the fact stands, that I never get breakage or failure. Another method which I submit to "Sodium," is to cut the hole in the glass rather larger than the diameter of the boss, then turn up a large diameter of bobbin of two thicknesses of hard fibre, cement the glass into the recess formed in the bobbin: he then will have the glasses with fibre centres, and he can attach them to the bosses without fear of breakage.—J. W.

[60841.]—**Porous Pots.**—Porous pots of high resistance are used for telegraphic work where long runs are required without attention. Their only advantage is that diffusion takes place less

rapidly than with the softer pots. If materials of uniform quality are used, the size of a cell has no effect on its E.M.F. If the cells in the table are round, the figures may be correct. If they are flat, the resistance of the larger sizes would be less in proportion.—G. Bowron.

[60842.]—**Flat Music.**—Hire a barrel organ for a month. When the piano begins, begin with your organ, always taking care to keep your time slower or faster than the piano. Persevere in this plan until the pianos come to terms. This will be less expensive and more effective than mechanical means.—Hendon.

[60844.]—**Steam.** — If you want to heat the whole mill at one time simply carry a 2in. pipe to top of mill, and then continue round the mill with 3in. pipes, having a fall to take condensed water down another 2in. pipe direct to boiler. Have a back-pressure valve in this where it enters boiler, and a small pet cock at highest part of pipe. Steam-pressure would be practically the same at top of pipes as in boiler, and the additional weight of condensed water is sufficient to open return-valve. Of course, boiler must be lowest point. It must be a very small engine to work with 356ft. of 2in. pipe; the condensation must be enormous. If all shut-off and pipes lagged, the pressure at end and in boiler should be the same.—T. C., Bristol.

[60846.]—**Electro-Deposition.**—The usual way of connecting vats to machine is to have thick copper rods from machine running the whole length of vats, connecting the rod for anode direct by a binding screw and copper band. The rod for cathode is connected to a resistance board, and from thence to vat; by this means you may regulate the current according to work under operation.—T. L. H.

[60847.]—**Faulty Coil.**—The absence of any increase of spark on connecting the condenser suggests that the fault lies in the connection of this apparatus—not an uncommon defect in early coil making. A spark of ¼in. from about ¼lb. of 36 s.c secondary is not, I should say, a bad result.—B. Harcourt.

[60853.]—**Artificial Teeth.**—The principal or main basis of the body of artificial teeth is felspar and rock crystal; but each manufacturer has his own special composition, shapes, and colours. E. W. Gough wants to know how he can fix them on gold plates. E. W. Gough had best put himself under training by serving an apprenticeship in the regular way, and in due course he will learn that, and other things dental besides.—Dens.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

60311. Probability Query for "Alioth," p. 23.
60321. Mathematical, 23.

60514. Silvertown Firing Battery, p. 118.
60517. L.B. and S.C. Engines, 118.
60521. To Mr. Lancaster, 118.
60526. Cable Winch, 118.
60530. Lens Grinding. To Mr. Lancaster, 118.
60532. To Mr. Lancaster, 118.
60541. G.W. Trains, 118.
60543. Steam Diggers, 118.
60552. Air-Gun Trigger, 118.
60558. Forging Engine Work, 118.
60559. Liquid Compass, 118.

Electrolytic Separation of Metals.—From solutions containing salts of various metals the metals may be completely and successively separated in a state of purity by using currents of different strengths. The current first applied must be only sufficient to throw down the most readily precipitable metal, but not the next following. The more of this first metal is deposited the feebler becomes the current, and finally a galvanometer introduced into the circuit is no longer affected; a sign that now none of the metal precipitable by the existing electromotive power is present, but only such saline solutions as do not conduct the feeble current, and consequently are not decomposed. If the negative electrode is charged and the electromotive power increased a second metal can be precipitated.—*M. Kilian.*

Propionic Acid.—Propionic acid occurs in considerable proportions in the tars resulting from the destructive distillation of resin at the temperature of bright redness. Propionic acid boils at 141·5° to 142°. Its sp. gr. at 0° = 1·0089; at + 18° = 0·9904. It remains liquid if cooled to − 50°. It dissolves in all proportions in water, alcohol, ether, benzol, and petroleum essences.—*Ad. Renard.*

QUERIES.

[60854.]—**F.C.S., F.I.C.**—Would any reader kindly say whether the Fellowship of Society of Chemistry and Institute of Chemistry can be obtained by one who is not acquainted with a Fellow? If so, by what means?—E. F. S.

[60855.]—**Pulleys.**—I should feel obliged if some of our readers could give me sizes of pulleys required for driving planing machine by flywheel 4ft. diam., weighing 3cwt. Also sizes of corner pinions for driving flywheel on anti-friction bearings.—Amateur.

[60856.]—**Battery.**—To Mr. Bottone.—I have made a small pocket coil for shocking. The core is a bundle of soft iron wires, 3in. long, 5-16in. diam., wound with about an ounce of No. 36 silk-covered wire as primary, with no secondary at all. Now I should esteem it a great favour if Mr. Bottone would give me dimensions and a few hints as to construction of a pocket battery suitable for working the above. Chloride of silver cell is too expensive. I tried it with a Leclanché cell with porous pot 6in. high; the effect was very slight. I then coupled this in series with a plate of copper about 2in. square and one of zinc about 2½in. square, dipped in a pot containing hydrochloric acid and water, and the coil worked famously. I should also be glad to know if copper can be used instead of carbon (which is very hard to cut) in a sulphate of mercury cell. —Rouge Gorge.

[60857.] — **Electro-Plating and Coppering.**—Will some experienced fellow-reader help me with the following difficulties? (1) How to doctor a silver solution that has lately deposited a coating (especially on g.s.) that is very liable to strip with burnishing? It deposits freely and a good colour. (2) How to prepare carbons so that the copper will adhere firmly? I find that sometimes it holds like "grim death," and at others I can almost wipe it off. (3) How, with a certainty, to get a bright deposit of copper from an alkaline solution of copper on steel goods?—In a Fix.

[60858.]—**Income Tax.**—I lent a person £100 at 5 per cent. on a deed of mortgage on his house. The person, on paying me the interest on the last occasion, produced the receipt of his last payment of Income Tax on this house, and demanded payment of the same from me, saying that it was my place to pay the Income Tax on the property for which I held the deeds. As I do not pay Income Tax, not having the necessary income, I denied my liability. Is there any new law which compels a mortgagee to pay the Income Tax on the mortgaged property?—C. J. W.

[60859.]—**Weight of Modern Steam Ships.**—Perhaps some of the readers of "ours" can tell us what is about the percentage of dead weight, meaning thereby the weight of hull and machinery, to the total displacement, in the large modern iron and steel steamships. — St. Aubyns.

[60860.]—**Turbines.**—In Cullen's "Turbines," published by Spon, I find the following anomalies in the formulæ: On p. 32, Q is the quantity of water in cubic feet per second, H height of fall in feet, P H.P. of the water at 75 per cent. $= \frac{Q\,H}{700}$; but on the opposite page it is distinctly stated that "the cubic feet of water per min., multiplied by the height of fall, and divided by 700, will show by the quotient the power of the wheel." Again, on page 33, in a note, $A = \frac{Q \times 60}{2\cdot08}$ for falls under 38ft., notwithstanding in the example worked out for a 9ft. fall, the formula used is $\frac{Q \times 60}{\sqrt{H} \times 2\cdot08}$. In one place r is given as $D \times 3\cdot6$; in another $d \times 3\cdot6$. Will any gentleman who has had occasion to consult the work for practical use tell me if he has noticed these and any others, and what course he has adopted in connection with them? My copy is dated 1871. I have written to the publishers, who have in turn communicated with the author; but have received no reply.—W. J. Taylor.

[60861.]—**Wind-wheels.**—A paper appeared within the last three years giving a description of modern American practice in the design of wind-wheels and windmills. I saw it in one of the English technical journals; but have not succeeded in finding it again. Can any reader kindly give me the necessary reference?—Q.

[60862.]—**Parallel Motion.**—I have the care of a Cornish pumping engine; cylinder, 84in. by 120in., with motion working very badly, vibrating towards centre of beam at each stroke. Will some kind engineer say if the following lengths of motion are correct? From centre gudgeon to piston links, 16ft. 6in.; centre gudgeon to motion links, 9ft. 2in.; from motion links to piston links, 7ft. 6in.; radius rods, 11ft. 2in.; parallel rods, 7ft. 6in.; links, 5ft.; brasses in good condition.—C. Ensor.

[60863.]—**Legal.**—Thirteen years ago, I bought three cottages with gardens, which are parted from another by a hedge. I have the plan on some old deeds, which shows the hedge belongs to me. My tenants have been accustomed to cut it. The adjoining garden has been sold, and the purchaser has dissuaded my tenants from cutting it, saying it belongs to him. I don't much care about the ownership; but he wants the hedge to grow up to hide the view of my cottages, which will shade the sun from my gardens. Will some kind friend say if I can cut it?—C. Ensor.

[60864.]—**Gas Products.**—In a small private gas-works here, am often troubled with an accumulation of tar, soot, &c., in the standpipes between the retorts and hydraulic main. The material used is Scotch Cannel coal. Shall be obliged by reply stating cause and remedy.—Robert Penny.

[60865.]—**Mathematical.**—Will some kind reader explain what is meant by a value passing through $\frac{1}{0}$, from $-\infty$ to $+\infty$, or from $+\infty$ to $-\infty$, and illustrate by a simple example?—H. B.

[60866.]—**Equatorial Pedestal.**—I am constructing a 4½in. Newtonian reflector, which I wish to mount equatorially. I have completed tube, both axes, bearings, &c.; but do not know what to use for a pedestal. Would it be best to make it of wood, or to use an iron drainpipe, the R.A. axis being 10in. long? I see Webb advises an iron pipe for an altazimuth stand; but I do not know how I could adapt it to an equatorial. Also I should be glad to know what weight I should make the counterpoise, the Dec. axis projecting about 10in., and the telescope, with mirror, &c., weighing 28lb. Will some fellow-reader kindly help me over these difficulties?—S.

[60867.]—**Photographic.** — What is best way to remove stains of developer from fingers, which seem to me worse than the old nitrate of silver stains to accomplish? —W. K.

[60868.]—**Numbering Stamps.**—I have one with revolving brass wheels, also ink; but the latter has got wrong (?) by age. It is not apparently sufficiently fluid, nor does it dry quickly enough. Can I add anything to that in the bottle to make it do so, and, if so, what, and how much?—W. K.

[60869.]—**Twin Screw and Paddle Engines.**—Will any correspondent be kind enough to give me information as to the advantages of twin screw and paddle engines (disconnecting and otherwise) over the ordinary kind?—Twin Screw.

[60870.]—**Horse Hair.**—I have a quantity of horse-tail hair. Would any reader kindly inform me how to make rope hair of it?—W. F.

[60871.]—**Coir Yarn.**—I would feel greatly obliged to any reader who would inform me how to bleach coir yarn or coco fibre?—W. F.

[60872.]—**Wooden Chucks.** — Will "O. J. L.," or some other reader please tell me which way the grain of the wood should run in making each ordinary wood chuck in box, beech, oak, and ash? Which is the best wood to turn some speed pulleys out of for a 3in. lathe? Should the gut band fit all three speeds?—W. M.

[60873.]—**Business done in the Dark.** — Will some kind reader inform us if it is legal to bar reporters during our local board sittings, and does not the arrangement come under Sir Benjamin Hall's Act? If so, where could the Act be obtained, and the price? I may say we have petitioned the board with a great number of signatures, praying for the admission of a reporter, which was refused.—Daylight.

[60874.]—**Dynamo.** — I have two bobbins, each of which is wound with ½lb. of No. 20 wire, 2in. by 1¾in., with ½in. cores. Can they be made into a small dynamo to light a 2½c.p. lamp? If so, please give dimensions of cores, armature, wire, &c., and the power required to drive: I was thinking of using cores of Gramme form, also armature of U-shaped pieces of sheet copper, arranged in a circle on spindle, insulated and channel wound with iron wire, and the legs afterwards connected with copper strips, the whole forming a ring armature. If this form is suitable, please give hints on construction and mounting. If preferable, I can have the cores forged.—T. S.

[60875.]—**Small Medical Coil.**—To Mr. Bottone. —I have made a small medical coil with a brass flange on the outside over the iron core to keep it in the centre. Does that make any difference to the vibrating of the spring, as mine will only work for a few seconds? When the tube is out, with two bichromate cells I get very little shock.—Fixture.

[60876.]—**Bottling Cement.**—Would some correspondent kindly give the recipe for a bottling or capping cement, which is composed of gelatine, glycerine, &c.? It is said to be very tight and very clean in use. I believe it was in your very useful paper where I saw it a long time ago; but I can't find it in any of the back numbers in my possession. Mine are not bound, so it is easy to miss it.—Ajax.

[60877.]—**Finishing Cast Steel in the Lathe.** —Would some correspondent kindly explain the proper way to finish best cast steel in the lathe? I have asked several turners, and got different answers from some of them. One said it ought to be finished dry, because soap-water and oil, by putting a skin on, quickly rubbed cutting edge off tool. Another said it should be done with soap-water, and the other preferred oil. Who is right?—Apprentice Turner.

[60878.]—**S.E.R. Locos.**—Would some railway contributor kindly send sketch and dimensions of No. 247, built by Atlas Works Co., and also No. 205?—H. I. W.

[60879.]—**Test for Field Glasses.**—Is it a good test for field-glass to see the blue companion to bright star in centre of Pleiades?—W. T.

[60880.]—**Boiler Supply.**—Can any of our readers say if there is any objection to the following plan to supply kitchen boiler with water? I propose to connect supply-pipe from main direct to underside of boiler (wrought-iron one), and then connect a pipe to top of boiler and lead it to scullery immediately behind. I would have a tap on supply pipe, so that I could shut off if necessary.—Dick.

[60881.]—**Pitch-Pine Stopping.**—Can anyone give information how to make a good stopping for above?—G. H. H.

[60882.]—**Model Gas Engine.**—I want to make a very small gas-engine, as my tools will not allow me to go in for large work. What are the dimensions of the very smallest gas-engine I may expect to work, providing it should be well made?—Watchmaker.

[60883.]—**Building Amateur Workshop.**—Will someone kindly advise on this subject? I am thinking of buying a second-hand iron building large enough to take two or three lathes, gas-engine, bench, &c. Would like it of oblong form. Presume it must be lined with wood inside. What distance should the wood be from the iron, and what filling should be used? Should I be likely to suffer more from rust than in the house? What would be the probable size required, and the cost? Would the floor be strong enough to take a 2-man engine without vibration, or should I have to cut away same and fill in with concrete? What height should the floor be off the ground, and must it stand on a brick foundation?—Amateur Tinker.

[60884.]—**Textbook of Mechanics.**—Can any of our readers recommend me some practical handbook, giving explanations of the functions of the more ordinary machines of an engineer's workshop, as lathes, planing machines, shaping-machines, &c. I have the appliances of a workshop at command, but feel the difficulty that

besets most amateurs—the want of that experience in the handling of these appliances, which his professional training gives to the regular engineer. I understand, of course, that skill of hand cannot be given by any book; but I should like to obtain, if possible, some work written for the guidance of workmen, and detailing the various combinations and characteristics of the machines—what they will do and what particular risks to beware of in handling them, so as to minimise as much as possible the necessity of having to do a piece of work more than once through inadvertently spoiling it.—An Amateur.

[60885.]—**Scissors Grinding.**—I have a 5in. emery wheel in hand lathe, and should like to grind the family scissors. Will someone kindly give me directions how to proceed?—Country.

[60886.]—**American Lever Timepieces.**—When the balance staff has dug enough in the bottom of the holes in which they run (made in steel screws hardened) to bind, how do you get the shape of the sinks back to the right angle?—Country.

[60887.]—**Enamel.**— I have a quantity of tinplate reflectors or shades for lamps, and I wish to enamel the same with white enamel. Will someone kindly give me a good recipe?—Pro Bono Publico.

[60888.]—**Achromatic Lantern Objective.**—I should be glad if some kind correspondent would furnish me with particulars for making the above to work at three different distances. With the shapes, diams., foci, positions, and distances in the tubes, and kind of glass used. I am quite able to fit up the tubes and rack and pinion work; but I cannot find in any of the back numbers sufficient information to work upon.—H. G. R.

[60889.]—**A Good Battery.**—Will Mr. "Cato" kindly oblige with details of the battery of which he wrote in last week's English Mechanic, Nov. 5th?—Peregrinus.

[60890.]—**Master Keys.**—Will some of "ours" explain the principle of these as applied to lever locks (an illustration will oblige)? Also the derivation of the word padlock?—H. H.

[60891.]—**To Mr. Bottone or Others.**—Could you tell me, if possible, what the battery boxes (of the G.P.O.) are insulated with inside?—Young Electrician.

[60892.]—**Annuity and Estate.**—Will some kind friend give me the present value of an annuity £115 with 32 years to run? Also the value of a freehold estate whose annual rental is £65, with working of the same?—W. R. L. R. N.

[60893.]—**Cement.**—A pot, or earthenware pipe (trap of w.c.) fits into end of thin sheet-copper pipe about 5in. diam. Will some reader please say what cement is used to make joint water-tight?—H. H.

[60894.]—**Varnish Brush.**—Will any reader inform me how to clean camel-hair brushes after using them in hard drying spirit model varnish? Have tried turpentine, but it does not answer.—H. H.

[60895.]—**To Mr. Bottone.**—I am making a Gramme dynamo, as described by you on p. 590, Vol. XLI. Armature is a malleable casting. Pole-pieces are ordinary cast iron, and F.M.'s made from 1½in. round annealed iron, screwed into pole pieces. Armature is wound with nearly 3lb. No. 18 d.c.c. wire in eight sections, three layers each, as two sections was under 2lb. of wire as stated. You gave 6lb. of No. 16 for F.M.'s. Is this for arc or incandescent? I want to light as many 20c.p. lamps as possible. Please say the quantity and size of wire required if shunt would be better. I want to run it as a motor occasionally.—W. P. W.

[60896.]—**To Mr. Bottone.**—I am making a coil with regulator to both circuits, as described by you in "Ours" lately; but can only get about ½lb. of primary on. I have wound it very evenly and tightly, and in four layers. Is this enough? Would the spark be improved by adding a condenser, with a switch to disconnect same when being used for shocks? If so, please say how many sheets and size.—W. P. W.

[60897.]—**Fire Engine Boiler — Shand and Mason's Patent Inclined Water-tube Boiler.**—Can any of our numerous readers kindly give me a description (with small sketch) of the above—the number of tubes and how fastened in the material used for the fire-box? and kindly state how the joints of the shell are made steam tight. I am given to understand the outer shell is movable and bolted on. Is sheet asbestos used for the joint?—H. R. W.

[60898.]—**5in. Gregorian.**—I have been making a 5in. Gregorian telescope, and now that I have put the mirrors in their places, I cannot get an image through the eyepiece, although when eyepiece is removed a very well-defined image can be seen in front of the small mirror. The mirrors are respectively 31in. and 5in. focus, and I have put them 36in. apart, and can move them from this 2½in. either nearer or further, but with no better result. Will someone tell me where I am wrong, or suggest?—Perplexed.

[60899.]—**To Chemists.**—Will any reader of "ours" please give the equations which go on in the reactions between (1) nitric acid and iron, (2) iron sulphate and potassium bichromate?—Joel, Ebbw Vale.

[60900.]—**Highland Ry. Loco.**—Perhaps someone will be able to send a sketch and dimensions of this engine, which was exhibited at Edinburgh Exhibition. It would be interesting to have a drawing of it, as sketches of the other engines exhibited there have been already given.—Amateur.

[60901.]—**Gas-Engine.**—How does the ignition take place in Dorrington's Amateurs and Little Compact gas-engines? Is the slide in the former worked in the same way, or by an eccentric? Will they both work with benzoline gas and Fletcher's generator?—E. R. Dale.

[60902.]—**Gas Furnaces.**—Having been rather successful with iron and brass founding, with the blowing machine illustrated in Vol. II. *Journal* of the A.M.S.; but now, not having access to the furnace, I use a generator 14in. by 9in. by 9in., a Fletcher furnace 5in. by 5in., and foot-blower about 10in. by 8in. It is very hard work. I have broken two cast-iron treadles. I also find the wire rusts, and then the net, and breaks, and the rubber bursts, and it is with great difficulty I can cast at all. Is my blower too small? I want to melt iron, &c., as I make chucks for lathes, &c.—E. R. D.

[60903.]—**Motions of Earth and Moon.**—In Encyc. Brit. (Astronomy, p. 797, first sentence), I find the following: "The earth in reality revolves in the course of a lunar month, around the common c.g. of her own globe and the moon's." It is further stated that the diam. of this orbit for the earth is 6,000 miles. Are these statements correct?—J. C. O.

[60904.]—**Lilium Auratum.**—Can any reader tell me whether it injures the bulb to allow, say, one pod of seed to ripen on a stem which was strong enough to carry 12 large flowers, or whether it is better to cut off the seed vessels as soon as the blooms fade?—Hortus.

[60905.]—**Induction Coil.**—Will anyone say, in making a coil to give 1in. spark, if it is any advantage to use a dividing disc? If so, what should be (1) the diam. of a core 7in. long, (2) the insulation between layers, (3) the size of condenser, and (4) the battery power employed?—Scottie.

[60906.]—**Lens.**—Will some reader kindly advise me in the choice of a lens suitable for taking animals (dogs, &c.) in the open air with instantaneous shutter? Would such as Wray's 5 by 4 of 5¼ back focus, which works with $\frac{F}{5\cdot65}$ stop, be suitable, or would it be necessary to work too close to the object in order to get it large enough on the plate, as I want to get a moderate-sized dog large enough on 5 by 4 plate at 8ft. or 10ft. distance?—Enquirer.

[60907.]—**Incubator.**—In Vol. XXXIX., No. 1009, letter 45063, Gerard Smith gives drawing of incubator. Would he kindly give distance between bottom of tank A and perforated bottom of wood L, and oblige?—T. P.

[60908.]—**Boiler.**—Will some of your kind readers of the "E. M." give me some information on the above? I am about to try to make a model engine boiler, horizontal (slide valve cylinder for same), 6in. diam. by 16in. long, with internal fire-box, if possible. I want to know how I must proceed to make the above. Would cylinder tin or sheet copper be best, and riveted or soldered be strongest for it? Also, what amount tubes, and size, would it require if necessary? Also, as to mode of fire-hole, and what would be the amount of steam this would work with safety? Also, size of cylinder most suitable. A reply or any other information on above would greatly oblige.—A New Beginner.

[60909.]—**Mangle Rollers.**—I have a wringing machine, of which the above are working loose on the shafts continually. I have tried various things to fasten them, but have so far failed to do so. I should be glad of advice from some reader of the "E. M." to give me some remedy for above. Is there not a cement that I could run in the centre hole of rollers? By so doing would greatly oblige.—A New Subscriber.

[60910.]—**Screw-Cutting.**—In an article on "Screw-Cutting Apparatus," in No. 1097, "O. J. L." promised your readers to give a description of an "entirely novel contrivance for tracing screws," and of which he hoped very shortly to send a fully-illustrated description, already written, but delayed at the maker's request while erecting some necessary machinery for its manufacture. I, and doubtless others of your readers, have been anxiously looking for the description in question. When may we expect to see it?—E. T. B.

[60911.]—**Steam-Engine.**—Could any of our friends kindly give me a little information? I want to cut off steam sooner in the stroke of engine. Is it possible to be done by shifting the eccentric on the shaft? I shall be thankful for full particulars through the Mechanic.—Slides.

[60912.]—**Dividing Brasses.**—Would someone kindly give the construction for finding the correct angle at which to divide the brasses of a horizontal engine, so as to get the division at right angles to the wear?—Brazen.

[60913.]—**Cheap Dynamo.**—Would Mr. Bottone or some other kind reader tell me the way to make a good, cheap dynamo, one that would light five 20c.p. lamps, and the best way to drive it? Would an electro-motor do?—C. Gunn.

[60914.]—**Writing Ink.**—Would some one advise what chemicals to use to prevent ordinary writing ink from turning brown or rusty? Why are roasted galls used by the trade for the manufacture of copying ink? I have heard they contain more tannin after roasting, and consequently make a stronger ink. If this is so, does this also apply to myrabolams?—O. J. K.

[60915.]—**Tannin.**—How can I tell when I have a 5 per cent. solution of tannin? What is the simplest method of estimating the amount of tannin in different materials?—O. J. K.

[60916.]—**Daniell's Battery.**—I am making some Daniell's cells, size of boxes inside 8½in. by 6in. square, porous pots 2½in. by 9in., corrugated copper in outer cell, and rod of zinc in porous pot, with the ordinary solutions. I want to know roughly, as I do not understand electrical measurement, how many of these I should require to light two 5c.p. lamps. Also, are the red porous pots the best for this kind of battery?—T. C. S.

[60917.]—**To Mr. Wimshurst.**—I am thinking of making one of your eight-plate influence machines. If you will answer me the following questions I should be greatly obliged. Should the dust-proof case have glass or wooden top? What is the right thickness for the discs—will 15oz. do? Will mahogany handles do in place of vulcanite for the terminals? Will thick brass wire heavily covered with shellac do instead of guttapercha for the collecting combs?—J. R.

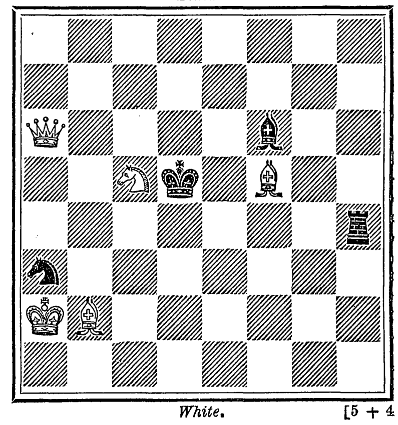
[60918.]—**Screw Cutting.**—Will any brother reader please assist me in the following:—I have a 4½in. centre screw-cutting lathe, with four threads per inch, leading screw when cutting screws of odd pitch, such as 5, 7, 9, and so on. I cannot make the saddle gear with the leading screw to bring the tools right for the second cut. If any one will explain this it will greatly oblige.—One in a Fix.

CHESS.

All Communications for this department must be addressed to J. Pierce, Langley House, Dorking.

PROBLEM MXVII.—By E. N. Frankenstein.
(From forthcoming collection.)

Black.



White. [5 + 4

White to play and mate in three moves.

Solution to 1,015.

White.	*Black.*
1. Castles.	1. K-K 5 (*a*).
2. R-K sq (ch).	2. K moves.
3. B mates.	
	(*a*) 1. K-K 7, or B 7 (*b*).
2. B-Q 4, &c.	
	(*b*) 1. P-K B 7.
2. R-R 3 (ch), &c.	

NOTICES TO CORRESPONDENTS.

Correct solutions to 1,015, by F. Kraser (a splendid problem) and J. Mackenzie; to 1,016, by Black Pawn, J. Mackenzie; to 1,014, by A. Bolus.

A. Dean.—We trust that our reply to your letter was found satisfactory.

A. Bolus.—Many thanks for the two problems.

We are open to receive names of competitors for two Solution Tourneys to be started shortly on similar lines to the last, as they were so successful. Tourney A will consist of 8 three-movers and 6 two-movers, and Tourney B of 12 two-movers. The prizes in A (provided there are at least 12 entries) will be 1, £1; 2, "English Chess Problems" (unbound); 3, Taylor's "Elementary Chess Problems" (out of print); 4, Rowland's "Chess Fruits." In B (if 12 entries, at least), 1, "English Chess Problems" (unbound); 2, Miles's "Chess Problems, 1885"; 3, Collins' "Problems"; 4, Gossip's "Chess Openings." The entrance fee in each Tourney will be sixpence, as before, to go towards defraying the cost of the prizes.

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Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the English Mechanic, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. IV., VII., XXVI., XXVIII., XXX., XXXII., XXXIII. XXXIV., XXXV., XXXVI., XXXVII., XXXVIII., XXXIX., XL., XLI., XLII., and XLIII., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.).

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

J. THEOBALD & COMPANY'S SPECIALITIES.

THE SKATING SEASON.

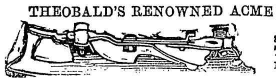
VERY PARTICULAR ANNOUNCEMENTS.
EVERY LOVER OF SKATING SHOULD READ THIS.

Last February we ordered 8,000 pairs of Skates, having previously cleared out all our old stock, so that every Skate we have got in the place is perfectly new. Many shops only buy once in four or five years, and bring out, season after season, rusty skates. The more Skates we can buy the cheaper we can get them, consequently the cheaper we can sell them, and yet there are thousands of persons who will never order Skates till skating really commences, then they are in such a hurry they cannot wait to send to London for them, but rush into the nearest shop, get inferior old Skates, and pay twice or three times as much for them. We want to reach this class of people; we want, if possible, to obtain their custom, and we have therefore hit upon a very novel plan, never before tried with Skates, which we hope will induce them to order directly they read this announcement. With every pair of Skates we intend to give a Free Gift. We make no charge whatever for the Gifts. It is simply done as an experiment on our part to see if it results in our selling sufficient extra Skates to pay for so doing. 500 pairs of Acme Pattern Skates are done up at one time in separate parcels—assorted sizes—and with each pair of Skates is packed up a free gift. The parcels are then securely tied up and the size and kind written outside each parcel. Then, as the orders come for them, they are simply addressed and despatched, no one being able to tell what Prize is in any parcel, so that the distribution is perfectly fair, and every one has an equal chance of getting the very best prizes.

The 500 Prizes put in every 500 parcels are as follows:—5 Silver Watches, 25 Real 9-Carat Gold Rings, 50 Sterling-Silver Scarf Pins, 25 Sterling Silver Brooches, 50 Leatherette Writing Cases, 20 Gold Pencil Cases, 50 Packets of Christmas Cards, each Packet containing 50 Cards, 100 Volumes of Books, 100 Fancy Scarf Pins, 25 Handsome Bracelets, 50 Pairs of Folding Scissors.

As soon as one lot is sold another 500 is done up, and so on.

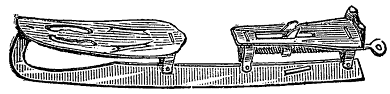
THEOBALD'S RENOWNED ACME PATTERN SKATES.



These are so well-known as to need no description. They are of best Bessemer steel throughout, and are simply secured to the feet by means of nuts and screws. Once the Skate is properly adjusted to the boot, it can be put on or taken off instantly by merely pressing a small lever. With key complete, price 5s. per pair, post free; or beautifully Nickel Silvered, 10s. per pair.

To save any error, please be careful to cut out Coupon and send it with the order.

ACME SKATE COUPON.
Entitles holder to ACME PATTERN SKATES at above prices, including Free Gifts, if ordered within 14 days of the date of this paper.
(Signed) J. THEOBALD & COMPANY.



THE KENSINGTON NEW STEEL SKATES.

These Skates we specially introduce to do away entirely with the old-fashioned wooden Skates, which are now so seldom seen, and which we have given up keeping entirely. The Kensington Steel Skates are now introduced for the first time, and we advise every one who wants a cheap, good Skate, to send for them. They are of steel throughout; strong, well made, with no nut or screw; but by means of turning a little handle at the back, a strong claw, working on a long screw, grips the heel firmly, while a short strap goes across the front of the boot. Price 3s. 6d. per pair, post free. These are NOT supplied nickel plated, but are only made in the one quality. With these Skates Gifts are also given the same as with the Acme Pattern, with the exception that owing to their being a much less price, we are not giving any Watches, and only 20 instead of 25 Gold Rings, the 10 prizes thus short being made up with extra books.

Customers must say exactly what length in inches they require the Skates to be, whether 7½, 8, 8½, 9, 9½, 10, 10½, 11, 11½, or 12 inches long.

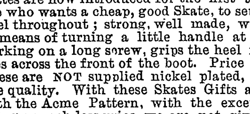
All Skates are sent off by Parcels Post per return.

Secure these Skates at these wonderfully low prices, with Gifts free, while they can be had. You stand a good chance of getting a good pair of Skates and a Silver Watch for 5s.

Initials engraved on any Skates at 1s. 3d. per pair extra. Not more than two Initials on each Skate, and this makes one day's delay.

Skates can always be had at above prices while our Stock lasts, but the gifts will only be given to those who order within 14 days of the date of this magazine.

KENSINGTON SKATE COUPON.
Entitles holder to KENSINGTON SKATES at above prices, including Free Gifts, if ordered within 14 days of the date of this paper.
(Signed) J. THEOBALD & COMPANY.



THE STUDENT'S MICROSCOPE

and 200 Objects. Has obtained high-class awards at various exhibitions. A strong, powerful microscope, magnifying many thousands of times, with 200 beautiful objects, shells, stones, insects, &c. Carriage free, 20d.

MAGIC CLOCKWORK MICE, either

White or Black. Best quality only. When wound up run all about a room or table, causing roars of laughter and consternation. Post free 14d. Rats, double size, 20d. Clockwork Cats, Dogs, Lions, Tigers, Horses, Goats, Stags, Rabbits, Squirrels, Chickens, Ducks, and Tortoise, post free 14 stamps each. Large Ducks, Horses, Omnibuses, Jockeys, Bears, Rhinoceroses, Carriage, Sheep, Lions, Tigers, Hyenas, Wild Dogs, Rabbits, or Cats, post free, 20d.

CLOCKWORK TRAINS. — Engine,

Tender, and two Carriages. Carriage free 2s. Better quality, 2s. 9d., 3s. 9d., 4s. 6d. Larger size, 5s. 6d., 6s. 6d., 8s. 6d., 10s. 6d. 12s. 6d., 15s., 21s. Railway, with Lines, Station, Signals, and men, complete, 13s. 6d., 18s., 25s., and 30s. Railway, with lines only, 4s. 6d. and 8s. 6d.

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PRINTING APPARATUS.—For Cards, Note-paper, Billheads, &c. Strong wooden press, assortment of type, ink, dabber, and instructions complete. Carriage free, 2s. 9d. Much larger sizes, 3s. 9d., 5s., 8s. 6d., 10s. 6d., 15s., and 25s.

THE KENSINGTON SECRET SWORD

CANES.—Invaluable for self-defence. Have the appearance of an ordinary walking stick, but each contains secret steel sword. Carriage free, 1s. 9d., 2s. 3d., 2s. 9d., 3s. 6d. Better quality, 4s. 6d. Very superior, with secret spring, 5s. 6d., 7s. 9d., 9s. 9d., 12s. 6d. 15s., and 21s.

THE KENSINGTON MODEL STEAM

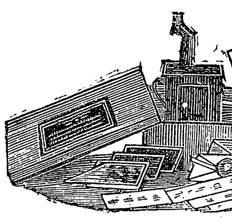
DANCING NIGGER. Greatest fun and excitement ever known. The Nigger will dance by steam for one hour at each operation. Strong metal boiler, heavy brass Flywheel, brass Supports and Uprights, Tripod Stand, Dancing Platform, Crank Movements, Brass Manhole, and Nigger complete, carriage free. 2s. 9d.

THE KENSINGTON RAT TOBACCO

POUCH. Greatest novelty out. This is a flexible indiarubber model of a life-size rat, which forms a tobacco pouch. It is so realistic that ladies scream on seeing it, 1s. 6d. Oysters, 1s. 6d. Frogs, 1s. 9d. Fish, 1s. 9d. Potatoes, 1s. 6d. Orange, 1s. 6d. Revolver, 2s. 3d. Post free.

OUR CELEBRATED BIJOU MAGIC

LANTERNS AND SLIDES.



Some people having tried in a feeble way to imitate these Lantern sets, which we have sold in such immense quantities for years past, by copying our description, we have this season altered our Slides, and given such quantities and value for money as defies all competition. We manufacture both Lanterns and Slides, other houses do neither, and therefore cannot possibly sell so cheaply.

Nothing is so amusing, entertaining, and instructive for the long winter evenings as a Magic Lantern, so long as Lantern and Slides are of good quality and show well. This we guarantee in every set we sell. Compare our sets with those of any other house.

Our No. 1 Set contains a best quality English-made Magic Lantern, fitted with best condenser and focussing Lens, best Mineral Oil Lamp, with rackwork adjustment, glass chimney, metal chimney, brass nozzle, with improved ventilation to lantern, slide holder, and silvered reflector, and the following large assortment of slides: 36 comic figures, 3 complete nursery tales, comprising 36 pictures (no other house in the world gives more than 1 nursery tale, as these are most expensive, costing 2s. each), 2 Chinese firework slides, 2 comic moving slides, 2 movable lever slides, 2 moving panorama slides, and 1 revolving slide—man swallowing rats, making 81 pictures in all, and candidly worth a guinea. The complete set, in box complete, 10s. 6d. This set shows pictures 3 feet in diameter.

No. 2 Set, a similar assortment, but both Lantern and Slides larger size, 14s. 6d. Shows 4 feet diameter.

No. 3 ditto, but much larger, a very excellent set for a present, specially recommended, price 21s. Shows 5 feet diameter picture.

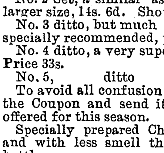
No. 4 ditto, a very superb set, showing pictures 6 feet in diameter. Price 33s.

No. 5, ditto ditto 7 feet, 50s.

To avoid all confusion we earnestly beg every person to cut out the Coupon and send it with their order, as these are special sets offered for this season.

Specially prepared Chemical Oil, showing much more brightly and with less smell than ordinary oil, 9d., 1s. 6d., and 2s. 6d. per bottle.

ENGLISH MECHANIC COUPON.
Entitles holder to SPECIAL SETS OF BIJOU LANTERNS AND SLIDES at above prices.
(Signed) J. THEOBALD and COMPANY.



MAGIC LANTERN

SLIDES for full size Lanterns, all splendidly coloured, 3¼in. square, 12s. per set, any of the following subjects:—Dick Whittington, Elephant's Revenge, John Gilpin, Blue Beard, Tiger and Tub, Cinderella, Crusoe, Gulliver, Views of London, Continental Views, Palestine Views, Life of Christ, Pilgrim's Progress, Overland Route, Arctic Expedition, Life of Joseph, &c., &c.

GRAND PRIZE STATIONERY

PACKETS.
EXTRAORDINARY ANNOUNCEMENTS.

Owing to the immense number of letters we have received every day since last Spring, when we advertised these packets for the last time, asking if they can still be had, we have determined to offer them again for a few weeks this Autumn. Each prize Stationery Packet consists of: A beautiful elegant Crocodile leatherette writing case fitted with compartments for note paper, envelopes, post cards, stamps, &c., also 24 sheets of good superfine note paper, and 24 Court envelopes, elastic band, a pen and penholder, a 4s. copyright song, a beautiful fancy ivorine opera glass for the watch chain, containing a wonderful little magnifying glass and photograph, a good pocket handkerchief, and a packet of 100 puzzles. We offer this entire lot, the most wonderful value for money ever given, for 2s., post free 2s. 3d.

In addition to the above, without any charge whatever, we shall put a free present in every packet. We make up 500 packets at a time, and in every 500 packets we are putting 30 volumes of books, 10 telescopes, 10 microscope, 50 real sterling silver scarf pins, 50 beautiful fancy scarf pins, 10 real gold finger rings, 10 real sterling silver brooches, 20 musical instruments, 10 gold pencils, 20 pairs folding scissors, 20 pocket knives, and the remainder of the prizes consisting of silver watches, paper knives, musical boxes, bracelets, pipes, toys, &c. Thus it will be at once seen that besides getting full value for money, every person obtains a free prize oftentimes of 10 times the value of their money. Please send orders at once, 1 packet for 2s. 3d., carriage free, 2 packets, 4s. 3d., or 3 for 6s.

Money instantly returned if the packets are not according to description. We have numerous letters from persons acknowledging receiving watches, rings, &c., in their packets, and these letters can be seen at our offices. This is a perfectly genuine announcement, as we have been established in Kensington over 50 years, and sold more than 20,000 of these packets last spring.

The coupon below must be cut out and sent with order.

ENGLISH MECHANIC COUPON.
Entitles holder to PRIZE STATIONERY PACKETS at above prices.
(Signed) J. THEOBALD & COMPANY.

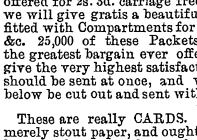
THE GREATEST VALUE EVER

OFFERED BY ANY HOUSE IN THE WORLD.

Kindly study thoughtfully what we guarantee every packet to contain. This packet is the outcome of several gigantic failures of manufacturers, otherwise it would be impossible to sell it at the price. Every packet contains 24 ordinary size Christmas and New Year's Cards with appropriate Mottoes, Flowers, Birds, &c.; 6 magnificent Gold Cards with figures of Children, Animals, &c., in beautiful colours, with Christmas and New Year's Greetings; 6 long Cards of Children dressed for Christmas Parties, with Holly, Flowers, and Greetings; 12 superlative Cards in Gold and Silver Bronze, with embossed Flowers and centre oval of Texts or appropriate Poetry for the Season in gold and colours—each of the 12 cards measures 8in. by 5½in., and are alone worth the value charged for the entire Packet; a set of 6 beautiful stamped out perforated Easel Frames, in splendid colours, with oval mirror containing words—"A Joyful Christmas," "A Happy Christmas," "A Merry Christmas," "A Happy New Year," "Home Sweet Home," and "God Bless our Home,"—and surrounded by an outer framework of trailing Flowers, the prettiest and most unique things ever made; a set of six Cards illustrating different phases in the life of a City Arab, in beautiful colours, and each bearing a Christmas greeting. These studies are taken from real life. In addition to all the above, one 2d. Card, four Cards at 3d. each, and four Cards at 4d. each. All these Cards of New Designs, most chaste and beautiful Flowers, Leaves, &c., in 10 to 20 different colours, with Christmas and New Year's Greetings and Verses, &c., of the richest possible manufacture, making in all a total of 69 Cards. Equal in value to what would cost, in an ordinary shop, about 10s. 6d. The entire lot offered for 2s. 3d. carriage free. To every purchaser of two Packets we will give gratis a beautiful Crocodile Leatherette Writing case, fitted with Compartments for Note Paper, Envelopes, Cards, Stamps, &c. 25,000 of these Packets now ready to be sent off. This is the greatest bargain ever offered to the public, and cannot fail to give the very highest satisfaction. To avoid disappointment orders should be sent at once, and we urgently request that the Coupon below be cut out and sent with all orders.

These are really CARDS. Many of the Packets advertised are merely stout paper, and ought not to be called cards at all. Also, beware of persons who send out cards which they have bought up, for next to nothing, from makers who cannot sell them because they are several years old. Our Packets contain the Newest Designs for this Season, and of the Best Quality.

ENGLISH MECHANIC COUPON.
Entitles holder to CHRISTMAS BOX PACKET OF CHRISTMAS CARDS at above price.
(Signed) J. THEOBALD and COMPANY.



THE FLYING

DUTCHMAN STEAM LOCOMOTIVE. This is the cheapest real steam working Locomotive ever brought out, and is invented and manufactured solely by us. Large metal boiler with four wheels, oscillating cylinder, steam tap, safety valve, steam pipe and furnace complete. Warranted to work. Carriage free, 3s. 3d.

THE SCRIPTURE OPERA GLASS.

A wonderful tiny Ivorine Opera Glass, for hanging on to the watch chain. On looking through it can be read distinctly, by aid of a microscope placed therein, The Lord's Prayer or the Ten Commandments, though neither is larger than a pin's head. Post free, 6d. each. One of the marvels of science.

THE ACTRESS OPERA GLASS. A

wonderful tiny Ivorine Opera Glass for hanging on to the watch chain. On looking through it can be seen distinctly, by aid of a microscope placed therein, the Portrait of an Actress in costume, though no larger than a pin's head. Post free, 6d. each. One of the marvels of science.

GRAND ILLUSTRATED WINTER CATALOGUE, over 500 Illustrations, 60 Pages, post free, one stamp. Novelties of every description, Conjuring Tricks, Chemicals, Clockwork and Christmas Toys, Cards, Games, &c., &c. Special Illustrated Catalogue of Magic Lanterns and Slides, 3d. Special Illustrated Catalogue of Model Steam Engines and Parts of Engines, 3d.

J. THEOBALD & COMPANY,

WHOLESALE MANUFACTURERS (ESTABLISHED OVER 50 YEARS),

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ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 10, and unacknowledged elsewhere :—

F. A. COBBUD.—W. Kelly.—Rev. C. H. Cope.—E. Weston.—C. Ashford.—Cuttriss and Co.—E. S. Hindley.—A., Liverpool.—A Fellow of the Royal Astronomical Society.—B.—Midnight Oil.—O. J. L.—Mac.—David.—G. R. H.—Beginner.—San Koe.—Rara Avis.—Amateur.—C. H. C.—Ernesto.—Septo.—H. J. Cress.—Pump.

P. M. (Can you not make a sketch for yourself and see the position it must be in?)—G. P. BEST. (All the information in connection with the City and Guilds Institute is given in the "Programme," which can be obtained from the Director, Sir P. Magnus, Gresham College, E.C.; but as you are so near, why not call at the Finsbury College?)—C. P. HALE. (Hamilton's.)—CHARLTON HALE. (See any textbook of mensuration.)—E. M. G. (We do not think there is any full account anywhere; but Ure's Dictionary has an article on the subject, and so has Payen's "Industrial Chemistry.")—JUGGINS. (A description will be found in No. 1,071, p. 102. 2. Any of the publishers of educational works has one or more in his list. 3. Ditto. See catalogues of publishers.)—A. J. P. (A series of articles on electrical motors and their construction appeared in Nos. 1026, 1027, 1029, 1041; but see the indices of the last six volumes.)—A. B. (No "notice" at all. It must be paid befor the expiration of the fourth year from the date of the patent, as fully explained in the "Rules.")—FAIR PLAY. (The police have no right to enter a house and search without a warrant, unless they have seen a thief, &c., entering it.)—CHATTERIS. (The instructions have been given over and over again. The steel is made red-hot—it is well to look at it in the dark—and is then immersed in water, salt and water, or oil, according to the quality of the metal and the nature of the temper required. It is then brightened in order that the colour of the temper may be seen, and is placed on a piece of red-hot iron. At first it becomes a pale straw yellow, and gradually darker until purple appears, and then blue. A brownish yellow is suitable for chipping chisels, mill picks, &c., the blues for spring steel. When the required colour is seen the steel is cooled off at once in water. In the case of chisels, &c., the smith tempers at once—that is, he heats the steel well, dips the end in water, and watches for the colour to appear from the heat in the shank; then cools.)—ARCHBALD. (*Engineering*, Feb. 5, 1886.)—A LEARNER. (Ahn's or Hamilton's. Any bookseller.) — POOR CLOCKEY. (Neat's-foot oil, purified by means of shavings of lead, and placing in the light. That is, put some bright shavings of lead into the glass bottle containing the oil, and stand it in the sun. This may be mixed with sperm, olive, or a little mineral oil; but when purified, which may be known by its ceasing to precipitate, it should be covered up from the light. If wanted very pure, it should be washed with alcohol, then with water, and finally be filtered through animal charcoal.)—BOOTMAKER. (Logwood and bichromate of potash. See "Scientific News," p. 212, and the indices of back volumes.)—DYER. (You want a coil or a very large battery, and there must be some means of completing the circuit in the shape of a metal plate to stand on.)—BEDFORDIAN. (The storm-glass has been frequently described. It is a thin glass tube 12in. by ¾in. in diameter, about ee-fourths filled with a liquid composed of camphor 2 drachms, nitre 1½ drachm, sal-ammoniac 1 drachm, proof spirit 2¼ fl. oz. Close with a brass cap, having a fine hole in it. It will not be of much use when you have made it.)—PITCH BOILER. (We think not; but there are articles in the cyclopædias.)—YOUNG EINGINIVER. (Why not put on a larger one, or procure one from the makers?) AN AMATEUR. (Terracotta is literally "earth baked"—that is, kiln-baked clay.)—SUBSCRIBER. (Out of print, but the makers supply a description.)—WANDSWORTH CHIP. (Nothing to be alarmed at; but take a walk after supper if the dreaming prevents refreshing sleep.)—ELECTICITY V. (No premium at all, we should think, with your qualifications. You should advertise for a situation, saying that you have served an apprenticeship to a mechanical engineer, and are well up in magnetism and electricity.)—NELLIE. (If it is mange, rub in a mixture of black sulphur, lard, and a very little lime. Carbolic soap would be a good thing to wash the dog with, and might avoid the necessity for using the sulphur dressing.)—STEPHEN. (The receipts in question are no doubt as useful as the preparations themselves.)—F. WRAY. (The only way is to make it red-hot in the furnace, and then cool as slowly as possible—*e.g.*, by covering up the fire and allowing it to die out.)—J. C. O. (On the contrary, we did not answer in the way you say, nor was the present the question put. See p. 297, No. 1028. The centre of gravity of the earth and moon is usually taken as 2898·5 miles from the centre of the earth, and the moon revolves round that point once a month. As you now ask a definite question—whether a certain statement is correct—we insert the query.)—DEAN AND CHAPTER. (We think you will find an answer in this week's Replies.)—TOP DRESSING. (Procure some of the manuals by R. S. Burn, published by Crosby Lockwood and Co., Stationers' Hall-court, E.C.; Denton's "Agricultural Drainage," published by E. and F. N. Spon, 125, Strand, W.C.; and Tanner's "Elementary Lessons," Macmillan and Co., Bedford-street, Covent-garden, W.C.)—BRIXTON. (Plaster of Paris, Keen's cement, or fresh-burnt lime mixed with white of egg. See No. 1060, p. 442, and the indices.)—STUD. (They cannot be recast, but the soft vulcanised rubber can be mixed with fresh rubber and sulphur, and re-vulcanised.)—A. E. C. (Apply to the secretary or manager of the company. We know of no examination.)—A. H. M. (You cannot appoint a "qualified substitute" and leave without the sanction of the managers.) JOHN MERRY. (It is impossible to say whether any book will be of service to a given reader without knowing something of that reader's capacity. 2. Simply an effervescing drink resembling "sherbet," except that the tartaric acid and carbonate of soda are kept separately in solution. It certainly will injure a "weak stomach.")—SCIENENTIA. (We are not aware that there is any periodical published dealing with such matters, but there are several scientific journals and magazines which deal with various branches of natural history.)—READER OF "E.M." (We know nothing of it, and cannot understand your description. Why waste your time over it?)—G. A. W. (Apply to Messrs. Shepherd, Rothwell, and Hough, Oldham, for a list of their machines.) — GLAM. (Fine emery might answer; but why will not ordinary fine sand do?)—D. D. (See pp. 52, 533, Vol. XLII., for instance, and the indices of the back volumes.)—DELTA. (See p. 50, Vol. XXXVIII. Don't buy a second-hand microscope unless you have the opinion of an expert or can test it yourself. See indices of back volumes.)—ANNOYED. (How will it answer when your dearest friend knocks at the door? However, you will find sufficient information repeated many times over in back volumes. If one wire is connected to the handle and the other to the knocker, anyone holding both at same time will complete the circuit.)—R. H. W. (As good a preservative as anything is made by boiling 1½lb. of whiting and 1lb. of soft soap in about a pint of water, stirring in 2oz. of dried and finely-powdered chloride of lime. That mixture is rubbed into the skin, and the feathers are dressed with an alcoholic solution of corrosive sublimate, which is too strong if it leaves a whiteness on a black feather when dry.)—E. F. FLEET. (A number has been sent you containing directions for making a Wimshurst machine, and if you refer to back volumes, or to the little book mentioned on p. 193 ante, you will have all the details needed. If you wish to understand all about "Electricity" you should procure Sprague's work on the subject, which is published by E. and F. N. Spon. There is no "practical" book in the sense you appear to mean.)

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Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, **Photo Apparatus**, wet or dry, cameras, sundries, &c., in exchange for Microscopic or Magic Lantern Slides.—Apply, PIGGOTT, Chemist, Huddersfield.

Commercial Self-inking **Printing Press**, new specimen of work sent with woodcut of machine, cost 50s. Exchange good Set of Drawing E. Instruments, about same value.—C. CAMPBELL, 483, Springburn-road, Glasgow.

"**English Mechanic**," 500 numbers, from 593 to 1093, with indices, clean and perfect. What offers in exchange?—STUBBIN, Buckshorn Oak, Alton.

Will exchange 30-c.p. **Dynamo**, Jones' laminated armature, Thirlmere water motor, 3 pulleys, flywheel, for good lathe or set of leads for light.—151, High-street, Chatham.

Lathe, 5in. centres, all iron, good condition, compound slide rest, overhead gear; offers to £6, part cash preferred; particulars, stamp.—17, Newland-street, Kettering.

"**Knight's Mechanical Dictionary**," first 18 parts, quite new, cost 2s. each. Will exchange for Engineering Books, cash, or offers.—T. BATCHEN, Inness-street, Inverness.

What offers for good **Steam Gauge**, 60lb. pressure, no use to me; cost £3 when new. Would take good Watch or anything useful.—C. HOLDER, 59, Ablow-street, Wolverhampton.

Homœopathic Medicines.—Popular Books on the Science exchanged for Medical Coils by the Medico-Botanical Gardens and Free Dispensary Company, Lydney.

"**English Mechanics**," Dec. 1881 to Aug. 1886; Lancaster Photo Lens, stops, instantaneous shutter, Eclipse. Exchange Electrical, or old large Camera.—FELL, Market Rasen.

Wanted 6in. **Gap Lathe**, with back-gear, centring, and other chucks, surface-plate, and tools; also bicycle rim bender. Offers.—W. B., Spencer-place, Blackheath.

Will exchange 9 Patent **Pens** that will write numbers of letters without taking from paper, and sold at 2s. each, for Opera Glass or Telescope.—R. SAUNDERS, Willenhall.

English Concertina, 48 keys, in mahogany box, by Dawkins, cost 4 guineas; offers to value 25s.—BLANCHARD. No cards.

Diamond Drills for china, glass, stone, &c., the same as used by china riveters. Offers. Stamp reply.—C. BLANCHARD, 29, Earl-street, Lisson-grove, London.

15 **Carbon Plates**, 8 by 2½; 7 Zinc, 6 by 2½, binding screws on all; small motor; 5 c.p. lamp; 2½in. electric bell; 6-cell Bichromate, 2C., 1Z., with lifting arrangement; 20 round, 16 flat porous pots; about dozen binding screws; "Sprague's Electricity." Wanted, mahogany bagatelle table, music type, or offers.—G. R. KING, Newport, I.W.

Six ton **Weighing Machine**, in good condition, lever 4ft. long. Part cash and exchange.—F. GRIFFITHS, Heath Town, Wolverhampton.

Photographic.—Contents of amateur studio, nautical sextant, magneto-electric machine, orguinette, double breechloader, bicycle, grandfather's clock, powerful Singer sewing machine. Offers requested.—A. GARRETT, Towcester.

Wanted Second-hand **Poppett Head** for lathe, 5in. or 5½in. centre. Exchange 4in. Poppett.—NEISH, Burghead, Elgin, N.B.

"**English Mechanic**," Vols. XXXVII. and XXXVIII., for Microscopic Slides, stained or injected.—JONES, Duke-street, Settle.

Vertical Engine, 4in., price £3 10s., or would exchange for old brass, copper, or anything useful.—J. L. GREENWOOD, 7, Dutton-street, Cheetham, Manchester.

Photographic.—Half-plate or larger lens wanted; will give 12in. plate electric machine, or small electro-motor, suitable for driving sewing machine.—B. D., 40, Sandbourne-road, Brockley, S.E.

Eight Iron Lalande **Copper Oxide Cells**, complete, 16 by 8 by 4, with three five-candle-power lamps, and 20lb. of copper oxide. Exchange for Photograph Apparatus.—F. HUDSON, Battle, Sussex.

Wanted, two **Bichromate Batteries**, glass bottles shape, complete, in exchange for new nickel-plated Bull-Dog Revolver, very handsome.—B. TAYLOR, Milbourne-street, Blackpool.

Tricycle, for Piano, double driver, front steerer, hill-climbing gear, buffer saddle, cradle spring, cost £25, lamp complete.—W. W. EVERS, Wath, Rotherham.

Wanted **Double Magnet Battery**, with multiplying wheel, all complete. Exchange "Cassell's Technical Educator," 26 6d. parts, complete, unbound; 24 6d. parts "Popular Educator," unbound, latest edition.—W. BEVINGTON, Alder-lane, Hindley-green, near Wigan.

Wanted, good powerful **Shocking Coil**, suitable for parties or bazaar. Will give good value in other Electrical Apparatus.—T. MORRELL, 54, High-street, Brierley-hill, Staffs.

Model Engine, horizontal 1in. bore, 1½in. stroke; wanted one smaller. Magic Lantern, with 12 framed slides, showing picture about 3½ feet.—Below.

Model Schooner, 30in. long, wanted cutter about 18 inches, or offers for above.—MEIKLE, 100, West Bow, Edinburgh.

Tricycle, Coventry lever, double steering, two track, adjustable pedals, cushioned seat, good condition, newly painted, Offers.—FORD, 75, St. Paul's-road, Camden, N.W.

"**Scientific American**," in weekly numbers, for years 1882-3-4, four numbers missing. What offers?—F. WEBBER, Curzon-street, Nottingham.

4 Horse-power Horizontal **Steam Engine**, in good condition, with governors all complete, part cash and useful exchange.—F. GRIFFITHS, Wednesfield Heath.

Tricycle, nearly new, part exchange; also 50in. bicycle, nearly new, Bown's ball bearings, cowhorn bars.—F. GRIFFITHS, Wednesfield Heath.

Wanted S. Bottone's new book "**The Dynamo**," in exchange for "Shelley's Workshop Appliances," quite new.—Address, JOHN RIGG, 26, East Hope-street, Glasgow.

Wire, Bell, and Mercury, for Back Numbers "E.M." or Books.—To correspondents who wrote to WALTERS, 25, St. Paul's-place, Canonbury, about this. See advt. Exchange, Oct. 29th. Letters accidentally miscarried. Please write again.

Whole-plate Folding Mahogany **Camera**, rising front, two dark slides, single and double, Terebour's Cabinet Lens, Tripod, Background on roller, printing frames, ¼ to whole plate, Glass Bath, and dippers, in case, Cabinet of Chemicals, two large Porcelain Dishes, Mounts, and Graduated Measures. Cost £20. Exchange for Tricycle, or £5 and Electrical offers.—T. A. CARTER, Electrician, Uttoxeter.

Electric Machine, 12in. cylinder, mahogany stand, almost new, packed, £1, or offers.—M., 99, High-street, Gosport.

Thirty back numbers "**English Mechanic.**" Exchange for others I have not got.—M., as above.

6 "**Illustrated London News**" volumes, well bound, and perfectly clean, carriage paid. Useful exchange.—HARRY B. SAUNDERS, Baker, Stoneham-street, Coggeshall, Essex.

Water Motor, half horse-power. Exchange for 20 candle-power Dynamo.—9, Queen Anne-street, Stoke-on-Trent.

Back-geared **Lathe**, 6in., 5ft. bed, 7 speed wheel (gut), Boiler, 2ft. high, with fittings. 12in. Slide-rest. Offers.—Letters, W. SMITH, Bilston-road, Wolverhampton.

Wanted, good **Carpenter's Tools** or Microscope in exchange for 21 2s. numbers "Cassell's Illustrated Travels," nearly new.—S. MASON, 68, Vauxhall-road, Gloucester.

Wanted, Astronomical **Telescope**, good maker and condition, 3 inches or upwards. Exchange Humber Tricycle, Hearson's Incubator, Books, Aurephone.—T., 15, Upper Leeson-street, Dublin.

Electric Bell, 4in., 3-cell battery in box, indicator 6 holes, 6 china pushes, 1 barrel push, all new. What offers?—M., 11, Victor-road, Holloway, London.

Bicycle, 52in., good, no rubbish; exchange for Lathe or Engine, or useful Tools.—GLOVER, 12, High-street, Derby.

Will give in exchange 60 complete numbers of "ENGLISH MECHANIC" for Pigeons, or what offers?—G. T. JAMESON, 24, Gwynne-road, High-street, Battersea.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 19, 1886.

NOTES ON THE CHAMBER ORGAN.—VIII.

By George Ashdown Audsley, F.R.I.B.A.

In the present article I bring my Notes to a conclusion for the present, and, while penning my last remarks, I cannot help expressing a sincere hope that what I have said on the subject under consideration may be the means of inaugurating a more satisfactory system of Chamber Organ building than that which has hitherto obtained. My special thanks are due to the Editor of the English Mechanic for the prominent position he has accorded to these articles in the pages of his valuable journal, and to the many readers who, both publicly and privately, have expressed their kind approbation of my humble attempts to advance the art of Chamber Organ building.

The Touch of the Organ.

The touch of the Chamber Organ is a matter worthy of most careful consideration; for on it depends, to no small degree, many refined effects and certain minute shades of expression. Extreme lightness of touch is desirable in the manual keys, combined with perfect taughtness of all the attendant mechanism or action, and, accordingly, instantaneous speech and faultless repetition in the pipe work. The action must be so accurately adjusted that the pipes speak properly when any key is depressed the thickness of its ivory. The touch should never be heavier than that usual in a grand pianoforte; indeed, for more than one good reason, the pianoforte touch should be imitated as closely as possible in the uncoupled claviers. In most cases the Chamber Organ will be played by persons accustomed also to the pianoforte, hence the desirability of having the touch of both instruments similar. A light touch is readily secured by the adoption of either the pneumatic tubular or the electric actions; but, for general purposes, I recommend neither of these for such an organ as has been contemplated in the foregoing articles. Putting aside their cost and other considerations, not necessary to be mentioned here, there is an objection to anything of so *absolute* a nature. I mean by the term *absolute* these peculiarities—the *full opening* of the wind-chest pallets, let the keys be depressed by the fingers in any manner whatever; and the necessity of depressing the keys to their full depth, or nearly their full depth, before any result is obtained. In the case of the electric action, the instant the contact is made by the key the pallet flies open to its *full extent.* It is impossible, in either the pneumatic or electric actions to arrest the pallets at any intermediate point: they must either be *closed* or *fully open.* A lingering, loving pressure of the keys has no modifying effect on the sounds produced when the electric or pneumatic systems are employed; and yet this lingering toying with the keys of an organ, if the organ is properly constructed, has a power which few, perhaps, have realised at its full value. I have known organists—musicians I was going to say—who disputed the possibility of modifying tone by the manipulation of the organ keys, and who almost laughed at the mention of a refinement they could neither produce nor realise. As I have already said, both the electric and pneumatic actions are so *absolute* as to render such a refinement impossible; and in almost all the organs constructed on the ordinary system the key actions are too coarsely made and adjusted to admit of anything beyond a uniform style of manipulation.

I have given some attention to this, as to other matters connected with the organ, and the result of my experience is that for the Chamber Organ nothing is so suitable as a perfectly-constructed lever, tracker, and roller action. When such an action is made by a master hand, of the finest materials, and lightly and accurately regulated throughout, it leaves absolutely nothing to be desired. To prevent loss of power, undue friction, and any objectionable springing or stretching, let the action be as short and direct as ingenuity can devise. The more perfectly the pallet is under the control of, and partakes of, the motion of the key, just as if they were glued together, the better the result aimed at will be. When the entire action is thus responsive, the organist has a new power in the points of his fingers, and it will not be long before he finds it out. I am free to admit that I am now speaking of refinements of touch beyond the ken of organists who derive their ideas from their acquaintance with ordinary organs, and especially those with pneumatic or electric actions; but I believe, so far at least as the Chamber Organ is concerned, nothing can be looked upon as too great a refinement, or as unworthy of the most deliberate attention. It is only in the multiplication of such refinements that a great result is achieved. It is not in great details that a violin by Straduarius differs from one by any ordinary maker.

It will be gathered from the above remarks that I favour the attached claviers, with which the advantageous short and direct action is alone possible; and that I do not, as a general rule, advocate the detached console in connection with the Chamber Organ. With reference to church and concert-room instruments, the case is widely different; refinements of touch, so valuable in a delicately-voiced Chamber Organ, would be altogether useless in large and loudly-voiced instruments in spacious buildings, and under varied acoustic conditions.

The Breath of the Organ.

The bellows have not inaptly been designated the "lungs of the organ"; and, accordingly, the wind which inflates them and gives life to the entire instrument may be spoken of as the breath of the organ. As in the human frame, so in the organ, capacious lungs and an ample supply of air are necessary to its proper functions. An organ can be asthmatical as well as weak humanity; and when so afflicted neither can do its work properly. Deficiency of wind is a complaint only too prevalent in instruments built in other localities besides the private drawing-room or music-room; but in Chamber Organs the disease is more likely to obtain, simply because there is, as a general rule, scant space wherein spacious lungs may be accommodated. It must be realised once for all, that it is in vain beautifully-voiced stops are planted on the wind-chests, that delicate mechanism is provided, and that swell-boxes are multiplied so as to secure satisfactory powers of expression, if the lungs are insufficient to pour throughout all the departments of the instrument an adequate supply of the breath which is the life thereof. There must be no misunderstanding about this matter—no compromise attempted: the bellows must be large enough, and so constructed as to meet the greatest demand that can possibly be made, and have wind to spare for as much again. Such being the case, it is obviously desirable to locate the supply bellows in some suitable apartment underneath or adjoining the organ, where there will be ample space for the bellows and whatever motor may be adopted for working the feeders. In the case of large church and concert-room instruments, the supply bellows are frequently located at a considerable distance from the organs; the wind being conveyed through long pipes, or trunks, to the reservoirs adjoing the wind-chests. Such an arrangement, however, is not to be recommended for a Chamber Organ; for it is important, if not imperative, that the wind furnished by the bellows be of the same temperature as the air of the room in which the organ stands. This fact must on no account be overlooked, for an instrument so delicately-voiced on so light a pressure is easily put out of tune by local currents of either cold or warm air, and especially by the wind passing through the metal pipes. Wherever the supply bellows are placed, arrangements must be made to convey wind from the organ-room to their feeders. This is best done by enclosing the bellows in a special chamber or box of wood, connected by an opening or trunk with the space immediately under or adjoining the organ. In the case of my own organ, the entire bellows—feeders, receiver, and pedal and manual reservoirs—are placed in a room directly under the organ, inclosed with tight woodwork, and supplied with air, from the music-room, through perforations in the floor. No better arrangement than this can be devised, allowing that the bellows-room is perfectly dry; but an adjoining room, on the same level as the organ, will answer equally well. It is, however, as a general rule, more difficult to secure such a room than one underneath the organ.

It is desirable to place the reservoir for the supply of the manual departments within the organ, as near as possible to the wind-chest, conveying the wind to it from the main receiver by a spacious wind-trunk, furnished, where it joins the reservoir, with a properly constructed valve or ventil. The reservoir for the wind of the pedal department may be at any reasonable distance, for there is not so great a risk of unsteadiness of wind in connection with the pedal pipes. It is highly desirable in all Chamber Organs to separate, as much as possible, the manual from the pedal wind, and this is most conveniently done by having separate reservoirs, supplied from a general supply bellows consisting of feeders and a receiver. The reservoirs must be weighted to give the required pressure of wind; while the general receiver must be weighted a little in excess, so as to keep both the reservoirs full at all times. Whatever the size and internal capacity of the receiver and reservoirs may be, it must be borne in mind that the continuous supply of wind depends entirely on *the capacity and satisfactory operation of the feeders.* There seems to be some uncertainty in relation to this fact, and our greatest writer on the organ has fallen into a strange blunder anent it. Let it be realised, once for all, that the feeders supply the wind; and that the receivers and reservoirs merely receive and store a very limited quantity for the purpose of imparting the required pressure or force to it—they are practically regulators of the wind, and it appears to me that they should be designated by the term, *regulators*, rather than by the name I have previously used, and by which they are commonly known. To speak of the different forms of feeders, and the construction of the most approved shapes of bellows, would be out of place in the present Notes; my readers must, therefore, be content with the above general hints regarding the lungs of the organ. Perhaps on some future occasion, should the Editor of this journal deem it expedient, I may be tempted to treat the Art of Organ Building in a thoroughly practical manner for the benefit of amateur builders and others interested in the subject.

Blowing Apparatus.

The present Notes would be obviously incomplete without some allusion being made to the appliances required for working the feeders, or what is commonly known as

"blowing the organ." For a Chamber Organ it is almost imperative that the operation of blowing be done without noise and out of sight, for nothing is more objectionable than the sight of an individual toiling away at the bellows handle—up and down eternally. Does not the handle seem to say:

"Men may come and men may go,
But I go on for ever"?

The necessity of doing this work noiselessly and out of sight is another strong argument for the location of the supply bellows in some neighbouring apartment. Blowing is both a monotonous and fatiguing operation, and when it has to be done by manual labour, let some contrivance be adopted to render it as easy as possible. The simple lever or handle should always be avoided when the feeders are detached from the organ proper. In the case of small instruments, which contain the supply bellows, the handle is generally the only means of blowing available, and it has then to be put up with as an unavoidable nuisance. When the supply bellows are situated in another room, the feeders, if they are of the ordinary form, should be three in number, and worked with a three-throw crank-shaft, supported on friction wheels, and having a flywheel and handle complete. By this arrangement the labour is reduced to a minimum, and great steadiness of blowing is secured. I commend this system to all who cannot afford, or cannot avail themselves of either a hydraulic or gas motor. When the bellows are encased, as above recommended, the ends only of the crank-shaft should appear outside—one end having the handle, and the other the flywheel. A wind indicator should, of course, be fixed close to the handle. The best form is that known as the "Eclipse Wind Indicator," invented and supplied by a firm in Boston, U.S.A. It is a most beautiful and ingenious little contrivance, mounted in a circular nickel-plated case, glazed. The indicating portion is formed of two discs of card—one white and the other black—so arranged, that in revolving the white one gradually covers or uncovers the black. When the bellows are empty the disc is entirely black, when it is full the disc is entirely white. Mr. Roosvelt usually places one of these indicators immediately over the manual claviers, in full view of the performer; so that he may at all times know the amount of wind in the receiver, and the manner in which the supply is being kept up. I believe I was the first to introduce the "Eclipse Wind Indicator" into this country; but it is but very little known in Europe at the present time.

I now come to the consideration of the motors or engines most suitable for blowing purposes, in connection with Chamber Organs. The only available and suitable powers are water and gas. The former, when it can be readily procured of sufficient pressure—say, from thiry to sixty pounds to the square inch—will always be preferred; but, as in my own case, when the supply is intermittent, gas becomes a valuable power. As very satisfactory gas engines of low powers are now made, and can be procured at moderate prices, no Chamber Organ of any pretensions need depend on the miserable hand blowing for its breath of life.

Water Motors.

For Chamber Organs, which require to be blown with the greatest possible steadiness, and without noise, the motor known as "Duncan's Patent Water Meter" is unquestionably the best yet introduced. As a proof of the absolutely perfect action of this motor, I may just mention the fact that a friend of mine placed one in his drawing-room, adjoining the organ, and merely covered with a glass case, without the slightest noise, vibration, or any other inconvenience arising from it. My own organ was, for a period of nine years, blown by a "Duncan," and it left nothing to be desired. This motor has two cylinders, with pistons and slide-valves, after the fashion of the steam-engine. The connecting rods to the blowing action extend directly from the piston rods. Sometimes only one piston-rod is connected with the feeders, but this is not to be recommended. When both are made use of, four feeders should be provided, worked, in pairs, by rocking beams connected with the piston rods in any convenient manner. By this arrangement the feeders are balanced and less power is expended. Full-drop feeders are to be preferred where practicable, so as to economise the consumption of water, and, accordingly, decrease the speed of the engine. For organs requiring a large supply of wind, double-action vertical feeders should be adopted, connected, in as direct a manner as possible, to the piston-rods. Of course, in the case of this, as in all other water motors used for organ blowing, the supply of water is regulated by a valve commanded by the rise and fall of the receiver of the bellows. Full particulars respecting this valuable motor may be obtained from Messrs. G. Forrester and Co., engineers, Vauxhall Foundry, Liverpool.

Of the single cylinder water motors, all of which are, more or less, jerky and noisy in their actions, I need say nothing here. I have done my duty in drawing attention to the most perfect motor in existence, to my knowledge, and so close my remarks.

Gas Engines.

It would be impossible, even if desirable, for me to consider the merits and demerits of the several gas engines in the market in a brief article like the present; but, as I am confining my remarks to matters relating to the Chamber Organ, the question of gas engines for blowing purposes narrows itself in a very satisfactory manner. For all organs which require a low power—say, from 2 to 4-man—I am firmly convinced the engine known as the "Bisschop" is the best. It is very simple in construction, and, accordingly, requires little attention to keep it in working order; it is vertical and compact in form, and, therefore, occupies a very small amount of floor space; it consumes very little gas; and it can be started with the greatest ease by anyone, after the first direction is given. It does not require to work at a high speed, and admits of control to a considerable extent without coming to a standstill; it requires no expensive fittings, water-tanks, or any special provision to be made for its reception; it is as noiseless in operation as one can ever expect a gas engine to be; and, lastly, it is the cheapest gas engine in the market. After a careful examination of the merits and demerits of all the engines known to me, I have decided in favour of the "Bisschop" for my own organ. Need I say more by way of recommendation? Particulars respecting the "Bisschop" gas engine may be obtained from Messrs. J. E. H. Andrews and Co., 80, Queen Victoria-street, London.

The chief difficulty in connection with the gas engine, in organ blowing, lies in the fact that it cannot be controlled like a water motor; that is, it cannot be made to work automatically—fast or slow, exactly in accordance with the demand on the wind.

Two methods may be followed with the "Bisschop." Fast and loose pulleys may be fitted on the crank-shaft of the bellows, and the belt moved from one to the other by a fork controlled by the rising and falling of the receiver; or a blowing-off arrangement may be adopted in combination with an appliance for reducing or increasing the speed of the engine within the imposed limits. The latter is the method I have adopted. When either of these methods are followed, it is advisable, if not imperative, to have reservoirs in addition to the receiver, so as to effectually prevent unsteadiness in the wind delivered to the pipes. The common objection to the blow-off system is the noise made by the escaping wind; but this can be entirely removed by covering the blow-off valves with a box or frame, over which is stretched a piece of thin flannel. The wind passes freely through this material without any hissing sound.

These remarks conclude my "Notes on the Chamber Organ." Hasty and imperfect as the Notes unquestionably are, I am gratified to learn that they have not been without interest to many readers of the English Mechanic.

DR. PAQUELIN'S AUTOMATIC BLOWPIPE.

An improved apparatus for generating and burning imflammable vapours has been recently patented in this country on behalf of Dr. Claude A. Paquelin, of 12, Place Vendôme, Paris. The invention relates to a sort of automatic blowpipe apparatus for the production of high temperatures; but it may be employed in its simple form for heating kettles, cauteries, soldering, branding, and goffering irons, and the like; and it may be combined with other parts so as to form a single apparatus or instrument of which it constitutes the heater. The heat developed by the apparatus may also be utilised for producing light by rendering a refractory material incandescent. In order that the invention may be more readily understood we have illustrated an example thereof in the accompanying drawings, and will proceed to describe it with reference thereto. Fig. 1 is a vertical section, and Fig. 2 a similar section taken on line 1—q of Fig. 1 of a lamp constructed according to this invention. The apparatus essentially comprises—1st, a closed vessel for the inflammable liquid traversed by a tube open at bottom, which is preferably central but may be at one side, the tube being surrounded by a wick or other porous substance which is immersed in the liquid contained in the vessel; 2nd, a jet nozzle within the tube in communication with the space for inflammable vapours generated in the vessel; 3rd, a chimney forming an extension of the tube wherein the gaseous mixture produced by the commingling of the jet of inflammable vapour with an induced current of air is burnt, and from which the burning mixture issues with force. The invention is based on the combination of these several parts, whatever may be the additions made for the purpose of adapting them to the various uses for which they are applicable. This combination permits of obtaining a large surface for heating the combustible liquid, of utilising the conductivity of the metal of which the apparatus is constructed, and of employing for the purpose of vapourising the liquid only the heat concentrated in the chimney without exposing the vessel to the direct heat of a fire. a is the closed vessel, which may be made of cylindrical or other form, and b the central tube passing up through it and surrounded by porous meaterial c. The jet nozzle d is placed within the tube b near the upper end and communicates by a duct e with a chamber f at the upper end of the vessel a. It is filled with a bunch of metal wires to filter the vapours and prevent the jet becoming choked. The chamber f is separated from the vessel a by a diaphragm having perforations g to permit the inflammable vapours to pass the nozzle d. This diaphragm may, however, be omitted, the vapours being contained between the top of the vessel a and the upper end of the wick or porous body c. h is the chimney into which is discharged the gaseous mixture formed by the vapour from nozzle d and the air drawn in at the open bottom end of tube b or at any other inlet which may be provided for it. The chimney may be a fixture, but it is preferable to make it separately and fit it upon the cross-tube e carrying the jet nozzle. The vessel a is provided with a filling orifice closed by a screw plug k, and also with a circular channel or gutter l at bottom, into which dips a pipe m, passing down through the vessel a and terminating at top in a funnel mouth n. The apparatus is supported upon a perforated bottom ring o, and the

FIG. 1.

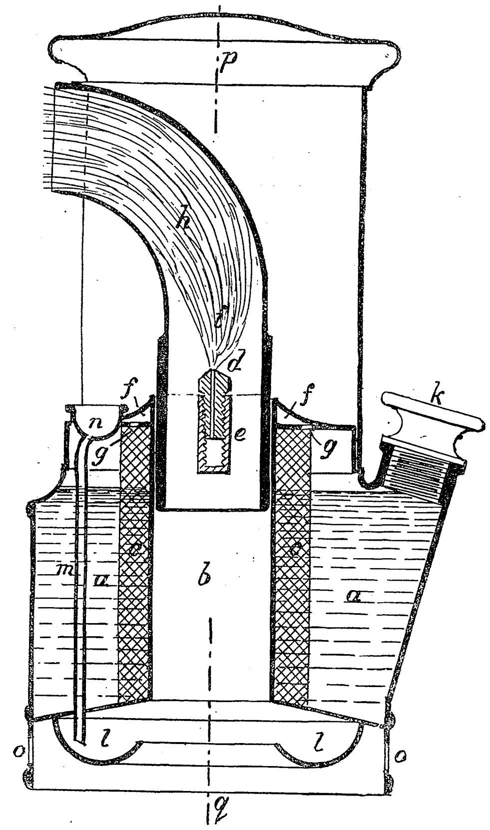
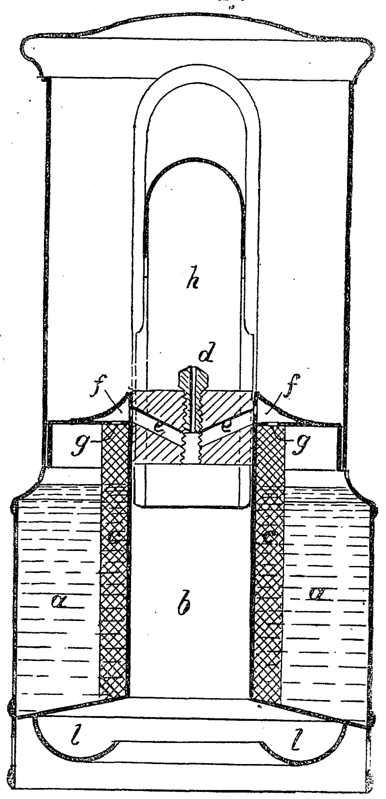


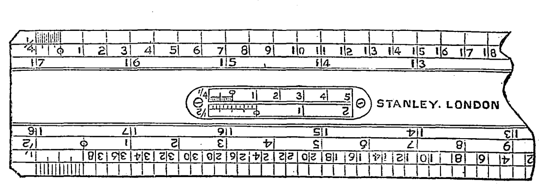
FIG. 2.



chimney is protected by a cap *p*. To use the apparatus, the vessel *a* being filled with inflammable liquid and the plug *k* screwed down tight, a small quantity of petroleum spirit or other inflammable liquid employed in the apparatus is poured into the circular gutter *l* through *n* and *m*, and is ignited beneath the vessel *a* to heat the vessel and start the generation of inflammable vapours, which, rising into space *f*, issue under pressure at nozzle *d*. By the inductive action of the jet, air is drawn through the tube *b*, the mixture thus formed constituting a forced jet, which ignites of itself in the chimney if a sufficient quantity of priming liquid has been used. The priming liquid in the gutter *l* being now consumed, the apparatus will continue to work automatically until the supply of liquid in vessel *a* is exhausted, this automatic action being due to the heat of the flame *i* conducted by the metal, of which the chimney *h*, tube *b*, and vessel *a* are made, to the liquid contained in the vessel and the porous substance enveloping the tube. The vapour is generated as fast as it is consumed at the nozzle *d*, so that the apparatus continues to be supplied. The apparatus when once started acts with great regularity, and there is no risk of explosion, inasmuch as in the event of the jet nozzle becoming obstructed the flame would be thereby extinguished. If desired, the apparatus may be provided with one or more regulators; for example, there might be applied at the base of the chimney *b* a fixed and a movable perforated part by adjusting the one on the other, of which the size of the apertures may be regulated so that the heat will be concentrated upon the chimney and the action of the apparatus be increased, and conversely if the perforations be made to coincide. Another similar regulator may be placed at the base of the apparatus to limit the influx of air to the tube *b*, which may consist of a perforated band movable around the bottom ring *o* so as to close the orifices more or less. Or a valve, cock, or other regulator, may be employed for controlling the draught. The several parts of the apparatus may be varied; as, for example, the container may be made of any form and the tube *b* be either open or closed at bottom, as before explained, the mixing of the air with the inflammable vapour being effected in the latter case at the base of chimney *h* only. The air may also be introduced partly through the tube *b* and partly through the chimey *h*. The nozzle *d* may also be placed at any suitable height of the central tube, but preferably at its upper end, in order that the vessel *a* may not be exposed to the direct heat of the flame but only to the heat transmitted by the metal. The gutter *l* may also be replaced by one of a similar kind, placed at the top of the container *a*, in which case one or more openings would be required at the base of the chimey for igniting; or the gutter may be entirely dispensed with and the apparatus be heated by placing it on a separate stand. In order to supply the gutter *l* in the apparatus shown with the exact quantity of petroleum required, a drop bottle or pipette, graduated if desired, may be provided. All the accessory parts of the apparatus would vary according to the purpose for which the apparatus is to be used, and the essential parts consisting in the combination of the container, central tube, nozzle, and chimney, may be applied to all kinds of apparatus such as soldering, branding, or goffering irons, &c., and would therefore vary in form and dimensions.

STANLEY'S PATENT ARCHITECT'S AND ENGINEER'S SCALE.

THE inch divisions at the end of ordinary feet and inches scale soon become faint by constant use, this part of the scale being always used. To avoid this, in the improved



scale a short piece of metal work is inserted at each end of the scale, upon which is divided a repetition of the ends of the scales. This metal scale is intended for taking off short dimensions, as the sections of timbers, thickness of brickwork, &c., with the dividers or with pencil bow. The metal is soft enough not to injure the steel points of the compasses, and yet hard enough to bear ten times the wear of the ordinary scale. Anyone using this scale may always keep sharp, clear divisions on the edge, and work more exactly than with an ordinary scale, even where only slightly worn.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—XVI.

By an Analytical Chemist.

Oils (*continued*).

(226.) THE following table gives the results of the examination of a very large number of samples of oils in common use. Of the three columns of specific gravities, the *first* contains the figures given by the best authorities for pure oils; the *second* those obtained for the majority of samples within the writer's experience; the *third* contains the gravities representing a considerable proportion of the total number of samples examined. The second and third columns may be taken as fairly representing the gravities of oils prepared in the ordinary way, and sold in the market during recent years; but the figures in the third column must not be regarded as the extreme limits for good samples.

With the exception of sperm oil, the figures in the first and second columns practically agree, or only differ to an extent corresponding to the difference between a sample prepared in or for the laboratory, and a commercial sample. It would appear that sperm oil of a gravity of ·875 is rarely to be met with in commerce.

(227.)—
Table of Specific Gravities of Oils in Common Use.

	Specific Gravities.		
	No. 1. From text-book.	No. 2. Majority.	No. 3. Very large proportion, vary from.
Vegetable oils:—	(at 100°F.)		
Cocoa-nut......		·911	·910—·911
Colza............	·9136	·914	·914—·915
Olive............	·916	·916	·915—·917
Cotton seed, refined	·920—·923	·922	·922
Niger seed, refined	·926	·926	·926
Linseed.........	·930—·935	·932	·931—·933
„ boiled...	·940—·950	—	·940—·945
Castor	·961	·962	·962—·963
Animal oils:—			
(*a*) Neatsfoot...	·915—·9178	·916	·915—·917
Lard	·915	·917	·917
(*b*) Sperm	·875	·881	·880—·882
Cod, pale ...	·923	·924	·922—·924
„ brown	·929—·931	·926	·926—·928
Seal	—	·925	·925—·927
Train or Whale ...	·923	·925	·925—·933
Lubrctng. oils:—			
Valvoline......			·870—·890
Rangoon			·901—·910
Crane's minrl.			·904—·910
Cylinder			·913
Watchmakers			·914—·918

Linseed Oil.

(228.) The tests given in these papers are chiefly with a view of determining the suitability of an oil for the particular purpose for which it is intended to be used, and are therefore not solely confined to a determination of the purity or impurity of the sample.

(229.) Linseed oil is used for paints, varnishes, printing inks, and in the manufacture of floorcloth. Its suitability for the latter purpose is determined on the large scale in the following practical manner:—Two gallons of the oil, with one per cent. of a mixture of equal parts of ground litharge and red lead, are boiled in an iron pot for from two to four hours, and at a temperature not exceeding 260° C. The process is quickened by blowing in air from an ordinary bellows. Samples are taken out from time to time, and cooled on an iron plate. If the sample becomes stringy when cool, the pot is removed from the fire, and the contents

stirred until cold. A suitable oil should be solid when cold; an unsuitable one would be semi-liquid or sticky.

(230.) The suitability of linseed oil for painting is determined by the following tests, which also apply génerally to oil for floorcloth, or for any other purpose :—

(*a*) Spec. grav.
(*b*) Inorganic matter, freedom from.
(*c*) Drying properties ; elaïdin test.
(*d*) Freedom from excessive acidity.
(*e*) Sulphuric acid test.
(*f*) Temperature at which fat deposits.

(*a*) *Specific Gravity.*—This is usually given in textbooks as ·930 —·935. There is so much difference in the method for extracting the oil that the limit is necessarily wide. My own figures show that ·931—·933 are the most common gravities, thus :—

s.g. ·930	7·7 per cent.	of the total number of samples examined.
·931	16·0 „ „	
·932	55·0 „ „	
·933	14·7 „ „	
·934	5·3 „ „	
·935	1·3 „ „	

Oils of the lower densities are expressed without artificial heat, and are of better quality ; but they do not keep so well as those of higher densities.

(*b*) *Inorganic Matter.*— Gently ignite two grammes in a porcelain basin until all the black carbonaceous matter has disappeared. The residue should not weigh more than ·05 per cent.

(*c*) *Drying Properties.*—A simple way of applying this test is by placing one drop on one sheet of glass and two drops on another ; spreading the oil on each glass as evenly and thinly as possible, by working the finger in a circular direction, beginning with the drop as the centre, and gradually extending the circles until the oil will reach no farther. Allow the glass sheets to stand in a place protected from dust, and at the ordinary temperature. A good oil will be "tacky" after 24 hours, and should be dry in from 40 to 48 hours. The kind of surface formed is also a matter of importance. A tough elastic surface is characteristic of good oils, and *vice versâ*.

The sheets of glass must be quite clean and free from grease or dirt before using ; the same sheets can be used again and again. A few drops of strong alcohol, followed by gentle rubbing, readily remove the oil from the glass.

As linseed oil is almost invariably used on account of its drying properties excelling those of any other oil, it is hardly necessary to remark that this test is a most important one.

The elaïdin test described in Art. 220 is also very useful in detecting adulteration in the form of a non-drying oil. Linseed being a rapidly drying oil, no solidification should be produced by this test, which it is always desirable to make at the same time and under exactly the same conditions on a sample of known purity.

(*d*) *Acidity.*—10cc. of the oil and 10cc. of neutral alcohol (60 o.p.) are shaken thoroughly, and then allowed to rest. The alcohol rises to the top, and 5cc. of the clear supernatant spirit are taken and titrated with decinormal soda solution, using litmus or phenol phthalein as an indicator. The number of cc's. of decinormal soda solution required to neutralise the 5cc. taken, when multiplied by 20 and ·006, gives the percentage of acid calculated as acetic. In good fresh samples the acid dissolved by the alcohol does not exceed 0·15 per cent. of acetic.

(*e*) *Sulphuric Acid Test.*—This is a colour test. Twenty drops of oil are placed on a small perfectly clean and white basin, or on a sheet of glass with white paper underneath, and in the centre of this one drop of the strongest sulphuric acid (s.g. 1·84) is carefully let fall from the end of a glass rod previously lowered until it nearly touches the oil. The acid acts powerfully on the oil, and in a few seconds a brown compact clot forms, which gradually deepens in tint until it becomes a dark chocolate. A loose clot, or the production of a different tint, would indicate the presence of other oils. But it is only an indication, for linseed oils are occasionally met with which do not exactly correspond to this test. Description fails to convey a clear idea of the colours produced in these colour tests. The best plan is to obtain a sample of first-class quality, and treat the two samples side by side in exactly the same way. This remark applies generally to the colour tests.

(*f*) *Temperature at which Fat deposits.*—This is a good test for linseed oil, as its solidifying point is as low as about − 20° C. Fat begins to deposit at about − 11° C.

(231.) The foregoing are the tests usually applied ; but others must be made if the results now obtained are not satisfactory.

The solubility in alcohol is a useful test. Linseed oil is soluble in 5 parts of boiling and 40 parts of cold alcohol.

The rise of temperature, as described in Art. 218, is a very important test, as the presence of other oils lessens the effect. The rise usually obtained varies from 100° to 115° C. But this test cannot be so satisfactorily performed on linseed as on other oils, owing to the rapidity with which the temperature rises, and the almost certain loss from the oil frothing over the glass in which the experiment is made.

It has been suggested to add a certain quantity of mineral oil—on which the acid has only a slight action—to the linseed oil before making the experiment ; but this plan is open to two objections—it necessitates two tests where one was previously sufficient, and it removes linseed oil from the comparative table of increases of temperature. These increases of temperature are of no value except for comparison one with another, and, therefore, they must all be obtained under like conditions. Whatever method is adopted for linseed oil should be extended to all the others.

(232.) Linseed oil is still very largely adulterated. But some of the oils formerly used as adulterants are now as valuable as itself. In searching for adulterants the analyst must make himself familiar with the market prices, and be guided accordingly.

The most common adulterants are rosin oil and cottonseed oil ; but there is practically no limit to the sophisticator's art. It is usually of much less importance to the practical man to give a name to the adulterant than to find out that the oil is not genuine and not suited to his purpose.

Rosin oil imparts a very unpleasant taste to linseed oil. It also raises the s.g., its own being about ·96 to ·98.

Although refined cotton-seed oil is now more expensive than linseed itself, inferior qualities are still occasionally used as adulterants of linseed oil. Cotton-seed oil affects the foregoing tests in the following way :—

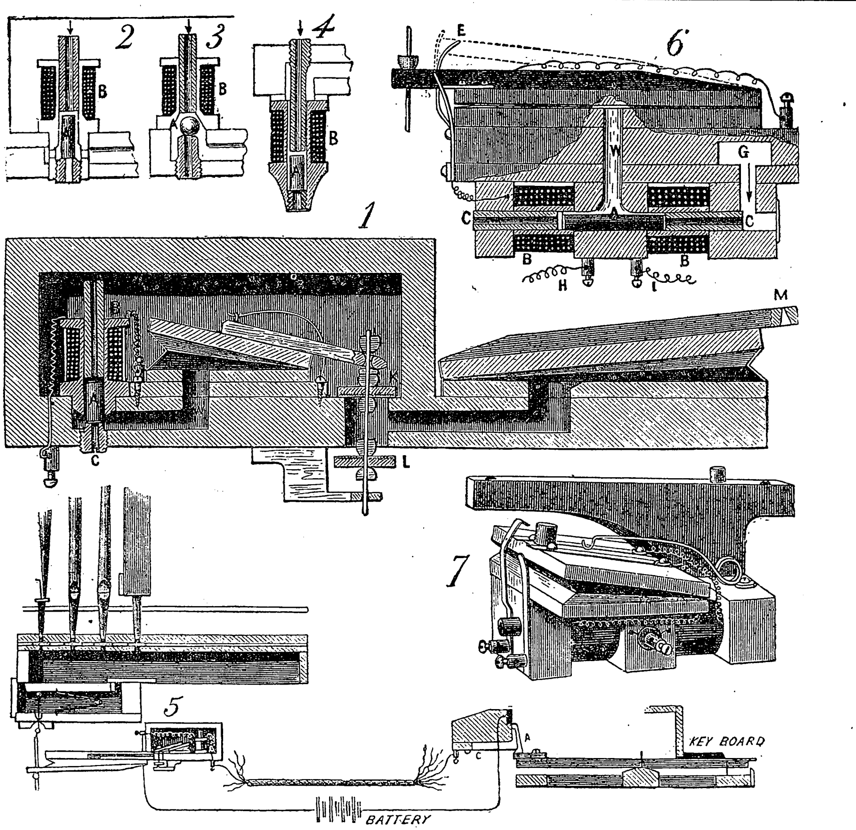
(*a*) It reduces the s.g.
(*b*) The drying properties are impaired.
(*c*) Fat deposits at or about 0° C.
(*d*) Sulphuric acid produces a violet colour.
(*e*) The increase of temperature with sulphuric acid is less.

Some linseed oils are very deficient in drying qualities, and are wholly unsuited for paints. "Baltic" oil is the best variety.

(*To be continued.*)

ELECTRO-PNEUMATIC ORGAN ACTION.

IN Vol. XXX. p. 525, we gave an illustration of the arrangement of the key-box and a specification of the great organ built by Mr. H. L. Roosevelt for the Cathedral in Garden City, Long Island, U.S.A. We give now an illustrated description of the electro-pneumatic action, invented by Mr. George Walcker, of New York, which has been tried and found to work excellently in the great organ of the Cathedral of the Incarnation. We need not repeat the specification. It will suffice to say that there are four manuals of five octaves each, and pedals, with 115 speaking stops, and 7,252 pipes (when completed). This remarkable organ is distributed over the cathedral in four distinct and widely separated portions ; but the key-box is in the choir, and all parts of the organ are under the complete control of the performer. The largest portion is in an octagonal chamber in the angle formed by the transept and chancel walls, and includes (in separate tiers) the great, the swell, and the choir organ, the reeds and mixtures of the pedal being included in the same swell-box as those of the great organ. Part of the pedal organ projects into the choir and part into the chancel, while another portion is placed, with parts of the great, swell, and the whole of the solo organ in the tower. Another portion of the organ is placed in the chapel beneath the cathedral, and comprises part of the choir organ and two of the pedal stops ; and the remaining portion, consisting of the echo organ and one pedal stop, is located between the ceiling and the roof. Separate claviers are provided where it is required at times to use one of the divisions, and also for tuning purposes ; but the object of the division was to obtain the most varied antiphonal effects. For instance, in the processional hymn with which the service commences, the choir form in the chapel, and their voices are accompanied by the chapel organ ; but as they come up into the body of the church, the tower organ takes up the accompaniment, and then as they reach the chancel, the division of the organ there located is brought into play. It will be easily understood that with the organ in the roof marvellous effects can be produced, especially as each division is provided with a swell-box. It is time, however, to describe the electric action as applied in connection with the well-known pneumatic devices, and a reference to Fig. 1 will give an idea of the arrangement adopted. The pneumatic movement is controlled by the electric attachment. Within a windchest a hollow cored electro-magnet, indicated by B, is mounted in a vertical position. A cylindrical armature, A, plays up and down below it. The armature fits loosely in a cylindrical chamber directly below the magnet. Its top and bottom are covered with discs of leather. Below the armature a nozzle C communicates with the open air. The windchest is in constant communication with the organ bellows, so that the air within it is maintained at a pressure above that of the atmosphere. Within it is a bellows that is held open normally by a spring. It will be seen that when the armature has fallen the bellows is filled with air from the windchest. The pressure is carried down through the hollow-core and space surrounding the armature and through the passage W ; the bellows, under the circumstances, being in equilibrium, remains distended, closes the valve K, and keeps the valve L open. This leaves the outer bellows free to remain open or shut, the tracker attached to the arm at M, acted on by the pipe-valve, keeping it shut. When it is desired to sound the pipe a current of electricity is passed through the wire. This draws up the armature and closes the opening in the magnetic core, and at the same time opens the nozzle C. The bellows in the windchest, having its interior put in communication with the outer air, at once closes under the effect of the air pressure within the box, and opens the valve K, which action closes the valve L, so that the outer bellows is forced open by the pressure from the windchest. The tracker is caused thereby to open the pipe valve, and the pipe begins to speak. In Figs. 2, 3, and 4 different modifications of the magnets and armatures are shown. All this is done so quickly that a sensitive pipe can be made to speak six hundred times a minute. These are the pipe movements, and one such magnet and attachments are supplied for each key in the manual and for each pedal key. For the draw stops a somewhat different apparatus is provided. Elevations of the draw stop mechanism are given. Two magnets, BB, are arranged horizontally, and supplied with a horizontal cylindrical armature, which is permanently magnetised. It is attracted to one or the other of the magnets, according to the one the current is caused to pass through. Air-pressure from the organ bellows comes through the passage G. When the armature A is attracted towards the left, as a current passes through the left-hand magnet, this air pressure raises the bellows and opens the stop. As the bellows rises, the spring F breaks contact with the piece D. This cuts off the left-hand magnet from the line ; but the polarisation or magnetisation of the armature causes it to retain its place. Hence the bellows stays open. But in rising by means of the spring E, and another contact piece corresponding to it, it throws the right-hand magnet into its own circuit. Then, when another pulse of electricity is sent by the opposite movement of the stop handle, it passes through the other magnet, and draws the armature to the right. The bellows under the influence of the spring shown in Fig. 7 collapses, closes the draw stop, and at the same time cuts off the current of electricity.



A separate wire is provided for each magnet going from the draw-stop handle; but a single return wire acts for both. The horizontal position of the magnets in conjunction with the polarised armature are the distinguishing features of this mechanism. The bellows acts by a tracker directly on the stop valve. One of these movements is supplied for each stop, and thus the whole range is controlled by electricity. An idea of the connection between manual and soundboard will be found in the section shown in Fig. 5. To the right is a key in its normal position. When depressed by the finger, it makes an electrical connection between the oscillating piece A and the contact piece B. All the magnets connect at one terminal with a single wire, which runs from them to the contact piece B, and includes in its course the battery. Each of the other terminals of the magnets has its own wire, which runs to the manual, each wire being connected by the binding screw and spring C to its own key. Hence when a key is depressed it actuates the magnet connected with it, and makes the corresponding pipe give its note. On the left of Fig. 5 will be seen the valve and action illustrated by Fig. 1, attached to the trackers leading to the pipe valves; but in this instance the "outer bellows" is below instead of above the supporting board, for reasons which will be obvious. Although these devices may appear complicated, and likely to get out of order frequently, we believe that the electricity has never failed to do its appointed work, while the great wind-valves, some of which have an area of 14in., are opened and closed with certainty and rapidity. We should perhaps mention that the current is supplied by a machine—not by a battery—while steam-engines are employed to work the bellows.

IS JUPITER SELF-LUMINOUS? *

In the concluding part of my paper on the occultation of Jupiter in April last, I referred to the question of Jupiter's intrinsic brilliancy, and expressed the hope that the question would be scientifically investigated. In order to clear the way, I will first state the case. Jupiter is, roughly speaking, about five times the earth's distance from the sun. It is impossible, therefore, that he can receive from that luminary more than one twenty-fifth part of the intensity of illumination which reaches the earth; that is, in inverse proportion to the squares of the distances. Now, from the time of my first telescopic acquaintance with Jupiter, I was struck with the impression that his brightness far exceeds what, by the above rule, it ought to be. The question naturally arises, how is this want of accordance with the laws of radiation to be accounted for, presuming it to exist? Some modern astronomical works just refer to this question, but as a rule they pass it over lightly.

The recent conjunction of Jupiter and Mars (28 June) was looked forward to with interest by me, as furnishing a favourable opportunity for photometric experiments with reference to the relative intrinsic brightness of these two planets; and I commenced my preparations several days beforehand. At the risk of being somewhat tedious, I think it will be well to describe in detail the means I adopted, in order that the results may be judged of at just what they are worth, and no more. I constructed a diaphragm (or shutter) for the telescope (8½in. reflector), consisting of two half-discs, pivoted at their circular centres, and graduated on their rims in degrees. This enabled me to shut off any proportional part of the aperture of the telescope from one half to the whole.

In order to equalise the conditions, so far as to have equal visual areas in comparison, I covered the field-bar of the eyepieces used with tinfoil (blackened), leaving open (for finding the object) a segment only, about one-third of the field. In the centre of the tinfoil I pierced a small hole with the point of a fine needle.

In observing, I used a Barlow lens in conjunction with the eyepieces, so as to enlarge the focal image. I at first employed the sun-prism (the image being viewed by reflection from the first surface of clear glass), thereby getting rid of the greater part of the illumination. This was still further reduced by a 3in. stop to the telescope. For comparison, a lamp was inclosed in a cupboard having an aperture covered with paper. The image of Mars being brought to the needle hole, the shutter was gradually closed until the brightness of the image equalled that of the lamp-light. The different readings gave an average of 90°. Dealing with Jupiter in the same way, the average was 29°.

I next varied the experiment by removing the sun-prism, and substituting a dark wedge (a makeshift affair for the occasion, composed of two slips of glass, in contact at one end, the other ends being slightly separated, the intervening space being filled with Canada balsam mixed with lamp-black). A suitable darkening with this being obtained, it was retained in position, and the shutter used for equalising the illumination. In this experiment each image was reduced to the minimum of visibility. The averages of the readings were 102° for Jupiter and 146° for Mars.

Between these two sets of measures there is considerable discordance; but they both agree in making Jupiter's surface much the brighter of the two—in the first set as 90 to 29, or nearly three times; and in the second as 146 to 102, or nearly 1½. Taking the mean, we have as 118 to 65, or nearly double. Their relative distances from the sun at that date were as 15,747 to 54,561. The proportion of the squares of these numbers is almost exactly as 1 to 12; Jupiter, then, instead of being $\frac{1}{12}$ the brightness of Mars, is by the above measure nearly double, or about 22 times as bright as he ought to be by the laws of radiation. The near conjunction of Jupiter and the moon on 7th July furnished opportunity for comparison between these bodies. On this occasion the readings averaged 180° for Jupiter and 80° for the moon.

I had not yet done with the question. In my experiments I had, by various means, stopped back all but the smallest fraction of the light received. The inquiry arose, did this small amount represent equal percentages from both bodies? I settled this question at home thus:—A small hole $\frac{1}{10}$in. in diameter was pierced in a bit of sheet metal and covered with tracing paper. This, with a flame behind it, made a capital artificial planet. I improvised a small telescope out of a short focus photo combination, using the same eyepieces as before and the dark wedge. To this arrangement I adapted a graduated shutter as before described. The light—a small gas flame—was inclosed in a magic-lantern, the lenses being removed; measures were then taken of the intensity of light as received upon the spot of tracing paper, the flame being at 1ft., 2ft., 3ft., 4ft., and 5ft. distant respectively. The average of a series of readings for these several distances in order was 180°, 110°, 61°, 31°, and 6°. Theoretically they should have been 175°, 112°, 63°, 28°, and 7°. This was, I think, sufficiently near to show the general correctness of the principle.

To sum up, then. As compared with Mars, I make Jupiter's surface brightness to be 22 times as great as it ought to be, and as compared with the moon 12·7 times. These comparisons, of course, go on the assumption that the surfaces to be compared are equally reflective—that is, of equal whiteness. That they are really *not* so may be considered as certain. But even supposing Jupiter's surface to be of the *whiteness of snow*, we have at the poles of Mars planetary snow with which to compare it, and illuminated with twelve times the intensity of Jupiter's sunshine; yet even this comparison I judge to be in favour of Jupiter. As compared with the moon, the vaporous envelope of Jupiter (whatever its nature) is probably more reflective than the bare and broken lunar surface. There *must*, however, remain a vast amount of illumination to be accounted for in some other way.

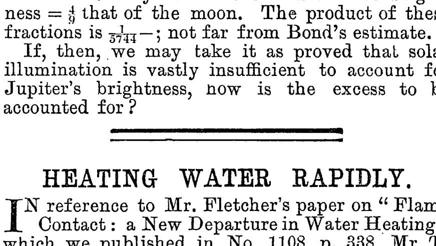
I must say that the result of my measures appears incredible even to myself. I therefore look for some corroboration. According to Mr. G. P. Bond's estimate, the light we receive from Jupiter amounts (at a mean) to $\frac{1}{6430}$ of that of full moonlight. Jupiter's visual disc (mean) is $\frac{1}{2553}$ of the full moon. My estimate of his surface brightness = $\frac{4}{9}$ that of the moon. The product of these fractions is $\frac{1}{5744}$—; not far from Bond's estimate.

If, then, we may take it as proved that solar illumination is vastly insufficient to account for Jupiter's brightness, how is the excess to be accounted for?

* Extracted from a paper read by Mr. A. B. Biggs before the Royal Society of Tasmania.

HEATING WATER RAPIDLY.

In reference to Mr. Fletcher's paper on "Flame Contact: a New Departure in Water Heating," which we published in No. 1108, p. 338, Mr. T. Pray, jun., of Hartford, Connecticut, writes:—Mr. Fletcher has done himself credit in his "heating" inventions; but in the idea advanced in the item referred to, he has been fully anticipated by at least thirteen years, if he puts forth the idea as an invention. With this exception: he advises copper studs, while iron was my own medium. With this please find sketch of an arrangement



which was used in 1873 upon two steam boilers, and in 1876 upon a greenhouse boiler of 30in. diameter, 54in. long, which displaced two large and one small cast-iron greenhouse boilers, and heated 9,000ft. of glass far better than the three did the previous winter, and with far less coal.

The first experiment was made by rivets 1¼in. diameter next the shell, 1in. diameter at small end, and set the whole length of both fire sheets and for nearly half the circumference of the boiler, 3½in. from centre to centre in alternate rows and spacing Fig. 1 shows first experiment, Fig. 2 the second. All sorts of trouble was promised by boiler-makers, but no trouble or expense of any kind ever came from the arrangement or boilers. The record of evaporation was high, no leakage occurred, and not

a cent was called for in repairs; and so far as my own experience goes, no other application has been made of the idea in this country (U. S. A.)

ON THE COLLECTION AND METHOD OF STUDYING FORAMINIFERA.*

By J. M. Flint, Surg. U. S. N.

I HAVE taken occasion to bring before the society, for the inspection of those who may be interested either biologically, geologically, or æsthetically, some specimens of the foraminifera collected by the Fish Commission steamer *Albatross* during the last 18 months, and selected, prepared, and mounted on board during the cruise.

The specimens before you are the beginning of what is intended to be a type series of this interesting group of animals. It already includes representatives of all the orders except Gromidæ, which are principally freshwater forms, and about half the genera mentioned by Brady in his *Challenger* Report, and numbers 125 species. The collections were all made on our Atlantic coast, and with the exception of a very few—not more than half a dozen species—were taken off the coast between Cape Hatteras and Martha's Vineyard.

Great quantities of this material are obtained by the *Albatross*, and its separation and preservation have been greatly facilitated by the devices of Mr. Benedict, the resident naturalist of the ship. The material is brought up from the bottom by means of what is known in the vernacular as the "mud-bag," a canvas bag about 2½ft. long by 18in. wide, the mouth held open by an iron frame. This bag is attached to the free end of the net of the beam-trawl, and it rarely fails to scoop its full of mud as it is dragged over the bottom. Being brought to the surface the mud is dumped into the table-sieve, the hose turned upon it, breaking up the lumps and carrying all but the coarsest particles through the sieve, where it falls into a tub below. This tub has several holes at different heights at the side; these holes are stopped with spouts, and over the spouts are fastened strainers made of fine linen "scrim." The heavier foraminifera fall at once to the bottom of the tub, the impalpable mud and the lighter foraminifera flow out through the openings of the tub, where the latter are stopped by the strainers. The material thus obtained is a comparatively clean mixture of sand and foraminifera, the proportions of each depending upon the nature of the bottom. Before being ready for examination this material requires a further thorough washing by decantation. It must then be washed with fresh water to prevent the formation of crystals of salt, and thoroughly dried.

The individual shells are picked out under a dissecting microscope by means of a fine camel's-hair pencil, moistened between the lips.

I may be excused for calling your attention to the method of mounting, since it is the only thing connected with the subject for which I can claim any originality. It was soon found that for the purpose of thorough study for identification of specimens the usual method of permanent mounting was extremely unsatisfactory. For the examination of objects of this character under the microscope nothing can equal what is known as Beck's discs and holder. By means of this accessory an object may readily be rotated in the field of view of the microscope so that all sides of it may be examined except that actually adherent to the discs. These discs are made of brass, with a short stem for insertion in the arm of the holder. By means of a fine chain concealed within the arm and passing around the axle of the milled head, rotation around a perpendicular axis is obtained; and the whole arm being permitted to revolve in its support, rotation around a horizontal axis is also secured. By a combination of these movements the object may be placed in any desired position without losing it from the field of view. The great advantages attending the use of this appliance led to the mounting of the whole series upon discs, any one of which may be placed in the holder and thoroughly examined. The specimen being secured to the disc, the latter is inserted into a wooden slide of the usual dimensions, and may be arranged in a cabinet in the ordinary way. For protection of these frail shells from dust and accident a cover is necessary, and it must be removable in order to get access to the specimen when it is desired to transfer it. This cover is supplied by curtain-rings, cemented one upon the other, and capped with thin glass, and it is secured by small tacks driven just far enough apart and just deep enough, so that the heads will catch in the groove between the rings. The cover is thus easily removed and replaced. For exhibition purposes, and for permanent preservation and reference as well, cardboard discs have been prepared. The specimens are planted in succession, as near the circumference as possible, and the covers fitted as on the single slides. This cardboard disc is designed to rotate on a pivot supported by the upper stage plate of the microscope, and by means of this rotation each object in the series may be brought, in succession, into the field. The dropping of a light spring into a notch on the edge of the disc indicates to the observer when the object is in proper position. The mechanical stage movements give control of the object as if it were on an ordinary slide. In the collection before you, one disc has been devoted to each family. From each of these have been selected the specimens on the disc under the microscope, to which your attention is specially directed. Whenever necessary to identification or to elucidation of structure, sections of the shells have been made, and the sections mounted on the same slide with the entire specimens. Some few very thin or delicate specimens have been mounted in balsam, as it brings out more distinctly the peculiarities of structure. These are placed on the discs for examination by reflected light; they may be removed and placed on a glass slip and viewed by transmitted light, if desired.

It may not be altogether amiss, even in a society of biologists, to recall a few facts regarding this group of animals, apologising to those who have made the subject a study for the trite remarks.

The Foraminifera comprise a group of animals belonging to the sub-kingdom Protozoa, class Rhizopoda. They stand nearly at the foot of the list in the classification of animal organisms by reason of the extreme simplicity of their structure, which consists of a minute bit of protoplasmic substance without differentiation of endosarc and ectosarc, without contractile vesicles, and until recently believed to be without even a nucleus. Like the other rhizopods they possess the power of thrusting out portions of the body substance or pseudopodia, which, when retracted, lose themselves again in the body mass. The character of these pseudopodia has led Dr. Carpenter to divide the Rhizopoda into three classes:—1. Lobosa, of which *Amœba* is the type, the pseudopodia of which are blunt or irregularly club-shaped, and show no disposition to unite with one another when they come into contact; 2, Reticulosa, to which class belong the Foraminifera, whose pseudopodia, projected in fine threads, unite whenever they come into contact, forming a network; and, 3, Radiolaria, of which *Actinophrys* is the type. The pseudopodia in this instance are projected radially, and do not unite.

But little is known of the life history of these minute and simple animals. Their ordinary mode of multiplication is undoubtedly by subdivision or fission. But there seems to be some definite limit to the possibilities of that process, and it is probable that some form of conjugation and encysting process will ultimately be discovered. Their mode of nourishment is supposed to be by the absorption of the organic matter in solution in the sea-water, since the pores of the shell are, in most instances, too small (the largest being about $\frac{1}{5000}$in. in diameter) to allow the introduction of any solid particles of food likely to be within their reach. All species of this group surround themselves with some form of shell or test, and the fact to which they owe their chief importance is their ability to separate carbonate of lime from its solution in the sea-water.

Of their distribution it may be said that, with the exception of polar seas, it is as wide as that of the waters of the ocean. The sounding-cup never fails to bring them from the bottom, and in some parts of the Atlantic the mud dredged consists of as much as 85 per cent. of foraminifera. Wherever the ocean has rolled in past geological ages since any living thing has existed, they have been. The chalk beds all over the world are composed almost exclusively of their remains. These chalk beds in this country cover thousands of square miles, and in some places are 9,000ft. in thickness. They are probably not less extensive in other parts of the globe.

The nummulitic limestones extending in a vast bed on both sides of the Mediterranean, through Northern India and Central Asia, are principally shells of Foraminifera, and get their name from a genus of large size, very numerous and conspicuous throughout the stratum. The Pyramids of Egypt are built of this stone, and rest upon rock of the same structure, in which the fossil foraminifera are easily visible to the naked eye. It is probable that the subcarboniferous limestones have the same origin. In short, the weight of evidence is that the foraminifera have had more to do in forming geological strata than all other animals taken collectively. Moreover, if the conclusions of Drs. Carpenter and Dawson in regard to the *Eozoon Canadense* are accepted, the foraminifera are the oldest in geological time of known fossils. So these minute shells, the product of the simplest of animal organisms, are not so insignificant in the economy of nature as they might at first appear.

Aside from their geological importance and biological interest, they attract attention by the beauty and infinite variety of their forms, and they illustrate better than any other series of animals the endless varieties that may be produced by the slight but persistent modifications of the mode of growth.

In all attempts at classification of such objects as these, external form must necessarily be the governing principle. There are, however, a few prominent distinctions based on physiological differences which should be considered. For instance, a large group of these animals form their tests of grains of sand, spicules of sponge, or the shells of other foraminifera. They repeat, in a rude way, nearly all the forms taken by the more delicate calcareous shells; but the physiological distinction is of more importance than the external resemblance, and properly causes the testaceous foraminifera to be classified apart from the calcareous foraminifera. Another broad distinction is based upon the arrangements for the protusion of the pseudopodia. In a portion of the group the shell is "imperforate," by which is meant that there is only one mouth-opening through which the pseudopodia can be thrust out. In the others the shell is porous, or "perforate," studded all over with minute openings, the largest not more than $\frac{1}{5000}$in. in diameter, through which portions of the body substance are extended for the absorption of nutriment. These latter generally have a conspicuous mouth-opening also, but this opening is believed to serve simply as an exit for the sarcodic substance in the process of growth. These then constitute the principal divisions based upon physiological differences which can be sustained—viz., into arenaceous and calcareous, and into perforate and imperforate. Other distinctions are based upon external form alone, and it is interesting to consider by what simple modifications the most astonishing results are brought about.

* A paper read before the Biological Society of Washington.

USEFUL AND SCIENTIFIC NOTES.

The Food of Paris.—The annual consumption in Paris of various kinds of food which can be closely controlled by the registers of the *octroi* was during last year 146,825 tons—an increase of 446 tons over the previous year. Of pork 148 tons had been consumed less, while the consumption of horseflesh, with a total of 3,830 tons, had augmented 337 tons, as compared with 1884; the average price of this last-named commodity is sixty centimes a kilo, while the meat of asses and mules command about seventy centimes. Of poultry and game the aggregate consumption was 25,044 tons—a slight diminution as compared with the year before. The quantity of fish, &c., amounted to 25,631 tons—a slight augmentation, more particularly in oysters. The consumption of butter and eggs has fallen off by nearly 160 tons, which decrease, so far as butter is concerned, may readily be accounted for by the greater use of margarine.

A Monster Electric Clock.—The Standard Electric Time Company, of New York, has, according to the *Electrical World*, been engaged for some time past in preparing the mechanism, &c., for the largest clock in the world, one having a face 25ft. in diameter. This clock is to be put against the wall of a building at the corner of Twenty-third-street and Fifth-avenue, resting on a lower building at the junction of the thoroughfares. The works are composed of sixteen pairs of electro-magnets placed around a 6in. gear wheel. At the face of each pair of magnets is placed an armature extending to the gear wheel. Every second the current from the main line to 252, Broadway, brings into circuit 64 cells of a local battery, energising one pair of magnets and starting the wheel, the impulse then affecting each pair in rotation, and distributing the pull or load very evenly. The armatures controlling the movement of the gear wheel are adjusted so that there is no jump when they act, the clock running with a smooth steady action. There are three gear wheels which turn a long vertical rod; a worm at the top of this rod works on a hollow gear wheel turning the hands of the clock. The dial is painted on the wall of the building, and the hands travel around in front of it as in the ordinary clock. This gigantic clock is intended to serve as an advertisement.

THE form which an electro-magnet should have depends upon the nature of the operations it is used to perform. A design of an electro-magnet which is very suitable for some purposes is not suited at all for others. Supposing it is desired to make an electro magnet which shall be capable of rapid changes of strength, or possess small residual magnetism, it should be made of very soft Norway or Swedish iron, and have the form of a short, stout bar, rather than a long, thin one. The reason for this is that the ends or poles of a magnet exert a depolarising action upon the mass of the interior of the magnet.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE first meeting after the vacation was held on the 12th November, Mr. J. W. L. Glaisher, president, in the chair.

Mr. Knobel drew attention to some paper prints from stellar photographs, which had been sent to the society by M. Gotard. Amongst them was a photograph of the Ring nebula in Lyra, showing the decrease in brightness at the extremities of the major axis of the ellipse. The exposure was made in 70 minutes. There were also photographs of the Horseshoe nebula and the Dumb-bell nebula.

Father Perry read a paper by Mr. A. Cortis, of Stonyhurst, on "Bands Observed in the Spectra of Sunspots." He said we found that a great deal of attention had been given both at Greenwich and South Kensington to observations of sunspot spectra on the violet side of D. Mr. Cortis and I therefore determined to confine ourselves to working at the red end. There is both selective absorption and general absorption, and besides bands in the spectrum, the solar lines are sometimes darkened and sometimes broadened, being winged on either side, though the central dark line is not widened. We have observed eleven bands at the red end of the spectrum at Stonyhurst, and have kept our attention especially fixed upon two—6,380 and 6,383. When you move the slit away from the spots you immediately lose these bands in the spectrum of the photosphere. You get complicated spectrum bands only in the spectrum of the spots. With regard to both these bands 6,383 and 6,380, they have been on one or two occasions split up into about three lines. None of the bands observed by us have any corresponding lines in the spectrum of the photosphere, with the exception of 6,380; but they have nearly all of them corresponding bright lines in the spectrum of the photosphere, as identified from Prof. Young's catalogue of such lines.

Mr. Ranyard: With regard to the observation of bands in the spectrum of sunspots, one is likely to be deceived by the mere alteration of illumination. My faith in what I had thought previously to be veritable broadening of lines and bands in sunspot spectra has been very much shaken by an experiment recently shown me by M. Thollon. While I was looking at the solar spectrum he placed a small object at a little distance in front of the slit, so as to throw a shadow on the slit, a shadow which was almost total at the centre, but had a penumbra on either side. It gave rise to a band across the spectrum which I immediately took to be the spectrum of an ordinary sunspot. In the dark band the lines appeared winged and thickened, and quite different from their appearance in the photosphere spectrum. I have recently repeated the experiment near to a sunspot, and I would advise others to do so. It has quite shaken my faith in the objective character of many of these winged lines and bands. I do not wish to state that there is no change in passing from the ordinary solar spectrum to the sunspot spectrum, except a change of illumination; but the evidence with regard to any particular line or change should be carefully examined in conjunction with the solar spectrum, seen under fainter illumination.

Mr. Maunder: Some years ago, in observing the spectra of sunspots, I found a number of shaded bands in the neighbourhood of the *b* lines. I have not examined the red region sufficiently carefully for bands; but I have no doubt of their existence. I do not think that those near little *b* can be due to a darkening of any portion of the solar spectrum. They were very distinct, and in their main characteristics resembled very much the bands described by Father Perry—that is to say, for the most part we were unable to see any lines corresponding to them in the solar spectrum, though occasionally we would be able to trace the band as corresponding with a very faint line. I believe that none of these bands are given by Angstrom; but one or two are given in Fiévez's chart, and on one or two occasions I have just been able to break up some of the bands into two or three fine lines, so that they presented just the same characteristics as the bands observed by Father Perry.

Mr. Isaac Roberts read a paper on "Stellar Photography," illustrated by a number of photographs. Amongst them were enlargements from negatives taken on the nights of the 23rd, 24th, and 25th of August of a region in the constellation Cygnus, which corresponds with a region photographed by the brothers Henry with their 13in. refractor, enlarged copies of which photographs the brothers Henry have presented to the Astronomical Society as a specimen of the great number of stars which may be photographed with their instruments with an exposure of 60 minutes. The enlargements made by Mr. Roberts were on the same scale as those of the brothers Henry. Mr. Roberts's photographs were taken with a 20in. reflector, and enlargements from plates exposed for 30 and 60 minutes were shown. In order to compare the photographs Mr. Roberts had counted the number of stars shown on corresponding square inches of the enlarged copies. On his own photographs he had counted on three square inches 109, 93, and 70 stars respectively, and on the corresponding square inches of the enlarged copies from the brothers Henry's photographs there are 59, 64, and 41 stars respectively, giving an average of 91 stars per square inch on the enlargements from his own photographs, and an average of 55 stars per square inch on the enlargements from the photographs of the Brothers Henry. He estimated that about the same number of stars were shown on his plates exposed for 30 minutes as on the plates exposed by the Brothers Henry for 60 minutes. Mr. Roberts also showed some original negatives of the Pleiades group, showing clearly traces of nebulæ surrounding the stars Alcyone, Maia, Electra, and Merope. The photographs of the Brothers Henry, which were exposed for three hours, showed traces of nebulous light round only three of these stars. On a negative of Mr. Roberts's, obtained on the 23rd Oct. with an exposure of 89 minutes, all the above named four stars were seen to be nebulous, and traces of nebula were seen extending through the whole of the Pleiades group. A negative, taken on the 24th of October, with an exposure of three hours, confirmed the nebulosity about all the four stars, and showed a still greater amount of nebulous light extending in streamers and fleecy masses so as almost to fill up the spaces between the stars, and extending far beyond them, as if the group were the centre of one vast nebula. Mr. Roberts said that he was awaiting with watchfulness for a clear interval during which he could make an exposure of the group for five hours.

Mr. Common said: I am extremely gratified with these photographs, not only because they have been taken in England, but because they have been taken with a reflector. In the early days when I took up photography, I came to the conclusion that if any good work was to be done it must be done with the reflector, because it brings the light of all parts of the spectrum to the same focus; and this is especially important now that the old collodion plates are not used, for the bromide plates are sensitive to a much larger region of the spectrum. Mr. Roberts stated that in his photographs the stars are not represented by sharp hard discs, as in the photographs of the Brothers Henry; but this is chiefly due to the method of copying they have employed. In some photographs taken direct from their negatives with which they have favoured me, the gradation at the edge of the star discs is distinctly to be seen.

Mr. Ranyard said: Mr. Roberts has not mentioned the beautiful way in which even the diffraction rays due to the supports of the photographic plates are shown round the images of all the larger stars down to the 3rd or 4th magnitude. There are eight rays, and on inquiry of Mr. Roberts I find that besides the three watch-spring supports which give rise to the six rays usually seen in reflectors, there was a focussing rod, which gives rise to the two other rays; the stellar point in the centre of the rays is much smaller than in the Henry photographs.

Mr. Knobel said: Mr. Roberts has been comparing his photographs with those taken by the Bros. Henry some time ago. I have recently been comparing some of the Henry photographs with those taken by M. Gotard, and I find that in the recent photographs of the Henry's there are a great many more stars than in the earlier ones.

Mr. Maunder gave some account of the observations of the recent eclipse in the West Indies. He said: I am not prepared with any account for the society. We divided into several parties when we arrived at Granada, so that if the weather was unpropitious in one part, it might not be so in another, and the precaution turned out to be very necessary, for Mr. Lockyer, who went to Green Island, saw nothing. Mr. Schuster, Capt. Darwin, and Prof. Thorpe went to the east coast of Granada. Mr. Turner and Prof. Tacchini to the North, and I went with Father Perry, 20 miles further North, to the Island of Cariaco. On the morning of the eclipse it was very fine at our station up to sunrise—almost immediately after sunrise heavy banks of clouds came up; before the first contact the sun was hidden, and we had a small shower, which obliged us to cover up our instruments; but fortunately before totality the cloud cleared, and the sun passed into a clear portion of the heavens. On the east coast of Granada Captain Darwin obtained a number of photographs of the sun both before totality and during totality. His idea was to test Dr. Huggins's method of photographing the corona in full sunshine, and as far as yet appears, his results negative the idea that Dr. Huggins has been successful. Dr. Schuster got two spectroscopic photographs; one with the slit radial, and one with the slit tangential—both will be useful. Father Perry tells me that Dr. Schuster also got five photographs of the corona; but I have not seen them. I myself got seven photographs of the corona, and I think that five of them are good. I was not successful with the photographs of the spectra. Professor Tacchini made some very interesting spectroscopic observations, perhaps the one of greatest interest is that the prominences we see with the eye during a total eclipse are not precisely the same prominences we see by the spectroscopic method during full sunshine, for the upper portions of the eclipse prominences give a continuous spectrum. I, myself, did not see any red colour in the prominences visible round the sun—to me they appeared white; but it may have been that the red region was so small in comparison.

Major-Gen. Tennant read a paper on the orbit of Comet 2 of 1883. Mr. Bryant had calculated an orbit of this comet, which was elliptical, and according to him gave a period of 90 years. On going over and comparing the observations of this comet by several observers, he found that they did not correspond satisfactorily with the normal places which had been used. After making several assumptions, he was inclined to think that a period of 2,000 years would be nearer the truth, or that the orbit might be parabolic.

Mr. Ranyard read a paper on the form of the area in the heavens from which the meteors of Nov. 26, 1885, appeared to radiate. He said there were many observers of this rich shower, and almost all agree that the meteors did not radiate from a point, but that there was a radiant area of some considerable extent. I did not observe the shower till well after its maximum; but from 40 or 50 meteors whose paths I observed and was able to trace back upon the heavens, I thought that the area from which they radiated was elliptical. I mentioned this to Col. Tupman, and he told me that in the chart of paths he had laid down the radiant area was distinctly elliptical. We agreed at the time that it was merely a coincidence, as we did not see any reason for such an elliptic area. When Col. Tupman described his observations at the meeting of this Society, he stated that the longer axis of his elliptic area lay north and south. This struck me as an additional coincidence with my own observation; but I did not think seriously of it till a few weeks after, when I saw a letter from Prof. Young, which was published in *Nature*, in which, after describing his observations, he says that the radiant was not a point, but rather a region about 4° long, north and south, by 2° wide. I wrote to ask him further about his observation, and he replied that the radiant region was elliptical, perhaps a little larger than he had at first estimated. Recently, during a visit to the Observatory at Nice, M. Perrotin showed me a map, on which he and his assistants had laid down the courses of 60 or 70 meteors they had observed on the night of Nov. 26. I at once saw that the paths did not radiate from a point, and without telling M. Perrotin of the other observations, I asked him to draw a contour line round the area of radiation. Both he and M. Thollon, who was present, drew elliptical curves with the longer axis, north and south, or rather inclined 10° or 12° to the west of the north point. There, therefore, appears to be some very definite evidence that the paths of these meteors *did* radiate from an elongated area with its axis north and south. I have been thinking over what can be the physical cause of such an area. If the paths of the meteors were all parallel, they would appear to meet in a point. This shows that at all events the paths within the earth's atmosphere are not parallel. It has been suggested by those who, like Sir Stawell Ball and Mr. Proctor, believe in the ejection theory of meteors, that if they were ejected in slightly different directions originally from the earth, they would not return moving in parallel paths. But if their paths outside the earth's atmosphere were not parallel, their orbits and their periods would be so very different, that they would not come up to the earth again in a single swarm. I am therefore inclined to assume that their paths in space before they encounter the earth's atmosphere are all parallel; but that, by reason of their irregular shapes, they are deflected into slightly different directions after they enter the earth's atmosphere usually before they have had time to become luminous, though there is some evidence that such deflection or "skidding" from their original course sometimes takes place after they become luminous. Prof. Newton, Mr. Hopkins, and, I think, Col. Tupman, have noticed meteors with curved paths, and I have on two occasions noticed such curved paths myself. In order to account for the elliptic area, it is necessary to suppose that there must be some arrangement of the longer axes of the particles in space which causes them to be deflected more to the north and south than to the east and west. I would suggest that if the particles are magnetic they would on coming up to the earth tend to arrange themselves with their longer axes parallel to the earth's magnetic axis. And in connection with this it is worth noticing that the axis of the contour drawn by M. Perrotin and M. Thollon, of which I have a tracing here, does not point due north, but some 12° or 14° to the

west of north, which about corresponds to the deviation of the magnetic meridian at Nice.

The meeting adjourned at ten o'clock.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE second meeting of the sixth session was held on Monday, the 8th instant. The chair was occupied by Mr. R. C. Johnson, F.R.A.S. Ten members were elected and 33 candidates were proposed. Messrs. T. G. Elger, F.R.A.S., George Knott, LL.B., F.R.A.S., and A. Cowper Ranyard, M.A., F.R.A.S., were elected Associates of the Society.

A paper by Mr. K. J. Tarrant was read on the "Micrometrical Measures of Twenty-Five Double Stars." The study of double stars was, perhaps, less interesting than lunar or planetary work; but the more the subject was investigated the more absorbing it became. By this he did not mean the mere attempt to split double stars, but rather a systematic study of those pairs where a motion was suspected or had already been discovered. He knew of no more wonderful result than to discern for themselves that the great law of gravitation extended to the far-off depths of space. The micrometrical measurement of double stars required three things—a good telescope, a reliable micrometer, and an inexhaustible stock of patience; as, in the cases of close stars, the observation would have to be repeated many times before results of any value could be attained. It was, however, a most important undertaking, and ought to be of the greatest assistance to the computers of a future generation. An accurate knowledge of their previous positions would enable them to calculate with certainty the amount of the proper motion, and might possibly disclose other interesting facts. This knowledge they did not themselves possess; but it was their duty to provide it for others who followed in their footsteps.

In a paper on "The Masses and Distances of Binary Stars," Mr. J. E. Gore, F.R.A.S., said: When the parallax of a binary was known, and the elements of its orbit satisfactorily computed, it was easy to find some of the masses of the component stars in terms of the sun's mass, and the real dimensions of the orbit. The parallax of a few of them had been ascertained. First, there was the famous binary star α Centauri, which, as far as was known, was also the nearest star to the earth. From its orbit, computed by Dr. Hind in 1877, combined with a parallax of 0·928″, he found the mass of the system = 1·79 times the sun's mass, and the semi-axis major 23·49 times the earth's mean distance from the sun. Assuming the latest elements found by Dr. Elkin (α = 17·50″, and period = 77·42 years), and his parallax of 0·798, he found the sum of their masses = 1·759, and the semi-axis major = 21·13 times the sun's mean distance. Second, η Cassiopeiæ. Dr. Dunér found for this binary a period of 176·37 years with semi-axis major = 10·68″. Combining these elements with O Σ parallax of 0·154″, Mr. Gore found the mass of the system = 10·722 times the sun's mass, and the mean distance = 69·35. The magnitude of the components was about 4 to 7·6; so they had a star of the 4th mag. with a mass about six times as great as that of α Centauri. The calculations of the elements of the well-known companion to Sirius were still more interesting, and there was no doubt that it was in rapid orbital motion round its primary, probably with a period of about 49 years. He had found the mass of this system = 71·63 times the sun's mass. Assuming the attraction of the companion to be the cause of the observed irregularity in the proper motion of Sirius, Auwers found that its mass must be about one-half that of Sirius; thus, we have the mass of a 10th-mag. star absolutely greater than that of the sun.

Mr. W. S. Franks, F.R.A.S., followed with a paper on "The Magnitudes of Double Stars," the determination of which he considered of great importance to astronomers. The old and well-known divisions into magnitudes was both vague and arbitrary, and, though it might never be entirely superseded, was certainly capable of much improvement. Sir John Herschel was one of the first to recognise the shortcomings of the prevailing system, and to suggest the better plan of indicating the exact brightness of the stars on a photometric scale. The reform thus inaugurated had been developed by Seidal, Wolf, and Zöllner on the Continent, Pritchard in England, and Pickering in America, each of whom used some special form of photometer. Undoubtedly the most valuable work of the kind was that by Prof. Pickering, published in Vol. XIV. Part I. of the *Annals of Harvard College Observatory*, both for the elegance of its methods and the completeness of the results. It contained the photometric magnitudes, expressed to the nearest tenth part, of 4,260 stars, being the mean results of some 100,000 separate measures. They might consider, then, that the true equivalent magnitudes of the naked-eye stars, for a certain epoch, had been satisfactorily ascertained and defined, though much still remained to be done before our knowledge of stellar magnitudes could be considered in any sense complete.

Mr. W. H. S. Monck, M.A., F.R.A.S., had framed some theories which he thought explained many of the singular appearances presented by the moon. The most noteworthy of these features were the absence of water and the great number of extinct volcanoes. Taken together, this was rather startling and quite unaccountable by terrestrial analogy, inasmuch as volcanic action on the earth appeared to be intimately connected with water. There was abundant indication of the former existence of water on the moon, and, he argued, this could not have been withdrawn into the interior—as had often been suggested—without provoking fresh volcanic outbursts. He rather attributed its disappearance to continual exposure of one side of our satellite to the heat which was radiated from the earth. It was more than probable that this heat, combined with an exceedingly low atmospheric pressure, had vaporised the water, which would thus be carried to the opposite, and colder side, and there condensed, if not frozen.—Mr. A. Newton Harris considered it unsafe to expect terrestrial occurrences to explain lunar appearances, which were in themselves quite beyond the range of our experience, at least, as regarded volcanic origin. At the same time, they naturally sought an explanation from analogy, and he had found what he thought to be the key in the "atolls" and coral formations of the South Pacific and Indian Oceans. In the clear water of those regions the sea bottom represented ring-mountains to perfection, and, granting a subsidence of the land, and a disappearance of the water, they would have a pretty near approach to lunar scenery.

In a description of some remarkable sunspots that were visible during the first fortnight in May, 1886, Miss E. Brown said that in many instances they were both unusual and striking. How immense this group of spots really was could only be realised by calculating its relation to the whole area of the sun's visible surface. According to Mr. Maunder, of the Royal Observatory, twenty-five of our earths might have lain side by side in this remarkable group. The group remained almost without alteration from the 2nd to the 11th of May, though towards the end of that period an alteration in its outlines gave warning that its dissolution was not far off. This, indeed, proved to be the case, for though some fragments reappeared during its succeeding revolution, their aspect was so different that it was doubtful if even it was the same group. Monsieur B. Lihou contributed an account of some observations which had led him to suspect a variation of light in the companion to Polaris. The idea was, he said, first suggested by the remarks of Mr. Isaac Roberts (*Monthly Notices* of the R.A.S. for Feby., 1886) with regard to the different times of exposure which he had found necessary to photograph this star. The duration of this exposure had varied from 4sec. to 60sec., and even, in one instance, to 15 minutes. This discrepancy seemed unaccountable, except by an actual variation in its light, and M. Lihou had commenced a careful series of observations in order to test whether this was the case. The observations were made with a 4in. refractor, and the variations were estimated from 9·5 to 10·5 magnitudes, the period being about 21 days.

In the second paper on "The Moon Surveyed in Common Telescopes," Mr. T. G. Elger, F.R.A.S., included the Mare Humorum and its surroundings. The 6th of next month would be favourable for reviewing that district, especially for studying the remarkable contour of the western border, and the curious ridges which traverse it. These latter deserved more than a passing notice, not only on account of the beauty of their form, but as exhibiting peculiarities of arrangement which tend to throw a ray of light on their origin. Their tendency to follow the curvature of the western border, like ripple-marks imprinted by the tide, was very noteworthy. This tendency was not confined to those on the surface of Mare Humorum, but might be traced in numerous other regions. The western border of the Mare, with its superabundance of complicated detail, included many remarkable objects, among them the incomplete ring Hippalus, and other smaller formations. The former looked as if it might have been breached by the pressure of an accumulation of the material within its borders, and which outspreads the Mare. The eastern side afforded still more interesting examples of these now incomplete rings than Hippalus. Lee and Doppelmeyer had been clearly destroyed on the side facing the Mare. In the case of the latter, when it was close to the terminator, distinct traces could be seen even with small apertures, of a former border in the shape of a low mound which extended across the opening. Mr. W. F. Denning, F.R.A.S., also contributed a second paper of his valuable series on "Telescopes and Telescopic Work."

SCIENTIFIC NEWS.

AMENDED elements and ephemeris of Comet Barnard are given in Dun Echt Circular, No. 130, from repeated and more extended observations. The time of perihelion is given as Dec. 16·4529 Berlin M.T.; π — ☊ 86° 31′ 42″; ☊ 137° 19′ 58·8″; i 101° 46′ 55·2″, mean equinox 1886; log. q 9·819841. The ephemeris reads:

	R.A.			N. Dec.	
Nov. 19	13h.	24m.	23s.	13°	38·0′
21	13	39	54	14	30·9
23	13	56	41	15	21 9
25	14	14	47	16	9·1

The position is south of Alpha Boötis, and the comet rises about 4 a.m.

Circular No. 11 of the Liverpool Astronomical Society, referring to the Rev. T. W. Webb's unpublished observations under date of Dec. 12, 1877, calls attention to the following note:—New pale orange-ruby, 7·5 mag., a fine, clear colour = O R4. 8 mag. W. Lies ± 4′ *s.p.* the ruby. Diff. from ξ and ν must be ± 47°. It lies 4m. *p.* 15′ N. from a star 6 mag., probably one in S.D.U.K. map ± 47° N. 0h. 36m. A single bad diffn. made ruby 5m. *f.* ζ, or 0h. 35″. The "6 mag." = + 47° No. 181. The "8 mag." + 47° No. 157. Hence we should have—

		h.	m.	s.	°	′	
From + 47° No. 181	=	0	32	24	+ 47	19·2	(1885)
From ζ Cassiopeiæ	=	0	31	6			"
From + 47° No. 157	=	0	30	50	+ 47	17·6	"

There is no star in Argelander here, nor could any red star be seen in this place with the 17¼ equatoreal on the evening of November 7th.

By the death of M. Paul Bert, France loses one of its eminent scientific men—one who had, however, devoted himself to politics of late years. He was born at Auxerre in 1833, and studied medicine under Claude Bernard, taking a doctor's degree in 1863. He devoted himself to research, and very soon attracted the attention of the scientific world by his papers, which led to his appointment as professor of the Faculty of Sciences, Paris, in 1869. With the advent of the Franco-German war Bert's pursuits were changed, but he still kept up some of his scientific work, and in 1875 received from the Institute the prize of £800 for his "La Pression Barométrique, recherches de Physiologie expérimentale"; and in 1877 was elected president of the Biological Society in succession to Claude Bernard. "The First Year of Scientific Knowledge," which we reviewed in No. 1088, is an excellent book for elementary schools, and has made the name of Paul Bert known throughout the whole of his native land.

The death is announced of Dr. Frederick John Farre, for many years physician to St. Bartholomew's Hospital, and at one time examiner in materia medica at London University. He edited Pereira's famous manual. Dr. Farre was in his 83rd year.

Dr. G. A. Fischer, an African traveller of some repute, died recently in Berlin, where he was awaiting the arrival of his notes and specimens from Africa.

It will be learned with regret that the health of Prof. Tyndall is not sufficiently restored to warrant him in undertaking the Christmas lectures at the Royal Institution. Prof. Dewar will, therefore, deliver a course of six lectures adapted to a juvenile auditory on "The Chemistry of Light and Photography."

Amongst the lectures to be delivered at the London Institution this session we notice that Sir R. S. Ball will deliver two on the "Astronomical Theory of the Great Ice Age," on November 22 and 29; Professor E. Ray Lankester, six on the "Elements of Biology," November 25, December 2, 9, 16, 23, 30; Dr. C. Meymott Tidy, three on "Chemical Action," January 6, 13, 20; and Professor S. P. Thompson two on "Electric Bells," February 10 and 17. On December 20, Mr. H. Seebohm will lecture on "Birds' Nests and Eggs"; on December 27 Mr. Eric S. Bruce on "War and Ballooning"; on January 17, Professor W. H. Flower on "Fins, Wings, and Hands," and on February 24 Mr. H. B. Dixon on the "Lighthouse Experiments at the South Foreland." The other lectures are historical, musical, and literary.

In No. 1,028, p. 295, Vol. XL., we gave an

account of some experiments carried out by Messrs. Sutton, of Reading, at the instigation of Earl Cathcart, with the view of regenerating the potato and discovering its original species. On Monday last a number of gentlemen, including Dr. Hogg, Dr. Masters, Mr. Shirley Hibberd, and other authorities in potato history, visited Messrs. Sutton and Sons' trial grounds at Reading to note the experiments, which have been very successful and satisfactory. It was agreed that the parent in the cross was not, after all, a true specimen of Solanum Maglia, but was a wild form of Solanum tuberosum of a distinctly different geographical origin from the variety which furnished the varieties commonly cultivated, and this wild form has been preserved for many years at Kew-gardens in a bed side by side with the plants of Solanum Maglia. Twenty-three plants were obtained in 1885, and the tubers set again in the present year vastly increased in weight, up to 122lb. from 15½oz. The cross is between the wild Solanum tuberosum and the variety known as Sutton's Reading Russet. In point of quality and shapely form they leave nothing to be desired, and reach a high standard of merit. Several other crosses have been obtained in this first attempt to introduce new blood into the potato, successful hybrids being bred from the wild species crossed with Walker's Regent, Paterson's Victoria, and other popular varieties.

Although the crop of tobacco raised by Messrs. Carter has not been sold in open market, it has been "cured" so successfully that it is considered to be worth from 6d. to 8d. per pound, and as the total yield is about 15cwt. from the three-quarters of an acre, that would show a value at the lower rate of £42, or at the rate of £56 an acre. At present, the other side of the account is not available; but such a return, if realised, would induce many to try whether tobacco cannot be raised with economy—though cultivation, manure, and "curing," no doubt, swallow up a very large portion of the sum that would be received for such a crop.

The Vice-Chancellor of Cambridge University has communicated to the Senate a letter received from the Attorney-General, to the effect that Mr. John Lucas Ward had left him the sum of £10,000 to be spent "in the promotion, without regard to sect or party, of scientific and literary research, or of either of those objects, in Cambridge or in the metropolis, or in both these places." After consultation with Prof. Huxley, Sir James Paget, and several others, a scheme has been formulated, and "The John Lucas Ward Fund" is to be devoted to the foundation of studentships in Pathology, open to males or females. It is also expressly set forth that studentships shall not be awarded as the result of a competitive examination; but the students are to be elected on the nomination of the Professor of Pathology—a stipulation which indicates the direction in which the wind is blowing in connection with competitive examinations.

A movement has, it is stated, been set on foot in Italy towards erecting in one of the principal towns an electrical crematorium. In this edifice the corpses will be instantly consumed by means of an intense heat caused by electricity. Various European cremation societies are reported to have despatched representatives to Italy to make inquiries as to the feasibility of the scheme, which it is expected will, if successful, soon replace the more elaborate methods now generally adopted. There does not seem any necessity to send representatives to Italy, as it is quite certain corpses cannot be "instantly consumed" by electricity.

The Artisans' Classes already started at the Royal Victoria Hall, Waterloo-bridge-road, S.E., are well filled, and some, we are informed, are in danger of being over-filled. A class in chemistry under Mr. W. P. Bloxam, and one in mathematics under Rev. P. H. Wicksteed, are also contemplated, if not already started. The fees are purposely made so low as to be merely nominal. Amongst the forthcoming scientific lectures we note that Prof. Rücker will discourse on the "Early History of the Earth and Moon," on Tuesday, Nov. 30; the Rev. W. H. Dallinger, President of the Royal Microscopical Society, will lecture on "Plants that Prey on Animals, and Animals that Fertilise Plants," on Dec. 7th, and on Dec. 14th. Prof. Boyd Dawkins will describe the "Introduction of the Arts into Britain."

Prof. Wrightson, of the College of Agriculture, Downton, can readily believe that there is a loss of two or three millions to the country through the ravages of the warble or ox botfly (*Œstrus bovis*), but thinks it might cost two or three millions to protect the cattle in this country from the attacks of the fly. It should be remembered, however, that the loss is of annual recurrence, while the expenditure to prevent it would become less yearly.

The Annual Report of the Department of Mines, New South Wales, for 1885, shows that the Government of the colony is aware of the value of such work in attracting capital, and that the portion of Australia known as New South Wales is rich in minerals. The reports of the Mining Registrars on the Gold Fields of Victoria show a decline on the yield of gold for the quarter ending June 30, 1886.

The Case School of Applied Science, Cleveland, Ohio, which was endowed by the late Leonard Case with property worth two million and a quarter dollars, has been destroyed by fire, the actual loss being about 200,000 dollars. One would have thought that a school of applied science would have been made as nearly fireproof as possible.

M. Poskin uses chromic acid as a caustic; but points out to the Liège Medical Society that it is necessary to use great caution. He heats moderately a very small crystal on a silver probe to which it adheres as a dark brown coating. If a green oxide is formed, the acid loses its caustic power. Its action is neutralised by a weak solution of carbonate of soda.

In a paper presented to the Paris Academy of Sciences M. de Forerand says that glycerin is attacked in the cold by alkaline metals with the formation of a glycerinate and the escape of hydrogen. The fragments of the metal become coated with solid glycerinate, and if heat is applied the matter turns black and an explosion follows.

The Handicrafts Committee of the Manchester Exhibition, of which Alderman W. H. Bailey, President of the Manchester Society of Engineers, is the chairman, have done a wise thing in offering a special prize of £20 to the exhibitor of any handicraft process at work likely to be of utility and profit to cottagers. Anything that will help home industry must be a real national benefit.

The committee of the Penrith Literary and Scientific Society has decided to have a course of lectures on astronomy (illustrated with photographs and diagrams) delivered throughout the winter. Mr. William Peck, F.R.A.S., is to be the lecturer. The opening lecture of the course was delivered on Thursday evening last (18th inst.).

Engineers' Tools, Amateurs' Lathes, &c.—The Britannia Company, of Colchester, have issued a new catalogue of the tools and machines constructed by them. It is freely illustrated, and is printed in 4to. size on thin paper.

Piston Valves for Locomotives.—According to M. Ricour, piston valves in locomotives wear at the rate of $\frac{1}{25}$in. for 125,000 miles, whilst with the slide valves the same extent of wear takes place with one-sixtieth of the mileage. The wear of the valve gear is reduced in the same proportion. The effect in the consumption of fuel is shown by the returns made at Saintes Station for the year 1882, where on all engines worked with slide valves, the coal consumed per 1,000 tons conveyed one mile was 226lb. against 234lb. in the year 1884, when 30 out of 40 locomotives had been fitted with cylindrical valves.

New Propelling Appliance for Ships.—In No. 1,062, p. 479, Mr. W. Griffin gave a brief account of a new device for propelling ships. Messrs. Hughes and Griffin, of Bilston, Staffordshire, have recently obtained acceptance of a complete specification (No. 209, 1886) which can now be seen at the Patent Office. The object of the invention is to so construct and arrange a number of paddles for ships, that they may enter and leave the water feather edge after traversing nearly the whole length of the ship, by which device the "slip and back weight are entirely removed." It is impossible to describe the invention without diagrams, which are not yet published.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

REDUCING A STAR'S PLACE FROM A CATALOGUE: ERRATUM — THE LIVERPOOL ASTRONOMICAL SOCIETY'S JOURNAL—SATURN'S RINGS — COMPLETION OF THE OBJECT-GLASS OF THE GREAT LICK TELESCOPE—PATH OF A FALLING BODY THROUGH THE EARTH—THE EARTH'S DENSITY—A NOVEL PLANISPHERE—MOTIONS OF THE EARTH AND MOON.

[26490.]—"VEUTON VEOR" (query 60722, p. 183) will probably observe from internal evidence that letter 26440 (p. 213) was written in very great haste. Reading it through now in print, I find that I have, in the third paragraph, in some way absolutely inexplicable to myself, included the secular variation in Precession in R.A. and N.P.D. in the quantities to be added to the star co-ordinates to determine them for the date specified! and even taken out the proper motion wrong. The calculation should, of course, stand thus: Mean R.A. of γ Orionis on 1872, Jan. 1, 5h. 18m. 15·926s., mean N.P.D. at same epoch, 83° 46′ 6·190″.

+ 3·2158sec.
+ 0·0020
———
3·2178
14
———
+ 45·0492sec., and 5h. 18m. 15·926s. + 45·0492 secs = 5h. 19m. 0·973s. Similarly—

− 3·632″
+ 0·040
———
− 3·592
14
———
− 50·288, and 83° 46′ 6·190″ − 50·288″ = 83° 45′ 15·902″. With the substitution of these quantities, the rest of the paragraph containing the gist of the reply to "Veuton Veor's" question is perfectly correct.

The Liverpool Astronomical Society may indeed be proud of the first part of Vol. V. of their *Journal.* I am loth to indulge in those "caparisons" against which Mrs. Malaprop protested; but it is difficult to avoid contrasting the 40 pages crowded with matter of interest to the amateur astronomer, and excellently illustrated by facsimiles of some of the author's sketches, with the wretched little three-page number which concluded Vol. IV. Précis of some of the papers which appear will be found on page 169 of the ENGLISH MECHANIC for October 22; but in addition to these there will be found an essay by that skilled observer, Mr. W. F. Denning, on "Telescopes and Telescopic work," which the beginner may peruse with considerable advantage: a remark which applies equally to Mr. W. S. Franks's "Division of Astronomical Work." The incipient Selenographer too will derive both pleasure and instruction from the perusal of M. C. M. Gaudibert's description of the Lunar Crater Cassini and from Mr. T. G. Elger's "Moon Surveyed in 'Common Telescopes'"; while an excellent popular exposition of the accepted classification of variable stars appears by Mr. J. E. Gore. Then we have biographies of four of the members of the Society whom it has lost by death during the previous twelve months; after which appear short reviews or notices of the books, pamphlets, &c., added to the Society's library. This is a novel and very useful feature. These notices are in turn followed by "Astronomical Notes," correspondence, &c., and queries and replies conclude the part. I would fain hope that this mere glance at its contents will suffice to show every amateur astronomer who has not yet joined the Liverpool Astronomical Society, how much merely in money's worth the

members receive in excess of their trivial subscription, and what really valuable aid to the observer is derivable from the perusal of its publications.

In the *Bulletin* of the Californian Academy of Sciences for September there appears a paper on Saturn, by Prof. George Davidson, which is well worth reading by all observers of that marvellous planet. I especially notice this here because Dr. Davidson, employing an Alvan Clark Equatoreal of 6·4in. in aperture, on several fine nights during 1885-1886, saw Encke's division in Ring A quite clearly, definitely, and unmistakably, tracing it on one occasion of superlative definition about 120° at each end of the ring's major axis. I fail to see how an observation of this sort can be controverted—clearly, not by anyone saying that he has looked at Saturn with a big telescope, and has *not* seen the division. This is merely the old story of the Irish pickpocket who, on learning that two men would swear that they actually saw his hand in a man's pocket, volunteered to bring six witnesses to state on oath that they didn't see him! Prof. Davidson also contributes a paper on "Transits of the 2nd and 3rd Satellites of Jupiter," and on the Annular Solar Eclipse of March 5, 1886, but these are, perhaps, of less general interest.

Apropos, by the way, of California, I hear that Alvan Clark and Co. announce that they have, at last, completed the object-glass of the Great Lick Telescope. In the skilled hands of Professor Holden this mammoth instrument ought to produce results at once interesting and important. Let us earnestly hope, then, that our experience of the work done by certain other gigantic telescopes will not be repeated in the case of the Lick Instrument.

An invitation from Mr. York (p. 221) to reply to query 60334 has just caught my eye; but turning back to the original question, with that number appended to it (on. p. 23), and studying some more recent answers to it, it seems abundantly evident that it has drifted into a discussion as to the path of a falling body down a hole or well bored in the earth itself. Of course, if the axis of such a perforation were coincident with that of the earth—i.e., at the Poles—the falling body would follow a path which would be a prolongation of the plumb-line. If, though, we were making the experiment at the Equator, the body when set free would be moving eastward with the earth's Equatorial velocity, or more than 1,000 miles an hour. Hence its "angular slope from the plumb line" would be at a maximum at two places—one at the point whence it was dropped, and the other as it was passing the earth's centre. That it must describe an ellipse round that centre is shown in Tate and Steel's "Dynamics of a Particle," where it is proved that any body acted on by two forces, one of which varies directly as the distance from the centre, and the other is at right angles to the radius vector, will perforce do so. On turning back, I find this very clearly and correctly put by "Dubliniensis" on p. 157. Of course, the earth's centre will be in the centre, and not in the focus, of such ellipse, as it would be did the attractive force act inversely as distance². So much for the paths of bodies falling through the earth from the Poles or Equator. At any immediate point on the earth's surface with latitude λ, a body so let fall would pass outside of the earth's centre by a distance $= 260 \times \cos. \lambda$ miles, and would move in a plane passing through the earth's centre, and at right angles to the great circle of longitude drawn through the place from which it was dropped.

In connection with this matter, will "Vulcan" (same numbered reply, p. 221) forgive me if I point out that he seems to be a little hazy on the subject of the gain or loss of a pendulum at the bottom of a mine. The crust or shell of the earth which lies above the pendulum produces no effect upon it at all. Take the Harton Colliery experiment, in which it was found that the pendulum was accelerated 2·25 secs. per diem; in other words, that gravity was increased at the bottom of the mine by $\frac{1}{19190}$th part. But this must obviously be taken in connection with the density of the rocks forming the spheroid beneath the pendulum. Were the density of the crust through which the mine was sunk two-thirds of the mean density of the whole earth, the weight of a particle would be the same, both at the top and the bottom of the mine. Were the crust perforated by the pit more than two-thirds the density of the interior, the weight of a particle would be less at the pit's bottom than at its mouth. While, finally, if the density of the whole earth exceeded that of the shell in a greater proportion than this the particle would —as it was found to do—weigh more at the bottom of the mine than at the top. As a matter of fact, the components of the crust of the earth accessible to us have a density less than three times that of water, while the specific gravity of the entire spheroid is very approximately 5·7. Gravity varies directly as the mass and inversely as the square of the distance from the centre of the attracting body, and in going down the mine you approach the centre of a smaller but *very nearly as heavy* a spheroid as that from whose surface you started. Were the earth homogeneous, its mass would vary as r^3 (r being the distance from the centre at any given point below its surface); hence obviously the attractive force towards that centre would vary as $\frac{r^3}{r^2}$, or directly as r.

Inasmuch as "D. D." (reply 60622, p. 222) has failed in obtaining a patent for what (assuming it to perform what he claims for it) must be an invention as useful as it is ingenious, why does he not give the readers of the ENGLISH MECHANIC at large the benefit of an illustrated description of so remarkable an instrument? I am sure that our Editor would not grudge either the cost or space for the diagram or diagrams.

The statement found by "J. C. O." (query 60903, p. 248) in the *Encyclopædia Britannica* is approximately correct. The mass of the moon is only about $\frac{1}{82}$nd of that of the earth, and, of course, it is their common centre of gravity that revolves round the sun. Hence the earth's centre is displaced by a distance of some eighty-secondth part of her distance from the moon, or 2,912 miles. This causes a seeming slight advance and slight retardation in her path, with a period of half a lunation; and this movement she, of course, to a terrestrial observer, transfers to the sun, whose journey through the Ecliptic is apparently disturbed in the same way. This effect is even more perceptible on Venus when she is nearest to the earth. If "J. C. O." will connect a large and heavy ball with a small and light one, by means of a piece of string, and throw them up into the air, he will note how they will revolve round a point close to the heavier ball of the two.

A Fellow of the Royal Astronomical Society.

SMALL STARS NEAR VEGA.

[26491.]—As much interest attaches to these at present, arising from Messrs. Henry's photographs, I think perhaps the details of my observations, undertaken at the suggestion of Mr. Sadler, may be worth insertion, more especially as Mr. Tarrant does not appear to have had very clear skies, having only seen his smaller stars on one occasion. My first observation was July 12. Air thick and unsteady; diagram shows nine stars within 6′ of Vega. I had no other opportunity until Aug. 6: Air clear and steady; 11 small stars seen. Aug. 10: 13 stars seen. Aug. 24: Air unsteady; 14 stars seen. Aug. 25: Flaring air; two stars more seen. Until this time I had been working with a film $2\frac{1}{2}$ years old. It was little tarnished; but from removal of dust deposited from London air was much worn and scratched. On Aug. 31st I got new film. Aug. 31: Air not clear, but improved as night deepened; never good while Vega was in view; 19 stars were seen, while two previously seen were not picked up. This night I found two minute *comes* to β Cygni, which do not appear to have been noted before, one being closer than the bright pair (to the blue star), and I found *comes* at 160° 25′ $\pm$ to Σ 2491. This completes my observations of Vega. I, however, looked on Aug. 30, and failed to see more than 13 in all.

On Tuesday, Sept. 7, I tried Polaris with small apertures, and found the *comes* visible with $1\frac{1}{2}$in. and a single lens; but could not see it with any eyepiece at all. Air was not clear, yet *comes* was easy with single lens. I used a Steinheil solid e.p. on Vega, upon a 9in. mirror; power 275.

I think a query was addressed to me some six weeks ago. The querist will not think me uncivil in omitting to answer when I inform him, since September 29th I have been in bed dangerously ill, and have little prospect of attending to anything for some time.

E. Holmes.

THE WILSONIAN THEORY OF SUN-SPOTS—U CYGNI—B 75—V CYGNI.

[26492.]—I am sorry that it has not been possible for me before this to reply to the remarks which, in letter 26080, p. 525 of your issue for August 13, "F.R.A.S." makes upon the concluding paragraph, *re* the Wilsonian theory of sunspots, of my letter in the "E. M." for July 30. He is quite right in supposing that in the last few lines "29" is a mistake for "27" June, but is wrong in his interpretation of the drawings. He assumes that the sun's limb was meant to be on the *left* side of the spot; but in point of fact, as I find by looking at the original sketches, the limb was on the *right* side, and the spot, therefore, as I understood when I sent the drawings, presented phenomena *in accordance* with Wilson's theory. I have looked over my other drawings of solar phenomena, and find that they include instances of spots in accordance with, and spots in direct opposition to, Wilson's theory, as well as spots behaving in a manner similar to that of which "F.R.A.S." gives the drawing appearing in his letter. I intend to carefully examine and classify my sketches, some of which are pretty elaborate, and will send the results to "Ours," with, perhaps, one or two drawings from them. Meanwhile, I may note the fact I have mentioned above, that the series includes instances of all three forms of spot.

U Cygni.—This is so splendid an object that, after seeing it, one is inclined to wonder much how it came to be that it should have been left to Birmingham to discover it so late as 1870, and to wonder, too, why it is that we so seldom see observations of it. I do not remember ever noticing any observation of it recorded in the ENGLISH MECHANIC. I had looked for it several times before; but, in consequence of some mistake, I did not find it till recently, on Sept 10 last. I found the pair a truly superb one. The red star was a rich ruby, and the companion a fine blue—the colours were in themselves very fine, and the contrast gave them an added vividness. The red star was about 0·3 mag. above the blue one. The date of maximum given in the "Companion to the Observatory" was September 20. On October 31, I saw it again. The stars were about equal, the red one being perhaps just the brighter; but *both* stars looked rather fainter than before. The one was of the richest ruby, the other blue, though not of so fine a colour. I observed that night, however, that no blue star was very well seen—not even the *comes* to β Cygni. Can "F.R.A.S.," or Mr. Tarrant, give me any further information respecting this pair, and tell me whether anything is known as to whether or not it is physically connected? Is anything known of the spectra?

B 75.—I have succeeded recently in obtaining two observations of this star. The first was on the 27th of September, when I found the colour fine ruby, and the star of between the 7th and 8th magnitudes. On the 25th of October I saw it again, when the colour was ruby, and the mag. estimated at $7\frac{3}{4}$. Mr. Espin has kindly furnished me with some observations of the star, all of which agree among themselves, and with the above, closely, in respect of magnitude. As to colour, the earlier of the observations mention *deep orange*, the later *pale red*. Taken in conjunction with the above obs. of a *ruby* colour, does this indicate any progressive deepening of the tint? "Birmingham" attaches no note of his own to his entry of this star, but cites this from Schjellerup: "Chacornac (Bull. Mét., April 12, 1858) éclat terne et nébuleux, 7·5." Can those using large apertures say anything further about this peculiarity? No spectroscopic result is given in Birmingham—has any been obtained? The star can be easily found in this way. A star lies *n.f.* κ^1 Tauri, forming, with that star and v^1 Tauri a right-angled triangle. B 75 lies a little *n.f.* this star, and is almost pointed at by the line joining κ^1 with this latter. It is not in Proctor's Atlas.

The same night as Mr. Ward (letter 26455, p. 217) was looking at V Cygni I was looking for it, though without success similar to his. I looked for it because of finding in the "Companion to the Observatory," under date Oct. 15, "V Cygni M." It appears, however, from Mr. Ward's letter that the star was about this time at or approaching a *minimum* instead of a *maximum*, as there stated. It thus seems that either there is a misprint in the "Companion," or the elements employed in the computation of this date are seriously in error. Which is the explanation?

Glasgow. **S. Maitland Baird Gemmill.**

"HAS ENGLAND GONE UP-HILL OR DOWN DURING THE LAST FIFTY YEARS?"

[26493.]—I have a strong conviction that the doctrines of "A Socialist" are economically unsound, and I am quite sure he is utterly ignorant of any real grasp of the question about which he writes so flippantly. Before "A Socialist" goes further, I would commend to his attention an article entitled "The Labour Convention at Richmond," which appeared in a Canadian paper, *The Week*, on Oct. 21, 1886. If "A Socialist" will answer the questions asked in the article in question without prevarication or "withholding aught," and continue to advocate his Socialistic doctrines, formulating with less verbosity his position, I will do my best to show where and why he is wrong, with the sole stipulation that the arguments shall be over our real names.

C. H. W. B.

[26494.]—If "Socialist" can briefly show us a practical scheme for ameliorating the condition of workers (genuine workers) he will be doing a service. In the past, Socialists have, as a rule, been on the side of destruction and disorder, which produce stagnation in trade and consequent want of employment, and distress.

By all means let us hear of any good they have done in the past, and let us participate and cooperate with them in any practical scheme for benefiting workers in the future. In order to see something practical before us, let "Socialist" give us a scheme for elevating the needlewomen and release them from the grinding system under which they work.

I belong to the class which, perhaps, he would

exterminate, although it is my aim to pay as good wages to my men as competition allows. Let "Socialist" point out how competition is to be superseded, for that is the problem. Selfishness prompts men to aim at large profits and large returns, and these are not often obtained without doing what is so much to be deprecated, screwing down wages.

The working classes may one day make a world-wide combination, and then they may demand what is a fairly just division of the profits, and I am sufficient of a Socialist to say that I shall rejoice to see the day; but one country cannot do this, or foreign competition will at once destroy our home and export trade.

A Worker and Capitalist.

[26495.]—No doubt it would be matter for general satisfaction if the various unpleasantnesses referred to by "A Socialist" should disappear. I gather from his letters that he attributes their continued existence to some fault on the part of one section only of the community—viz., the capitalists. I have conversed with others holding similar views, but have always been disappointed to find that they were unable to propose any intelligible new plan or general principle on which things might go better. Perhaps I have been unfortunate in my teachers.

Will "A Socialist" say what he proposes as a comprehensive substitute for our present arrangements, taking into account two great principles, the truth of which, I presume, he will not deny, viz.:—

1. The greatest good of the greatest number.
2. The survival of the fittest.

Though, indeed, the first would be enough in itself, as a little consideration will show that when we consider future as well as present generations, the second is included in it.

I do not ask "A Socialist" to trouble about the mere patching up of details such as might be, perhaps, done by regulating hours of work, or rate of remuneration for any particular employment; or methods for relieving certain persons from the necessity of parting with portions of their clothing for inconvenient periods; or for abrogating any particular one of the various pecuniary miseries we can all see around us; but it would be of interest to have an outline of the general principle or plan by which these things could be obviated, and the division of the joint product of capital and labour made permanently satisfactory.

Belfast. **J. Brown.**

[26496.]—If the moderate letters to which "Socialist" replies deserve to be called "howls," what word shall fitly describe his own astonishing farrago of wild abuse and reckless assertion? Let me suggest to him, that what I may call the "Yah! Boo!" style of controversy, though perhaps cogent among, and to be excused in, the aborigines of the gutter, is scarcely dignified, still less convincing, even when addressed to "such liars, swine, and idiots" as are capitalists, according to "Socialist."

But before going further it would be most desirable to have from "Socialist" a clear definition of the expressions "the people," "the true worker, or working man," and "the capitalist." These slip very glibly from the lips of Socialists and their congeners, but are often used (especially the last, which is generally coupled with an abusive epithet) in such a manner as to betray a very hazy idea of their true meaning. Take my own case, for example: I earn my living, and, moreover, earning somewhat more than sufficient for my present wants, have invested that surplus. Am I, then, a "true worker," or a (more or less) "bloated capitalist?" Do I belong to the "real people" or not, and if not, why not?

I fear I do not, since, according to "Socialist," the "real people" are those who cannot afford watches, &c., and who pawn their clothes. But why are such folk more deserving of the name of "the real people" than as many dukes or greengrocers?

If "Socialist's" theory, that the man with dark prospects saves, be correct, surely the lessening of bank deposits should be a cause of rejoicing rather than lamentation, since it implies that the prospects of the savers are brightening. In any case, though, it should be good tidings for Socialists, for it shows that there are fewer "swinish," &c., capitalists, slothfully absorbing their "plunder" of 2½ per cent. Why, by the way, is it more "plunder" for one man to earn a wage by hiring out his money, than it is for another to do the same by hiring out his labour?

As to tram-men. Will an artisan give a penny for a box of matches when he can buy a similar one for a halfpenny, even though he knows that he latter can only be sold at so low a price through the maker being paid starvation wages? And if the artisan is justified in so doing, is not the tram director equally justified in laying out his money to the best advantage? Indeed, the director is the better justified of the two, since *he* is not spending his own money only, but that of others who have trusted him. I quite admit that tram-men only earn a low wage, but "Socialist" must remember that they only give in return low class (*i.e.*, unskilled) labour, a commodity which, thanks to pseudo-free trade and similar blessings, is a drug in the market.

It seems to me that the two chief rocks on which Socialists split are—1st, their ignoring of the fact that headwork, which can be only supplied by the minority, earns, as it deserves, a higher wage than handwork; and, 2nd, their assuming as a fact the fallacy that all men are physically and mentally equal.

Faber.

[26497.]—Your correspondent, "A Socialist," is wrong when he says his "capitalistic opponents are *evidently* badly hurt," and we are quite as much entitled to consider his letter a "ludicrous howl." Every point he raises is perfectly answerable to any reasonable, enlightened mind.

A man has £2,000, and invests this amount in the tramways and is able to get a dividend of, say, 10 per cent. This would give him an income of £200 per year. This man would be a "capitalist." But if this man has instead to live on, say, only £100 a year out of his £2,000, he would in 20 years be a beggar. "A Socialist" objects to a man taking the former position, and certainly cannot wish to see him in the latter state, of which there are so many, unfortunately. For, if all took this latter form of living, there would soon be no employment for the thousands who, on the tramways, &c., live as servants to "capitalists." Should all become socialists hereafter, one man will always strive to be richer than his neighbour. Equal wealth is impossible.

"A Socialist" *only* shows that the savings-banks have 8s. 3d. less than in 1861, he does not raise the question—whether the "£2,670,000" (and perhaps a greater sum) is being more usefully employed in trade and enterprise. His 8s. 3d. is no fact until he has settled this point.

Then, with regard to the population of Ireland, "H. G. E." is correct in taking the last few years as between 1871 and 1881, for he has the results of the census, which are facts. We cannot talk properly of the few years since 1880 until after the year 1891, when the new census will have been taken.

The case of "A Socialist" is not very strong if he cannot put it before the "E. M." in a more practical form than in his letter, which is not of the tone your readers most admire, neither businesslike nor amusing.

J. P.

[26498.]—Your socialist correspondent, like a good many other people, sees things his own way only. I am not learned in Socialistic views; but it appears to me that he does not consider a class which certainly exists to a pretty fair extent in this country, and of which I may take myself as an average example. Coming of a poor family I left school at twelve years of age to work for my living, and thirty-five years ago there were no restrictions as to time of work. I was kept at it from 6 in the morning until 8 or 9 at night. I never owned sixpence (until I was over 20 years old) which was not needed for food, clothing, and lodging, but succeeded, by the aid of free libraries, in obtaining a fair theoretical knowledge of chemistry, electricity, and engineering, which were utilised in my daily work. I never needed a day's work, never asked for a situation, and at the present time may perhaps be classed as a bloated capitalist, employing about two hundred men and boys, each earning more money than I did myself, and working little more than half the time. Out of the number I employ, some few have worked to educate themselves, and are in positions of trust with good incomes, but not one in a hundred of the juniors seems to have the slightest idea of educating and improving himself.

A large part of my capital has been made by my own hands, working at the bench, and I know workmen at the bench who can command very high rates owing to their exceptional skill. If I can obtain at the bench £5 per week and spend one, I must end as a capitalist, and all the Socialism in the world cannot prevent it. If I, like others I know, earn £5 per week and spend it all, it needs only a little reverse to make me a bankrupt, and then I ought to become a Socialist and claim the spending of the money earned by the man who does not spend it himself. A community of goods, like a community of wives, is, from all past experience, bad for the world and bad for individuals, doing away with all stimulus for special skill and exertion, which is the soul of all advancement.

Not a Socialist.

[26499.]—Will "A Socialist" (26474) solve the following problem? He himself admits the decrease in population and material prosperity of Ireland, and the chronic complaint of Irish agitators is that capital is not invested in Ireland. If, then, capital brings all the evils in its train that "A Socialist" contends it does, how is it that Ireland (free from the curse of "capitalist greed," &c., &c.) should be still going down-hill, and her people emigrating to lands where capital is more abundant?

If Socialists would indulge in a little less vapid froth, and examine such instances as I have mentioned above, and would try and discover how workers without capital—i.e., reserve labour—could undertake any work—e.g., railway and canal construction—that gave no immediate results, perhaps they might discover that the "impudent capitalistic libellers" are not the only ones who have still something to learn.

I also notice that in "A Socialist's" letter he first states that the "Darker a man's prospects are the more he saves"; then goes on to prove that men are saving less, then laments the fact. Apparently a little logic, or, if that is not necessary, a little more humanity, might be also added, while "A Socialist" is acquiring the elements of political economy.

F. W. W.

[We are deluged with letters on this question which we cannot insert. The controversy has already been carried utterly out of the bounds which limit discussion in this journal, and we must at once stop it.—Ed.]

ORGAN WINDCHESTS.

[26500.]—In reply to the letter by "C. H. D." (26472), I have much pleasure in giving my opinion upon the windchest alluded to. In principle the windchest is good; but it is open to grave question if the mode of its construction is satisfactory. Many windchests have been devised on the same principle—namely, furnishing each pipe with a special valve or pallet, doing away with all sliders, and bringing on the stops by simply admitting the wind into their respective chambers. In nearly all instances, the difficulty of accurately adjusting the numerous valves, and the heaviness of touch caused by the necessity of opening so many valves at one instant, have proved fatal objections to the adoption of such windchests. So far as can be seen from the drawings and descriptions given on pages 414, 525, and 597, Vol. XXXII., I am clearly of opinion the same objections will obtain in the windchest alluded to by "C. H. D." Supposing a department—Great, Choir, or Swell—contained only six stops, it would be necessary for every key to push up (against the pressure of the wind) six circular valves, varying from 1¼ to ½in. in diameter. The touch, under these circumstances, would be extremely unpleasant; on first touching a key, considerable pressure would be necessary to unseat all the valves connected with it; afterwards, almost all resistance would cease, and the key would go down with a jerk. Nothing is more disagreeable in an organ than a jerky touch. There can be no question as regards the advantages of doing away with the sliders and their attendant evils, and supplying each pipe independently with wind; but the means proposed of doing all this, in the windchest in question, are anything but perfect. This windchest was invented by Herr Walcker. A writer speaking of it remarks:—"It can be seen at a glance that the mechanism necessary to control so many little valves must be complicated and liable to derangement from atmospheric changes, &c., and that it is probable that the touch may be found to be quite heavy, owing to the organist having so much mechanism to put in operation."

The only perfectly satisfactory windchest on this principle is that known as the "Roosevelt Patent Windchest." In it there are no sliders, and every pipe has a separate valve, as in Walcker's invention; but all complicated mechanism is rendered unnecessary by the wind in the chambers being made to open the valves of the pipes. All that each key has to do is to pull down a small disc-valve, of about 1¼in. in diameter, against the upward pressure of a light pallet spring. By simply pulling down this disc-valve, twenty or more valves, admitting wind into the same number of pipes, are instantaneously opened. So perfect is the contrivance that the most rapid repetition is secured. With reference to this, it has been justly said by the inventor of the windchest, that the "paramount achievement, however, is the acquisition of *repetition* to a degree of perfection never before obtained in an Organ, and equal to that of the most perfect pianoforte." Another great advantage lies in the fact that the use of this windchest "effectually supersedes the usually complicated employment of the pneumatic lever, as it relieves weight of touch, even in the largest organs, with equal efficacy."

Returning to the Walcker windchest, alluded to by "C. H. D.," I may say that I consider it altogether unsuited for the Chamber Organ.

G. A. Audsley.

CHAMBER MUSIC AND MUSICAL INSTRUMENTS.

[26501.]—I cannot help feeling gratified at the many kind words of approval which have appeared in your correspondents' letters with refer-

ence to my "Notes on the Chamber Organ," and, now, it is specially gratifying to have the support of our good friend, "Country Solicitor." At one time I firmly believed he was so Mustelified that he could never be induced to believe in anything of the pipe organ species; but wonders will never cease even in this non-miraculous age. "Country Solicitor," in his last letter (26485), expresses a wish that, after so much pleasant correspondence, I should give, in your columns, my opinion on the "Mustel Organ," and on his instrument in particular. With your kind permission, Mr. Editor, I shall have much pleasure in doing so.

My opinion might be summed up in this brief sentence—the "Mustel Organ" is the king of all harmoniums or instruments of the free-reed class; but I am afraid so short and dogmatic a statement would neither satisfy "Country Solicitor" nor the rest of your musical readers. It has been my happy privilege to hear "Country Solicitor's" "Mustel" under his own consummate management; and I can assure you it was a musical treat of a very high order. As I listened, I realised that it was one thing to *possess* such an instrument, but quite another thing to be able to *play it as it ought to le played.* "Country Solicitor" has achieved a mastery over all the peculiar powers of the instrument which, it is quite safe to say, very few executants could, under ordinary circumstances, hope to attain. It is evident, notwithstanding certain defects and shortcomings, inherent in instruments of the harmonium type, that the "Mustel" is a remarkable instrument, capable of almost limitless powers of expression, and *nuances* and varieties of tone colour of surprising character; but it is also evident that great skill, practice, and natural musical talent are necessary to the satisfactory development of its capabilities on the part of the performer. If there is any fault to be found with the "Mustel" in this matter of expression, it lies in the fact that it lends itself to, if it does not naturally provoke, a weak and sentimental mannerism or style of playing. Those who possess or may in the future possess a "Mustel" will do well to bear this in mind; for nothing is more wearying to the listener, or less artistic, in a musical sense, than an exaggerated expression and a restless sentimentalism.

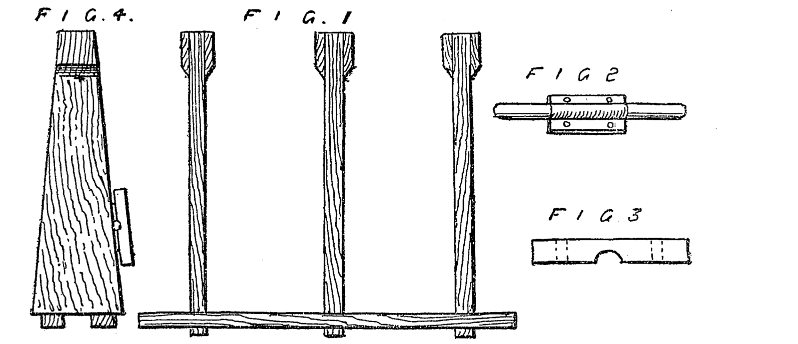
As all the peculiarities and features of the "Mustel" have already been fully described by "Country Solicitor" in these pages, it would be out of place for me to recapitulate them here. I need only give my testimony to the almost marvellous refinement and delicacy which characterise the tonal scheme of the instrument; the rare artistic skill which is displayed in every detail, as well as in the general conception of its structure; and the perfection of the several appliances placed at the disposal and under the perfect control of the executant. In all these respects the "Mustel" stands alone amongst all instruments of the harmonium class.

There cannot be two opinions as to the perfect suitability of the "Mustel" for both solo and concerted chamber music. So thoroughly do I recognise this suitability, that did I not possess a true Chamber Organ I should most certainly acquire a "Mustel," in preference to any other reed instrument of European or American manufacture known to me. **G. A. Audsley.**

ORIGINAL ELECTRIC EXPERIMENTS —AN IMPROVED ARRANGEMENT FOR A COMPOUND WIMSHURST MACHINE.

[26502.]—Upon looking up Mr. Wimshurst's "Few Practical Hints, &c.," on p. 201, No. 1,076, of Nov. 6, 1885, I find I am at variance with him upon some points. I think, then, he teaches that there is one angle or position upon each of the discs at which the best effects may be obtained. Now there is no reason, electrically speaking, why said brushes may not be placed, one pair perpendicularly, and the opposite pair horizontally, or in any other position so long as they are at right angles to each other. The only considerations coming into play are, Where is it most convenient to place your conductors, and also where are the bands to be placed? Next, I find that if the brushes are properly fixed, the machine, as might naturally be expected, works precisely as well whether it be turned to the right or left, but of course the place where the most electricity is given off, will not be the same. Then, as to the said brushes, there is no advantage gained by connecting them directly to the axle, being connected to any part of the framing answers equally well; more than this, we may remove them, and substitute four Leyden jars with a jump of, say, $\frac{1}{8}$ on my 24in. discs. Of course these jars must be provided with brushes.

Looking at the details of the compound machine figured upon page 192, of October 29th, 1886, it occurs to me that the bosses are too short to allow the bands to be sufficiently insulated from the discs. They are marked as $1\frac{5}{8}$, and with the position of brushes in the drawing as shown they would assuredly abstract a large quantity of the



electricity. As a proof of this, I may mention that if two sheets of glass be placed one over the other and separated—I cannot say just now how far, but certainly at three-quarters of an inch—and slips of foil laid upon the top sheet so that they almost touch at one end of each, if a rubber be applied to underside of the bottom sheet, it will be found that the electricity will pass from one to another in order to keep its original place of production opposite to said rubber.

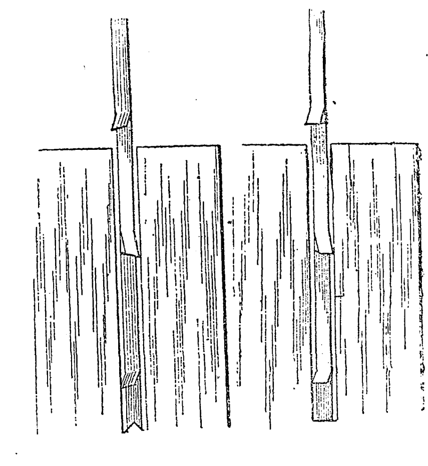
I conclude that a brush may be considered as a miniature rubber. I find that when any of these discs are used for a certain time, that there is a deposit formed upon the glass along the brush tracks which requires to be cleaned off, and I don't see how this could be conveniently done whilst the plates are so close to each other. I will now describe the nature of my proposed improvements—say, in this instance, for 19in. plates. Fig. 1 represents a portion of the baseboard, with three standards to carry four discs, any multiplication to be carried out in a similar manner. Fig. 4 is a side view of one of these standards, the top thickening pieces to be of, say, baywood, and the remainder, say, pine. Fig. 2 represents a malleable piece of cast iron similar in shape to a butt hinge, but solid enough to be bored through its length, so as to take the steel rod, which being turned up a shade larger it can be heated and shrunk on. The four screw holes are to adjust it upon top of the centre standard; the two outside castings will only require to have the rod projecting upon their inner sides. Now, I consider that $2\frac{1}{2}$in. is the shortest length the boss ought to be, and would incline to say 3in. This mahogany boss is to have the brass tube fitted into it right through, the face for the glass to be turned perfectly flat, cylindrical in its length, and the V groove as near its opposite edge as possible, the steel rod to be turned to fit as truly as possible. Thus we avoid making any hole in the glass, which is such a source of weakness and of ultimate fracture; and we get a convenient means of taking out any required plates without the ticklish job of threading all upon one spindle, and we can get at them more readily to oil the same. The driving gear would be fixed as shown by wooden cleat, Fig. 3, on right-hand side of standard. The neutralising rods for the two outside discs could be soldered to a slip of sheet brass, having a hole so as to slide on to the steel spindle, and be secured in position by a small screw into the standard; those for the two central discs could be made like one T on top of another, attached to a suitable base, so as to screw to the base-board of machine, and I would recommend that these be placed vertical, so as to deliver the electricity to each sector whilst it is opposite a standard, as it gives none off at that time, as I cannot see any objection to having conductors (if they are to be used) of varying heights to suit the place where the best result is to be obtained. In this arrangement the base-board is assumed to be solid, with slots for the driving wheels to fit partly into, so as to get as long a band as convenient. If it were to be glassed around, it would require a slight modification in the outside standards. These drawings are not made to scale.

A., Liverpool.

THE SHAPE OF SAW-TEETH.

[26503.]—With reference to what is said on page 233 about the shape of saw-teeth, the following remarks, which I saw in an American paper, may interest some of your readers:—

"As to the filing, I have found that a splitting saw, if filed as near square across the saw as possible, gives the best results. It cuts freer, leaves the stuff smoother, and will keep sharp as long as a saw which is filed at an angle or fleaming. If you believe in filing the teeth at any angle with the axis of saw, let me show you something which perhaps you have already noticed and can explain to your own satisfaction. After you have sharpened your saw, take a piece of lumber and try it. After cutting in a little way, stop and see the shape of the end of kerf. The points of the teeth have cut ahead and left the wood in the middle of kerf, projecting back towards the saw (Fig. 1). What cuts away the wood that forms this point? It must of course be removed by whatever edge the tooth may have crosswise of the saw. With the saw filed as in Fig. 1, there cannot be a very thin edge, and consequently it won't be an edge that will cut wood, and as it will require some crowding to make it tear or bruise off the wood, won't the crowding tend to force the points of the teeth away from the centre of the cut, making the saw cut a wider kerf than it should, and checking the speed until it runs slowly enough for each tooth to be



heard as it enters and leaves the wood? I claim that the cutting edge of the teeth on a splitting saw should be as nearly as possible at right angles with the grain of the wood operated upon. This is accomplished by filing the saw square across, both the front and top of tooth, as in Fig. 2, which leaves every tooth with an edge or point like the edge of a chisel. For a cross-cut saw the points of the teeth should 'resemble the point of a knife, so as to cut off the wood at each side of the kerf.' The centre of the kerf will take care of itself now."

It will be seen that there is much to say, even in connection with the teeth of saws; but it seems to me that much depends on the kind of wood, as well as on the shape of the teeth, set, &c. What do your practical readers think of the matter?

E. A. M.

"HOW A BOY MAY RAISE A SOLID TON WEIGHT WITHOUT MACHINERY."

[26504.]—I have read with much amusement the letter under the above title, which appeared on p. 195, and I should like to put a question—"Where's the boy?" If a boy, or a man for that matter, can raise a ton weight, whether solid or not, in the manner described by "B. R.," why should he not also get into a tub and lift that and himself up by the handles? "B. R." has "demonstrated" his process on the small scale. It is unwise to experiment always on the scale of 12in. to the foot; but if "B. R." had adopted that scale on this occasion, he would have been a little wiser than his letter on p. 195 "demonstrates."

Nun. Dor.

STEERING OCEAN STEAMERS.

[26505.]—I observed the letter on p. 67, by Mr. James McCash Govan, "not by the merest chance," but directly it appeared, though I have not had time to reply before. He is, no doubt, acquainted with the reports made to the British Association on the steering of steamers, and with the experiments made by Prof. Osborne Reynolds and the committee; if not, he might refer to them or to your back volumes. In Vol. XXVII. p. 649, there is an abstract of a report, in which it is stated that a screw-steamer, by using the rudder, should be able to turn herself through a *quadrant*

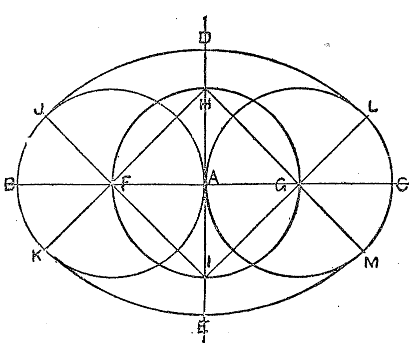
without having advanced five lengths in her original direction. Probably nine out of ten masters would, when a collision is imminent, order the reversal of the engines, in spite of the reports presented to the British Association, in which the folly of that action was denounced, because it had been demonstrated by experiments. I am not aware that I ever said "counsel" had anything to do with the "finding" of the inquiry; but if counsel are employed to represent the conduct of officers and owners as favourably as possible, other counsel ought to be employed who are capable of putting the expert evidence through cross-examination. Many a statement is made before boards of inquiry which would be turned inside out if "counsel" were able to see its absurdity.

Nun. Dor.

EASY METHOD OF MAKING AN ELLIPSE.

[26506.]—THE accompanying easy method of producing an ellipse may be of interest to your readers. So far as I am aware, it is original and new.

At the point A let two straight lines, B C and D E, cross each other at right angles. From



the centre A, draw a circle F G H I; and from F and G draw two other circles of the same circumference as F G H I.

From the points H and I draw four straight lines through the points F and G to the points J K L and M. Then from the centres H and I draw the arcs J D L and K E M.

An ellipse of any size may be produced by making the diameter of the first circle half the length of the desired ellipse.

Dudley. **H. C. Crew.**

THE "15-COACH TEST"—MIDLAND LOCOMOTIVE WORK AND DOUBLE-ENGINE RUNNING.

[26507.]—I OBSERVE that "P." (letter 26091, page 528) states that the "15-coach test," as applied to express engines, "consists in an engine drawing 15 coaches (180 tons) at 60 miles an hour on the level." I have pointed out, in a recent letter, that this is a complete misapprehension. The standard weight per coach adopted for the purpose of this test is 10 tons, not 12, and therefore of the test train 150 tons, not 180. A train of 180 tons weight represents 18 coaches, according to the rule laid down. This has been explained in your columns over and over again by our valued fellow-correspondent Mr. C. E. Stretton, so that I am surprised to find any of your readers ignorant of the rule. The standard trains used in the celebrated Newark brake trials ranged from 149 to 151 tons in weight, and were kept as nearly to the prescribed 150 tons as the different "makes" of rolling-stock permitted. The standard test of an express engine is to haul 150 tons (exclusive of its own weight, and that of its tender) at the rate of a mile a minute on the level. I have known an old engine with 6ft. drivers, and cylinders only 15in. by 22in., take 15 coaches at 60 miles an hour on the level. But the coaches only weighed six or seven tons each. On the other hand, I question whether the most powerful modern locomotive could take 15 Pullmans or Midland 12-wheeled bogies at anything like 50 miles an hour on the level. The term "coach" in such a comparison is misleading, for it may mean a vehicle of 5 tons or another of 24. It would be much better to deal with absolute known weights. Still, as a rough-and-ready mode of reckoning engine work, the present practice of estimating 10 tons to a coach is sufficiently near so long as it is clearly understood that these "coaches" are to represent 10 tons each.

Another of "P.'s" statements which needs correction relates to the working of the Midland trains. He says:—(1) "All the Midland Manchester trains average 11 coaches from St. Pancras. and even this light weight is divided over the Peak," and (2) "It is very rare to see a Midland express with over 14 coaches and one engine only; once get over 14, and a pilot goes on."

I am at a loss to understand upon what data these sweeping assertions are based; but, from my own long-continued personal observations during last year and the year before, I am able to give them a direct contradiction. I have known the M.R. Manchester and Liverpool expresses over and over again taken over the Peak undivided, and with one engine, although consisting of 12, 13, and 14 coaches, and in excellent time, too. I have myself timed Nos. 1315, 1563, and 1564 on several occasions with such loads, and in all weathers, time being admirably kept. As to (2) the assertion that a pilot is always taken with 14 coaches, it is ridiculously inaccurate. During all my lengthened observations of the M.R. working at St. Pancras station, I did not once see a train either arrive or depart with two engines to 14 carriages or even to 15. I once knew the day Scotch express leave with two of the 800 class on, and 16 coaches; but in that case the pilot left at Wellingborough, the run thither being done considerably under time. And I once came in with the Scotch express of 17, and two engines; but that run was accomplished in 16 minutes under time from Leicester. I only once saw a pilot on a Midland express of 14 coaches, and that was on the midday Manchester express which left St. Pancras with only one engine (No. 1489), and ran from Kentish Town to Bedford in 59 minutes, but took a pilot (No. 108) thence to Leicester, the weather being unfavourable. The same engine, on the same train, another time, left St. Pancras with 15 on, ran from Kentish Town to Bedford in 58 minutes, and then took No. 824 as pilot to Leicester. That was the only instance of a second engine being used with 15, in my experience, on any part of the M.R.

On the other hand, No. 814 kept time with 19 from Normanton to Leicester, and No. 812 with 20 over the same distance; No. 1573 with 20 from Aisgill to Skipton, and No. 1309, with the same number, from Skipton to Normanton. No. 829 brought 16 from Leicester in 1 hour 59 min. to Kentish Town (stopping there by signal) in spite of slackening to 10 miles an hour at the foot of the Desborough, Irchester, and Ampthill banks, the two former by signal. The same engine took a train of like weight from Leicester to St. Pancras in exactly two hours. The Scotch express is referred to in all these cases, which were by no means exceptional. On one occasion the up Scotch express had two engines on, with 17 coaches, from Leicester to London, being a little late at the former station. But in that instance the distance was run in 1 hour 52 min., and there is not the slightest doubt that either of the engines used could have easily drawn that train, or even a longer one, within the 2 hours 8 min. allowed. All these are given from personal observation, and very careful timing.

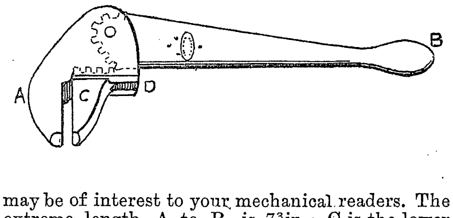
Evidently your correspondents must have seen "return pilots" going home after bringing in a heavy up-train, for most assuredly engines of the 800, 1472, 1562, and 1,667 classes can take 15 or 16 coaches, and keep time with the greatest ease.

Charles Rous-Marten.

Wellington, N.Z., Sept. 22.

SPANNERS.

[26508.]—TALKING of spanners (e.g. 26458), I wonder whether many of your readers know of an excellent French one, first introduced to my notice by a cycling friend, which I tried in vain to get in England, and at last obtained at the "Forge Vulcain" in Paris, after many fruitless attempts at other shops there. It is called "Clef Samuel," and possesses the great merit of tightening itself one way, and relaxing its hold when turned the other way, so that it adapts itself to any sized nut. It beats everything else in the spanner line which I have come across. I append a sketch of it, as it



may be of interest to your mechanical readers. The extreme length, A to B, is 7⅝in.; C is the lower jaw working up and down slide D, by means of ratchet connection, with the stand B inside (shown by dotted circles). It will take nuts from ⅛in. to 1in.

C. H. C.

OPERA AND FIELD-GLASSES, &c.—TO "O. V." AND MR. E. HOLMES.

[26509.]—"O. V." MUST not think that I have overlooked his query; stress of work has prevented me from writing before. There is considerable difference in the proportions adopted by different makers: some prefer a dumpy arrangement. I think there is nothing but greater portability to recommend that form. 5·5in. for the o.g.'s and 2in. for the eyepiece lenses are good proportions for the foci of opera-glasses of six-lens construction; with diameter of o.g.'s not to exceed 1⅝in. These give a power of 2·25, which is quite enough, to my mind. Anything greater only shows up rouge powder and other "properties" too much. Little, if any, difference is needed in the focus of the eye lenses for "field" or "marine." The increase of power necessarily being the effect of the o.g., which is proportionally increased in focal length and diameter until the limit is reached. Twenty-eight lines is the usual limit. In 10 and 12 lens forms the proportions of foci differ within certain limits. The highest I have seen that could be used comfortably have a proportion of 5 to 1. Some years ago I worked a large number of lenses for those compound glasses that were furnished with three sets of eye lenses marked "opera," "field," "marine." Of this form it could be said that the "opera" was too powerful, or the "field" and "marine" too weak. I need not tell our old friend that in this form of Galilean telescope we cannot let the eye travel out of the centre without getting prismaticity; to get the best effect, constant central vision is necessary. Although some advocate an increase of power up even to 10, I do not advise it, for however well the aberrations are corrected, the difficulty of keeping up this central vision is increased in proportion with the power. As to the 16-lens glasses: well, I have heard of five-wheeled coaches—I have never seen the latter; the former I have, and should say the fifth wheel and all lenses beyond 12 are equally useful. I am, however, too dull to discover where this usefulness comes in.

A statement made by Mr. E. Holmes, in his last-published letter, *re* the "English v. Foreign Microscope" controversy (wisely ended by our patient Editor), I must refute, as it affects my status in the eyes of the readers of the "E. M."

I beg to state to Mr. Holmes that I am *not* an "interested party," as an Englishman understands that phrase, seeing that I write independently, and have not a *shilling* of money invested in any firm whatever. When I have, if ever, I shall let Mr. H. and all "ours" know.

Prismatique.

EGYPTOLOGY, &c.

[26510.]—IF the early Hebrews seem, "Memnon" tells us, "to have been all Sadducees," will he tell us what to understand by the phrase being "gathered to his fathers," said of Abraham, Aaron, and Moses; or "gathered to his people," said of the same, and of Ishmael, Isaac, and Jacob? It is certain that the bodies of none of the three former were buried within hundreds of miles of any of their kindred. Abraham's immediate father had died in Mesopotamia; and earlier ancestors at Ur in Chaldea. Aaron and Moses were each ordered to ascend a desert mountain, to "be gathered to thy people"; and Moses was buried by no human hands, but by some landslip or avalanche; the Lord buried him, and "no man knoweth of his sepulchre." It was necessary to oppose all the false rubbish taught in Egypt about spirit life, and this could only be done by leaving all inevitable allusions thereto as vague as possible. The prohibition of dealing with witches, necromancers, or "mediums" (as they are now called), not only implied such dealings with the dead to be real (as "Ramases" says); but when Saul broke this law, the ghost of Samuel is declared to have come and prophesied, though not by the woman's agency, because unexpected by, and frightening her.

Even in Job, probably the oldest story, it is implied that he would, like David, rejoin his children. It is plainly declared that at last *everything* he had lost was doubled, but though the numbers of each kind of cattle are so, the numbers of sons and daughters are simply those of the dead ones exactly repeated. Jeroboam's queen was told that her young son should die *because* he was the only one of the family wherein some good was found? Very odd Sadduceeism. But, in fact, it takes long ages of corruption and sophistry in any nation to bring even their rulers to Sadduceeism, as that of Hezekiah, Julius Cæsar, or Byron. It was no more possible to a horde of simple proletaries, just delivered from two centuries of bondage, than was their being legislated for in a foreign language.

When "Memnon" asks for evidence that Moses wrote Coptic, it was enough to point to wherever he is said to have written anything. If writing for his people at all, it must have been in their sole possible language at the time. And to say their later language ought to retain Egyptian words, is equivalent to saying the last Disraeli (Beaconsfield) must have mixed Italian words in his English, because his grandfather had been born in Venice, or rather because his ancestry had four centuries ago.

What on earth can "Memnon" mean by the "ascription of the same story to Abram, Gen. xii.,

and to Isaac in xxvi.?" Is Gerar another name for Egypt, and is Abimelech the same as Pharaoh, and the Philistines as the Egyptians? Or was losing his wife, and being taken into the King's harem, the same as having it accidentally discovered that she was not his sister? and being expelled the country in disgrace the same as being declared "much mightier" than the king, and begged to make an alliance with him? Though Isaac and Jacob were, at some dates in the 400 years, rich in cattle and silver and gold, the prediction that they should all the time be landless "sojourners" in land that was not theirs, always remained true, and Jacob was invited into Egypt lest he "and his house come to poverty." It is never said of them, but only of Abraham, that God "had blessed him in all things." What is the difference between ordering Noah to have two of every animal, and afterwards ordering seven of *some* kinds? And would not any writer who held that God had not revealed a name as his to anyone before Moses, necessarily apply that name to the God of their fathers from the beginning? How otherwise was he to make it understood that two names were not those of two Gods? But such a string of worn-out quibbles, repeated parrot-like out of Voltaire, without even examining one, are not worth notice. Each of the six books after Genesis begins with the copulative conjunction "and" or "now," stamping the whole as one writer's single work. And as he left it, so it stands. There is no trace of any words interpolated, though doubtless of some dropping out, and the numeral dates being corrupted two ways, in the Jewish and Samaritan copies. Even were there no other witness, the absurdities thus produced in them, and self-consistency of the LXX. alone, could leave no doubt which of the three kept them genuine. But Josephus, agreeing with the latter, is an independent witness, and *on this one point* quite as weighty as any of them. He was one of the 24 chief-priests when Jerusalem fell (though not living there) and was allowed by the emperor to take and keep a choice Temple copy of his national scriptures, which he employed, of course, in writing his "antiquities." There is all the means possible to conceive, of telling which versions are the falsified ones.

If "Memnon" wants "one or two points" selected for his attack, I advise him to concentrate forces on the Deluge, its recency and universality. Let him open the late C. Darwin's first *Journal of Researches*, and explain the facts ending Chapter VIII. without the fall, about 50 centuries ago, of a fresh sea from the sky, and upon every part of this globe at once.

Nov. 15. **E. L. G.**

EGYPTOLOGY.

[26511.]—A PAGE of the MS. of my letter must have slipped out, as my quotation from Genesis and other matter have not been completed. They may not have been of much importance; but I should like to complete the quotation.

After the word "transferred," at the end of letter, add "to signify a century."

"Memnon" (26477) in replying to "E. L. G.," raises a few other objections, which I should like to notice.

The fact of the name Jehovah being put into the mouth of the patriarch before it was revealed is cited. The answer is easy enough. All nations have had a general and personal name for the Deity or their gods. As it is claimed that Moses wrote the patriarch's words, it was natural for him to use the personal name revealed to him.

"Memnon" may find that the Jehovistic and Elohistic theory has been squashed by Quarry's exact list of names and passages. The "Speaker's Commentary," a work by very decently-educated men, gives the list, I think, and upholds the authenticity of the Pentateuch.

There is too much testimony in all nations regarding the Deluge to allow unbiased minds to doubt of its occurrence. The language of the Bible regarding it is here, as elsewhere, the language of common life. It is the testimony of human witnesses as to what they saw, heard, or was revealed to them, put into their own manner of speech, and this, while exhibiting their own imperfections, does not impair the testimony.

Miracles being admitted, and even Prof. Huxley says that it is only a matter of testimony, then to slow the rotation of the earth and preserve its form, so that the sun hasted not to go down for a whole day, appears to me to be as simple as any miracle in the Bible.

Nov. 12. **Ramases.**

[26512.]—WILL "Memnon" pardon me for interposing for a moment in the controversy with respect to one point—the Deluge? He remarks most truly that the "Bible says it covered the whole earth." But what was the "whole earth" then? In judging of the Bible, it is only fair to take what it does say. Gen. i. 10 declares that the waters were gathered together unto *one* place and the dry land appeared. Consequently, the Bible at the Creation and at the time of the Flood is responsible only for *one* dry land and *one* ocean. According to the Bible the land was watered by evaporation, as no rain fell till the Flood. What was the extent of the dry land we cannot determine; but as Greswell says: "Nor were such a problem as this, By what amount of the surface of water constantly exposed to evaporation, greater than at present, might the same physical needs of the animal and vegetable kingdoms of nature be supplied even at present, independently of rain? to be proposed to the chemist or geologist, would it be difficult for him to solve in a general way." The Bible up to the period of the Flood is no way responsible for any land south of the shores of the Mediterranean. Greswell says, again: "This peculiarity of the constitution of the world before the Flood is the true explanation of the mistake and apprehension of that of the post-Diluvian world, into which the oldest geographers among the Greeks and the other nations of antiquity appear to have fallen in common: that of assuming that the earth of their own world was surrounded by an ocean on all sides too. This fact was true of the earth before the Flood, and having been handed down by tradition into the post-Diluvian world, it naturally led to the mistake in question. Nothing was more likely to be assumed at first than that the post-Diluvian world, in its external constitution, was nothing different from the ante-Diluvian."

I hope that these quotations may throw some light upon an apparent—and I am sure only an *apparent*—difficulty as to the Mosaic history. A great deal more might be added, which consideration for your space forbids; but if "Memnon" is, as I believe he is, only anxious for the truth and a fair criticism upon Moses, I venture to recommend to him and your readers Greswell's "Three Witnesses," London, 1862. **Ponto.**

[26513.]—"RAMASES" scarcely proves his case by asserting (26476) that he gave as evidence the early Jewish historians, as, for instance, Joshua; because they are quite as doubtful as the Pentateuch. As for Joshua quoting Deuteronomy, that is rather against the age of the former, as the latter is supposed to be the book found in the Temple in the time of Joshua by Hilkiah—who, it is likely, wrote it and placed it there. He *may* have had traditions, or old annals, or writings to work up; but the late character of the book has been fully shown by De Wette, and also, I understand, by "Ramases'" favourite, Gesenius. I only briefly refer to this at present, as I prefer to urge the Egyptian point. I do *not rely* on Manetho. I rely on the list of great Egyptologists whose names and opinions I gave, and consider that "Ramases" ought to look with respect on such men as Bunsen, Lepsius, Mariette, Brugsch, &c., who carefully studied all known historical records bearing on the subject, and all ancient existing monuments, &c., found in Egypt. All these great men place the beginning of the Egyptian monarchy (not the beginning of the civilisation of Egypt) *long before the time Genesis ascribes to the universal flood*. That is the point I urged on "Ramases,"—not the value to attach to a late historian like Manetho, of whose work no undoubted or perfect copy remains, only quotations. M. Sayce says: "It is plain, therefore, that Manetho's list has come down to us in a very corrupt condition, and that the numbers contained in it must be received with extreme caution. Moreover, the Christian writers who have handed them down were intent on reconciling the chronology of the Egyptian historians with that of the Old Testament, and were consequently likely to curtail it as much as possible." "His statements, notwithstanding the imperfect state in which they have reached us, are in the main correct." Mr. Sayce is Deputy Professor of Comparative Philology at Oxford, and is a man of weight and great information. He considers Mariette's date for Menes to be most nearly right, and it is 5004 B.C., or nearly 3,000 years before the Flood. He says: "We shall provisionally adopt the dates of Mariette, whose long-continued excavations in Egypt have given him an exceptional authority to speak upon the matter; but those who have sailed up the Nile and observed the various phases through which Egyptian art has passed, will be inclined to think he has rather fallen short of the mark than gone beyond it." But Genesis says the universal Deluge took place only 2288 B.C. (or, according to Usher, in 2348), and that for a time Noah's immediate descendants (the only living people) lived somewhere in the far East, and only dispersed in Peleg's time. Does "Ramases" really accept these dates? Can he bring himself to squeeze up the development of the great, the peculiar, the intricate and definite civilisation of ancient Egypt into a few miserable years to suit Genesis? Can he suppose it sprang into full life from such people as Noah's sons and daughters? To me it is absolutely impossible to do so, nor can I imagine anyone free from overmastering theological necessity who could do so. If "Ramases" really doubts the great antiquity of Egypt, he should study the remains of Ancient Egyptian art, which he will find highly developed, and quite different in all respects from anything Babylonish or Hindoo. The great temples at Thebes, &c., are of the time of Moses or thereabouts, but are unmistakably modern compared to the old Memphite pyramids, tombs, and figures. The style of temple of the 18th and 19th dynasties is quite different from that of the older period, which can be ascertained from the fronts of old tombs, from the Sarcophagus of Mycerinus (a model of an old temple), and from the remains of the temple near the Sphinx. These, though so old, are the stone developments of a wooden style, every detail representing carpenters' work, the date of the invention of which is absolutely unattainable, being lost in the mists of extreme antiquity.

Then the Pyramids themselves are of immense age. Ferguson, in his celebrated "History of Architecture," says of them: "If one point in Egyptian history is proved with more certainty than another, it is that the Great Pyramids of Ghizeh were erected by kings of the 4th dynasty; and it seems impossible to find room for the now ascertained facts of Egyptian chronology, unless we place their erection at least 3,000 years before the Christian Era," and, speaking of their structural qualities, he says, "Nothing more perfect, mechanically, has ever been erected since that time; and we ask ourselves in vain how long it must have taken before men acquired such experience and such skill, or were so perfectly organised as to contemplate and complete such undertakings." How long did it take to develop the hieroglyphics, and the Osirian system they were used to express? No better statue can be found of its kind than that of Chephron, the erector of the second pyramid; it is of the hardest stone, is deeply imbued with the peculiar spirit of the style, and is of splendid workmanship. How long can "Ramases" suppose it took to develop such an art? It is the oldest movable stone statue in the world; but is probably not nearly as old as the Sphinx, which that particular king restored; yet the Sphinx is also as peculiar as anything in Egypt. Then the splendid tomb of Ti is of the 5th dynasty, and is as perfect in sculpture and painting as the best work of any later period. Will "Ramases" say that some immediate descendant of Shem, Ham, or Japhet designed and carried it out? One of my principal points was the gross improbability of Moses only allowing 1,000 years from the late period of Rameses II. or Maneptha in the 19th dynasty for the rise of the whole civilisation from Noah and the contents of his Ark.

If Moses was learned in the learning of Egypt, it seems wholly impossible he could do so, and if he were not, how can we rely on Exodus, which says he was? That is the question I want "Ramases" to answer. "Ramases" admits that Menes was known in Rameses II.'s time, so that Moses ought to have known what was inscribed on public monuments.

"Ramases'" remark about Deut. xviii. remains to me of very doubtful value, and if Moses, or the writer or writers of the Pentateuch, believed in immortality, it is a great pity they did not say so, and so spare apologists the difficult task of trying to prove that they did by their condemnation in one case of "necromancers." Does "Ramases" forget Bishop Warburton's well-known book on "The Divine Legation of Moses Demonstrated on the Principles of a Religious Deist, from the *Omission* of the Doctrine of a Future State of Rewards and Punishments in the Jewish Dispensation"? I will leave the point with your readers, reminding them that the particular doctrine omitted was the central point of Egyptian doctrine, and that "Ramases" supposes that Moses believed in it.

That the death of Moses should be recorded is most natural, though not by himself; and I fail to note any difference in style between the part in which that notification is made and the rest. "Ramases" can only assert that there is, but cannot prove it.

That kings were promised to come from Jacob's loins is only another proof of the lateness of the book; as even in the time of Samuel kings were objected to as bad and irreligious by him in his character of prophet, and kingship could not be supposed to be a reward of virtue till kings had been accepted by and were familiar to all classes of the Jews.

As to Gesenius, if a generation means 100 years (which I do not admit), then the Jews were about 400 years in Egypt (four generations). Gesenius approved of Van Bohlen's work on Genesis, and Van Bohlen's views are generally the same as mine.

I fully admit that Genesis must be considered to be a valuable historical document; but do not look on the stories of Abraham, Isaac, Jacob, and Joseph or Moses to be real history. *The genealogies* are probably compiled from old short records, but refer more likely to nations than single persons.

Memnon.

EGYPTOLOGY.

[26514.]—"MEMNON," in his remarks about Samuel being the author of the Pentateuch, proves too much, because the office and position which Samuel held (high priest and judge), as also the reformation he accomplished, would have been an utter impossibility without the previous existence of the Pentateuch and its being believed in by the Israelites. That Samuel was the arranger of the Pentateuch along with the book of Joshua, and that he wrote Judges, I don't suppose there is any reason to doubt; but editing or arranging is one thing, being author or forger is another and totally different, and splendid as were the abilities of Samuel, it's just rather too much to ask us to believe in such a stupendous forgery, or that the Israelites were such fools as to accept it, more especially when we take into consideration the miserable state of affairs disclosed in the Book of Judges.

Also, "E. L. G." fails in his explanation of Joshua's miracle. Those Bible miracles may be accepted or rejected (it's entirely a matter of private judgment); but to try to explain them or thin them down is satisfactory to no one, because they have all this in common: that they just supply the exact amount of help for the work to be done and then cease. They are also, *without exception*, in strict harmony with the narrative, so that if the miracle is explained away, then the narrative must go with it. And "E. L. G." will soon see the necessity of keeping *strictly* to the Scripture statement, if he will take a scale map of Palestine and a pair of compasses (and taking the narrative strictly as a military movement), measure the ground covered along with the work done: it will then appear that the main point has always been overlooked—viz., that unless the two miracles (sun, moon, and hailstorm) had taken place, the work done could not have been accomplished. Joshua's march up the steep pass from Gilgal to Gibeon was about 20 miles, the fighting up the rise to Beth-horon was over six miles of ground, and Joshua having gained the ridge, from which he had a view of the valley of Ajalon, stretching away for 25 miles to Jarmuth and the plain beyond, his military experience told him that unless he could head, turn, and slay the Amorites before they escaped to their cities, his movement would be a comparative failure; at the same time he must have seen that the night would come on before the work could be done, that an extension of the daylight was required;—hence his request, and the miracle as an answer. The amount of ground covered in a straight line from Gilgal to Jarmuth is just over 50 miles, and, adding the return back to Makkedah, made up a pretty stiff bit of work; so that if the miracle is explained away, then the narrative must go with it. **Dens.**

AN EXTRA-MUNDANE VISITOR.

[26515.]—ON Tuesday, Nov. 2, at eight minutes past eight, I saw a magnificent meteor. It appeared as a tiny star almost at the zenith, and its rapid motion first attracting my attention, descending as it did with a luminous train, apparently 30 yards in length, of a bluish-white light, resembling the electric-arc in purity of colour.

The nucleus appeared as large as a man's head, and could easily be distinguished by its increased brilliancy: as it fell to earth the extremity of the train was broken up into sparks, which reminded one of the sparks produced by friction against a grinder's wheel by the conversion of motion into heat. Its path of flight was inclined at an angle of about 15°, and, roughly speaking, it descended almost vertically upon the town. I went in search of this fragment of "cosmical matter," but all to no purpose. Several persons saw it fall, and all say, "Why, it fell within a stone's throw of us"; while another person, who was some miles from Newport on his bicycle, said, "It dropped about two or three fields off." So what is one to do when virtual images present themselves?

I estimate its transit from the minute point of light at the zenith to its impact with the earth as seven or eight seconds at the most.

No hissing noise accompanied this meteor by the rapid displacement of air, but a slight odour of sulphurous acid I could distinctly smell just after it had fallen. This is not altogether unknown, as meteors, in some instances, have shown as much as 7 per cent. of iron pyrites upon analysis.

Newport, Mon. **A. Treyer Evans.**

SUGAR ANALYSIS.

[26516.]—WHILE Mr. Allen is favouring us with help on the subject of grape sugar, I would ask him to give us further information about the "other substances" to which he refers as reducing the alkaline solutions of copper tartrate, and which, therefore, sometimes introduce fallacies. This point is one on which Sutton's "Volumetric Analysis" is silent, and it is one of considerable importance in the arts.

In cases of diabetes there are sometimes reactions under Fehling's test which are but very imperfectly explained in textbooks. Sometimes, instead of the full red precipitate of copper suboxide, in possible diabetic cases one gets a muddy yellow discolouration, which will neither yield a clear filtrate nor a definite subsidence. There are also other doubtful changes. What is the significance of these?

Would Mr. Allen favour us with his opinion on the new ammoniated copper test (vide *Lancet*, March 1, 1884) and the fallacies to which it is liable? For the ammoniated copper test, 4·148 grammes of crystallised sulphate of copper are prescribed to the litre, while Sutton prescribes, for Fehling's solution, 34·64 grammes; yet in the standard Fehling 10 cubic centimètres are said to equal 50 milligrammes of grape sugar, while in the ammoniated copper solution 10 cubic centimètres are said to equal 5 milligrammes of grape sugar. Hence in the one solution 4·148 grammes of copper sulphate perform the same duty as 3·464 grammes in the other. How is this?

In making up these standard solutions, the precise quantity of copper oxide contained in each cubic centimètre is, I believe, the point on which their standard depends. But, in the caustic alkali, may we use soda or potash indifferently for all purposes of sugar testing? And, in the alkaline tartrate, may we also use the Rochelle salt, the disodic tartrate, or the dipotassic tartrate, indifferently? Does it, in fact, make any difference whether we use an alkaline sodic tartrate of copper, an alkaline potassic tartrate, or an alkaline sodio-potassic tartrate? Then, again, need the caustic alkali or the alkaline tartrate be adjusted with precision, in order to make the test work accurately?

What are the chemical changes induced in the grape sugar and in the tartaric acid under the action of the alkaline copper tartrate tests?

Mr. Allen's special knowledge on these subjects is such that we shall be much obliged if he will kindly supplement our ordinary textbooks with his guidance on these practical points.

M. O. H.

CARBONATE OF MANGANESE.

[26517.]—THE ore mentioned in your last issue by Mr. Blackwell (26487) as sold by him from this district for many years was not carbonate of manganese, but was taken from the oxidised "outcrop" of the bed which does not show any carbonate on analysis, having been turned into an oxide by the action of the elements.

The bed can be traced over a large tract of country, and has been extensively worked as far back as fifty years ago, the produce being sold for chemical purposes; but the people who then worked it only stripped off the oxidised outcrop, as the pink carbonate could not then be turned to any industrial use. This method of procedure was also followed at the mine from which Mr. Blackwell bought his ore, the pink carbonate being left behind as useless.

We must claim to be the first discoverers of this pink substance being carbonate of manganese, and utilising it for the purpose of spiegeleisen-making at Mostyn. **Henry S. Lancaster.**

The Dyffryn Mining Company, Llanbedr, R.S.O., Merionethshire, Nov. 15.

LAUNCH ENGINES.

[26518.]—IN reference to Mr. Taylor's letter, No. 26402, page 173, which I have been unable to reply to earlier, my opinion on the failure of the engines having two h.p. cylinders and one l.p. was chiefly due to excessive back pressure on the h.p. pistons. If we assume that the pressure to be maintained in the receiver must be 20lb., the engine under notice had two 7in. cylinders and one 12in. diameter, steam pressure 70lb., and the rate of expansion was 5. Effective mean pressure in h.p. cylinders was 58lb., with of course a back pressure of 20lb. on each piston, from which it will naturally appear that from the extra back pressure and the power absorbed in the l.p. cylinder that there is a decided loss. In your case, by placing the two h.p. on top of the low there would be no gain of power, but you would have more economy in fuel.

I hear that one or two yacht builders are fitting the triple-expansion engine in the larger size yachts. I have before me an account where a yacht, 113ft. by 20ft. by 13ft., having cylinders 9½in., 15in. and 24½in. in diameter respectively; stroke of piston, 18in.; steam pressure, 150lb., she obtained a speed of 8½ knots per hour in unfavourable weather.

Engineering, Manchester.

"F. A. M.'s" LATHE.

[26519.]—WOULD not the upper slides be better if so made that the upper member was borne upon a shelf projecting from each side of the lower, instead of resting upon the surface of the latter, as is shown, for example, in the illustration of Taylor's slide-rest which appeared a short time ago? I think I recollect "J. K. P." in an old letter speaking well of this construction. The lower short slide might with advantage have brackets to support its overhang at each end.

The "vice screw" alluded to by "Vulcan," p. 156, is, I presume, the tailscrew of tool-holder. It will be found an advantage to turn this screw upside down, as I have in my own lathe. The lever then is quite out of the way, for it slips between the plates; the pressure is borne by the broad head of screw instead of the narrow point, and the tail of upper plate may, if thought advisable, be made thicker to withstand wear, without practically taking more room than at present. There should be a stud on the head, taking into groove on the lower plate, so as to keep both parallel.

I should like to see fixed levers or other devices for dispensing with the use of spanners more freely employed. The saving of time, especially on an "odd job" lathe, would be considerable, to say nothing of the bother of perpetually hunting for the appropriate wrench, the chance of using an ill-fitting one, and perhaps damage done by accidental blows. The change-wheel gear, for example, affords several opportunities in this direction, and I recollect seeing a suggestion that spring snaps might be used with advantage, instead of nuts, on the change-wheel studs, since there is not much strain to be resisted. It would be an advantage, too, if the backgear wheel could be clamped to the pulley without the use of a spanner, especially if, as in my lathe, there is a division circle on the rim of the wheel, which is liable to damage should the spanner slip.

The handle that clamps the traverse slide has scarcely room to turn, especially after wear. May I suggest an eccentric fastening to grip by pressing down the handle? If, however, a screw bolt be preferable, it might have a large capstan head or be prolonged so that the handle might be low enough to clear the two brackets.

I would suggest also a taper set-pin to each of the circular movements, such as is, I believe, generally fitted to an eccentric chuck, as a readier and more accurate mode of setting them to "square," than the use of graduations.

The slide-rest handles are, I think, most convenient in the form of a good-sized, milled-edged disc, with a *small* handle, or rather, knob, so as not to get in the way when turning the disc. I remember a letter of "D. H. G.'s" on this point well worth reading, as need hardly be said. A much more regular feed can be given with a disc than with a crank, and the handles are better balanced. They will be more readily put on if about ¼in. of either the square hole or square peg be bored or turned circular, since it is quicker to put a round peg into a square hole (or vice-versâ) than a square peg into a square hole.

As to covering the sliding collar, how would a strip of thin, hard brass, rolled up like a tubular shaving, answer? the point being that it would expand and contract with the traverse of the mandrel, and therefore might be always in place, whilst a removable shield, if left in situ by accident, would be crushed during the traverse, or spoil the half-nut.

I am afraid these comments are but trivial, but "F. A. M.'s" well thought out design scarcely leaves room for more vital criticism. **Faber.**

The Golden Chub.—In the neighbourhood of Liverpool a successful attempt has been made to acclimatise the "Golden Orfe," a beautiful variety of chub. It comes from Bavaria, and has proved a hardy, healthy fish. It rises to the fly in enclosed waters, so that the fly-fishers may find sport in other places than running rivers. Round Liverpool it is impossible to enjoy any good fly-fishing, owing to the lack of trout streams, but this "orfe" is likely to supply the want. Ornamental fish, such as the goldfish, will not breed in our climate, or if ever they do the offspring is almost black; but with the orfe it is different. They breed freely, and the offspring retains the beautiful golden colour of the parent. It attains the length of 10in. or 12in., but has been known to reach nearly double that size, and weight about 6lb. For an aquarium it is a splendid fish, being almost as beautiful, and far more hardy, than the goldfish. They generally bear the trace of a dark-skinned ancestry in a few blotches of a brownish colour; but their good qualities more than atone for this. Some ponds near Liverpool have been stocked with them, and the result, so far, have been very satisfactory.—*Liverpool Mercury.*

THE Severn Tunnel, which has been opened since September 1st, for goods traffic, will shortly be opened for conveyance of passengers, which will add to the convenience of the travelling public, especially between the West of England and South Wales. The Great Western Railway Company have adopted Mr. C. E. Spagnoletti's new system of electric locking for working the traffic through this tunnel.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

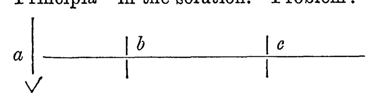
[60137.]—**Marking Ink.**—It is not quite clear what sort of ink "L." requires. That described on p. 562, last vol., is intended to be liquid, becoming indelible only after exposure to light. I do not believe it is really indelible; but it is the best I know, and I gave it for what it is worth. It seems to me that some of your querists ask for recipes which would be commercially valuable—if they existed. Now, I should like to say, once for all, that, while I am quite willing to dispense my small modicum of knowledge through your generous pages, I have no notion of "inventing" for the benefit of others. If I knew of a preparation which would answer as an indelible marking or stamping ink without the use of salts of silver, I think I should just expend a little more than a sovereign on some pieces of paper which would have my name written upon them, and be deposited in due course at a certain place in Southampton Buildings.—SAML. RAY.

[60192.]—**Annuity and Estate.**—In reply to these queries, the value of an annuity of £115, with 32 years to run, may be found by multiplying the value (115) by the number of years' purchase or value of £1 per annum at 5 per cent.—thus: 115 × 15·80 = 181,700 = £1,817. The same rule applies to the freehold estate thus:—Annual value, £65 × 20, the number of years' purchase at 5 per cent. = £1,300. The number of years' purchase at 6, 7, and 8 per cent. respectively would be 14·08, 12·65, and 11·43.—WM. P. MILLER.

[60216.]—**Mineral Waters.**—Dr. Allinson, upon visiting the celebrated (for 200 years at least) mineral springs of South Wales, situated on or near the banks of the river Wye, at Builth and Llandrindod, would, after hearing the oral traditionary lore about the wonderful cures effected by the minerals contained in these springs, soon alter his mind. He admits that cures take place, as at Malvern, where the water filtered through granite is chemically pure; but it so happens that cases incurable during a long sojourn at Malvern have become cured permanently in a few weeks at Llandrindod, notably hard tumours, scrofula, syphiloids, chronic abscesses, &c.—this, too, at a period (previous to the discovery of iodine therein) when medical men of standing declared that there was no element in these said springs which could account for these particular diseases getting well. The mineral springs of South Wales are of three kinds—i.e., saline or purgative, sulphurous, and ferruginous. Strange to say, these three are generally near to each other. Visitors seem to rely on the saline, the sulphurous being taken in the proportion of a wineglass to ten tumblers of the former, while special caution is always observed in taking the ferruginous water, owing to the adverse symptoms always found to result from large, frequent, or long-continued doses. Yet, used in doses of a tablespoonful three or four times a day, astonishingly beneficial action often soon happens and remains. In the steel rolling mills, where I am employed, many of my fellow-workmen experience symptoms of disordered health through inhaling iron oxide dust, which is so fine that it floats in the air we must of necessity breathe, with every vibration of the machinery. These symptoms seem to be identical with those against which visitors to the South Wales mineral waters are specially cautioned. At first, our fresh hands actually experience every appearance of improved health, better appetite, greater bodily strength, and higher spirits; but the opposite soon follows, and remains —so long as the men remain in the works. We have heard much about the two opposite actions of drugs or medicines, or poisons, and I write this hoping to hear still more, especially as to how to avoid the disordered digestion which long-continued inhaling of this iron oxide most surely causes, the actual daily dose of which, absorbed by the delicate moist surface of the lungs, reaching the organs of digestion through the circulation of the blood, cannot amount to many grains. In order to anticipate misconception on Dr. Allinson's part, we experience no local irritation to the lung surface itself—only those symptoms known to be caused by iron—when taken into the stomach in large or long-continued small doses.—REGULUS Swansea.

[60334.]—**Falling Bodies.**—I did not say I preferred "Vulcan's" reply. I did not know that "Dubliniensis" professed to give mathematically accurate replies. I beg his pardon, if it is his due. "Angulus" will see, I think, if he supposes the earth cut in halves, and the two halves separated, that when they were allowed to come together again, there would be pressure over the whole of the dividing plane, and, consequently, at the centre as much at least (more than) as at the sides.—M., York.

[60334.]—**Falling Bodies.**—I thank "Dubliniensis" for the correction of his proposition and for his references, though my challenge was not made with the intention of producing the former. My opinion is "acknowledgedly uninformed" to some extent; but on some points, and those the most important connected with orbital motion, I consider myself peculiarly competent to speak. I have not access to W. and T.'s "Dynamics"; but I now believe "Dubliniensis's" answer is correct physically. But mathematicians seem to differ, and it is interesting at times to discover how far. 10 water does not seem to me extreme density: platinum is 23. I do not think pressure (attraction) of gravity "slight" at earth's centre, but *nil*. To get 11,000 odd tons per sq. in. as total pressure at centre of earth, it is not only necessary to consider it homogeneous, but fluid also; or the vitreous crust must rest on a fluid below. I do not attach much weight to my own opinion, but I doubt the interior fluidity. Those who are very sure ought to be very right; so, will "Dubliniensis," or other, give a solution of the following problem in dynamics? I venture to differ from the "Principia" in the solution. Problem:—



c = centre of force, force varying inversely as the square of distance.
a = point of projection of b at infinitesimal velocity, at right angles to a, b, c, or axis major.
$a\,b$ = distance body falls in unit time, = $\frac{1}{9}$ a, b, c.
$a\,c$ = unit of distance, or $a\,b$ may be taken.

To find path, or other end of major axis, and time of falling to centre c in units $a\,b$.—VULCAN.

[60352.]—**Fire-Engine.**—Bore of cylinder, 7in.; stroke, 6in.; bore of pump, $7\frac{3}{8}$in.; ram, $5\frac{1}{4}$in.; length of air-vessel to delivery, 2ft. 11in.; diam., $11\frac{1}{2}$in.; diam. of flywheel, 2ft. 1in.; suction inlet, $3\frac{1}{2}$in.; delivery outlet, 2in. full; boiler: taper from bottom to centre, $7\frac{1}{4}$in.; diam. of bottom and centre, 1ft. $8\frac{1}{2}$in.; outer shell, 2ft. $3\frac{3}{4}$in. at bottom; length from bottom to top (outside), 4ft. $0\frac{5}{8}$in.; No. of tubes, 85; size, $\frac{7}{8}$ outside.—SAM KOE.

[60455.]—**Chemical.**—I must leave this query to the "inventors." I confess I do not see how it is possible for a dry pencil to make a raised mark on paper.—NUN. DOR.

[60506.]—**L. T. and S. E. Side Tank Engines.**—I think "Scales" is wrong in stating the weight of these engines at about 40 to 42 tons. If he will refer to page 319 of Volume XXXVII. he will find the weight given there as 56 tons 1cwt. 3qrs.—B.

[60523.]—**The Daniell Cell for Electric Lighting by Glow Lamps.**—As lamp makers, we really must protest against the remarks of Mr. Striffler and the advice given by him on p. 240 (reply 26479), as such advice is calculated to do harm to the advance of battery lighting. Mr. Striffler advises as an "economical means of lighting" for lamps to be overrun the marked voltage —for instance a lamp made for 5c.p. to 8c.p. Unless our readers have more money than they can do with, we should strongly advise them not to follow Mr. Striffler's plan, as no lamp, however well made, is expected to, nor can the filament bear such a pressure strain for long without eruption. It is therefore most disastrous and suicidal to recommend such a practice for general use. Fancy any electrical engineer of scientific experience running a 50 volt lamp of 16c.p. up to a brightness of 26 candles at a constant pressure of 75 to 80 volts E.M.F.! We fancy if Mr. Striffler tried the experiment, that after about 20 minutes' enjoyment of a good light he would find himself in the dark, in company with a lot of black glass globes with strangled filaments of no value. One can therefore well understand the reason why Mr. Striffler's 6 volt lamps of only 5 ohms resistance explode when fed from a modified Daniell cell of 15 elements as described, especially when such a battery would be far more suitable to feed eight of our 18 volt Standard lamps of 10c.p. run in parallel, or, probably better still, fourteen 5c.p. lamps specially made to run two in series, but coupled as one lamp to the branch wires leading from the main circuit. Lamps of low resistance, it is quite true, are well known to take a little more current than lamps of high E.M.F.; but this does not matter, as it requires fully 40 per cent. more outlay for plant to obtain the same lighting effect, and fortunately the public, as they become more enlightened, begin to realise the advantages of using a glow lamp of low resistance for small installations over a lamp of the Edison type of h.r., and invented by him especially for central station lighting, for which they are admirably adapted; but there is no disputing the fact that a glow lamp of low resistance is far the best and more economical for small domestic electric light installations where only a few lamps are required and not overrun the normal candle-power described by the makers. As Mr. Striffler has written in a somewhat ambiguous manner respecting our battery lamps, in reply we simply challenge and defy him to procure from any other maker a 6 volt 5c.p. lamp of 4·5 ohms resistance of any type of lamp, from Edison downwards, with an efficiency of 3 watts per c.p. Whether such results are "wonderful" or not, we are quite content to leave the answer to our scientific electricians to judge for themselves. We have no wish to "crack up" our lamps or unduly praise them; but knowing that we have gained a reputation amongst the trade as makers of the best and cheapest lamps in the market for battery use, which are also free from infringement (just now a very important feature), we have a right to protect them. At the same time, if Mr. Striffler is content in paying 5s. for an article not so good as that sold by us at 3s., he is at liberty so to do; but there are at present in England and abroad over 10,000 users who are nightly burning our lamps who, we feel sure, will not take the same view as that of our worthy contributor, who, by the bye, even himself admits that they are "cheap and good," and coming as it does from a prejudiced consumer scores another point in favour of the so-called "Wonderful," as advertised in Sale Column by—SHIPPEY BROTHERS.

[60564.]—**Timber Truss.**—Hurst's "Tredgold" or Tarn's "Tredgold" will give the information required. The first is published by Spon, the other by Lockwood.—NOMEN.

[60565.]—**Mastic Varnish for Oil Paintings.**—There is no secret in the making of the varnish; but it must be applied in a warm, rather dry atmosphere. Ten ounces of picked mastic to a pint of the best turpentine is about right. Set on a sand-bath until dissolved, then strain through a fine sieve. Thin with best turpentine if too thick. N.B.—Mastic varnish improves with age, and to assist in the solution of the gum it is advisable to pound it small, and mix it with powdered glass or coarse silver sand, which may be made warm with advantage before mixing.—SAML. RAY.

[60567.]—**Broken Backbone of Bicycle.**—If the querist is going to ride the machine himself, I would advise him to have the backbone properly repaired, or preferably replaced by a new one.—ESSAR.

[60568.]—**Bleaching Greasy Silk.**—I do not think spirits of salts is used for bleaching silk, except in the form of nitro-muriatic acid, or aqua-regia. Mix five parts of muriatic acid with one of nitric acid and leave it for several days in a warm place (about 75°-80° Fahr.); then dilute with about 15 times the bulk of water, or so as to make a bath at 3° or 4° Twaddell. The skeins should be worked quickly through, and be removed promptly when the bleaching is complete, otherwise a permanent yellow stain would be produced. Remove every trace of acid in several waters, or running water. The method of bleaching with peroxide of hydrogen, or with oxygen itself, is said to be cheaper; but that I cannot say anything about.—NUN. DOR.

[60582.]—**Wood Bits.**—This is surely a matter for trial and experiment. The twist drills with lip and spur are specially designed for wood boring; but whether they would meet the requirements of "C. B." seems to me purely a matter for trial.—J. T. M.

[60591.]—**Tempering Springs.**—"Springee" is mistaken; the "stick" is of use in tempering, as it shows at what temperature to cool off. I don't think his "fun" (!) has given any one pain.—A SPRING SMITH.

[60598.]—**Etching applied to Die-sinking.**—It is possible to get raised lines on a steel die by etching away the other parts; but I suspect it would be more costly than the usual process. The lines would require frequent varnishing to prevent them being undercut by the acid, and it would need some experiment to determine the best acid or mixture to use.—SAML. RAY.

[60599.]—**Pinion Wire.**—This wire is drawn with corrugations, and is good enough for common work, especially when the die is kept in order; but it is not fit for use in fine watchwork.—D. G.

[60606.]—**Screw Thread on Thin Brass Goods.**—Your correspondent can spin or rub the thread up on a mandrel or "form" in the lathe; but in the factory it is done by a special machine. —SAML. RAY.

[60608.]—**Torpedo Defence.**—The nets are hung from projecting sprits about 18ft. from side of ship. The nets resemble a magnified piece of chain mail, the links being usually of galvanised iron of about 3in. mesh. But considerable variety of pattern exists.—NUN. DOR.

[60615.]—**Paring Machine.**—I should think a full brown would be the best temper for such knives—that is, as hard as possible with some amount of elasticity or springiness. It is a matter for experiment. I do not believe potash or any-

thing of the kind can have any effect.—SAML. RAY.

[60699.]—**Photo. Enlarging.**—If figure is clear of all the rest in group, cover them up and copy, enlarging to size desired. If not altogether clear of the others, most likely head and shoulders are. Cut out oval hole in white paper (if no better method suggests itself) by means of the letter "O" which will be found of proper size and shape in almost any newspaper. With this, cover the group showing head and shoulders through opening, and proceed as above directed; the result will be a vignette instead of a full-length copy of figure, which I think will meet the requirements of "Amateur Photographer." For instructions in copying and enlarging see Jabez Hughes' "Principles and Practice of Photography," older editions (9th edition, page 89).—R.

[60744.]—**Question in Dynamics.**—"W. A. S." is right and I am wrong. I had forgotten that the string when once set in motion must go on moving, as there is no friction or anything to stop it. Accordingly, the monkey would have much ado to hold his own, much more to make any progress up the string. If he stops trying to climb, he will go downwards with the string.—M.I.C.E., Bath.

[60744.]—**Question in Dynamics.**—In the replies to this query there seems to be considerable confusion between the (abstract) weightless rope and the (material) monkey at the end of it. The "monkey" seems to be in the problem, indeed (to use a popular phrase); but only as a means of shortening the distance between the two equal masses hanging from the said rope. Whatever force tends to shorten the rope, tends to raise both the monkey and the weight. And these two equal masses, acted on by equal forces, must move at the same velocity (by the laws of motion). Therefore, under the conditions of the problem as to friction, &c., the monkey will pull himself and the weight up equally, so that if they are level at starting they will always remain so, whether the monkey pulls in or slackens out the rope.—NEPHESH.

[60762.]—**Engine Flywheel.**—Yes; 6 or 7 horse nominal boiler should supply the engine, and 50lb. would suit. As regards driving saw, you will notice "Machinist" gives you good advice in this week's number. Act on it, and also go in for a new boiler, or, at the least, have it inspected by one of the many boiler Insurance Companies inspectors before purchasing. I presume you mean 1½in. bore pipe to supply engine. I should have nothing less.—T. C., Bristol.

[60781.]—**Corundum for Aluminium.**—It depends entirely on the price of the corundum, which contains, according to analysis, 68·90 per cent. of Al_2O_3. The greatest percentage of Al_2O_3 in kaolin to be obtained in Cornwall is 60·76 per cent., which can be purchased, I believe, at 20s. per ton.—F. W. GERHARD.

[60799.]—**Screw-Cutting.**—"H. O." is correct in saying my answer is wrong, as I should have written $d - 1\frac{1}{3}$ p. instead of $1\frac{2}{3}$ p. He may be correct as to his decimals, as they are also given in a book I have; but Molesworth gives height of thread = pitch, from which must be deducted $\frac{1}{3}$ of height, and therefore of pitch, for rounding top and bottom of threads. This amounts to $\frac{2}{3}$ p., or $\frac{2}{3}$ p. off 2 threads pitch—that is $1\frac{1}{3}$ p., as given above.—T. C., Bristol.

[60801.]—**Mechanical.**—TO MR. BOTTONE.—The resistance of bath, with electrodes of any given size in it, can only be obtained by actual measurement. The best means is by the aid of a Wheatstone bridge and a set of coils. See my advertisements in Sale Column.—S. BOTTONE.

[60816.] — **Gas-Engine.** — I had a ½H.P Otto which made noise the same as "Engine Driver" describes, and wrote makers, and they told me to file the gas supply valve (which is opened by the governor) hole inside a little larger—very little, to let engine have little more gas, which I found cured the noise complained of, and for six months or more hardly heard noise once a day. It has now returned again a little. I put it down to what A. Ricardo states in No. 1,129—viz., gas explodes in exhaust. Cleaning cylinder does not remedy it, as I tried before I wrote the makers; what they wrote me certainly cured my engine for the time.—YOUNG CUTLER.

[60817.]—**Windmill.**—(1) About one-fifth the energy of the wind is transmitted by the sails. (2) At different distances from the axis, the whips travel at different rates; therefore, the angles vary, to catch the wind at the best advantage. As much weather angle at tip would let all the wind slip by without pressure, owing to the velocity of the tip. These angles were carefully calculated and experimented on by Smeaton. (3) Horizontal and vertical mills, with sails to drive away from the wind, some with movable and some with fixed shelters, have been tried by many, but with little success, excepting a form invented and practically tried by Mr. P. Vallance, who described it in these columns some years back; and I have made some models (with six horizontal arms carrying vertical sails at the ends which set themselves to the proper angle for the wind automatically, and run back edge to wind with movable louvre boards controlled by a governor to always give nearly the same speed, and never requiring any part to be taken off in any wind) that worked very satisfactorily, and if I wanted power in a suitably windy place, I certainly should prefer a horizontal of this kind to the usual vertical, as giving off more power for space occupied, and they can be simply put on the top of the building, and catch the wind equally from whichever point it blows; when wanted to stop, one central rod opens all the louvre boards.—ALBERT COLLINGRIDGE.

[60820.]—**Chamber Organs.** — The specification of a chamber organ, given in your last issue by "Uranium," is good; but it seems to me that the same number of stops distributed over three manuals would give a more effective instrument. I inclose a specification of my own organ, which is satisfactory in every way. The 8ft. tone is full and rich, and the piccolo in the swell gives a pleasing brilliancy, which is in happy contrast to the screaming fifteenths to be met with on the great of some chamber organs I know. After several years' acquaintance with my organ, I do not know of any stop that I could add, or any that could be spared, without disturbing the perfect balance of tone. I should be very pleased to show my organ, or give any further particulars concerning it, to either "Taube" or "Uranium."

SPECIFICATION OF ORGAN.

GREAT ORGAN.
C C to G in alt. 56 notes.

1.	Open diapason, metal.........	8ft.	56 pipes.
2.	Clarabella, wood	8ft.	56 „
3.	Principal, metal	4ft.	56 „

SWELL ORGAN.
C C to G in alt. 56 notes.

4.	Open diapason, metal......... (Grooved to No. 5.)	8ft.	44 pipes.
5.	Rohr-flöte, wood and metal	8ft.	56 „
6.	Gemshorn, metal...............	4ft.	56 „
7.	Piccolo, metal	2ft.	56 „
8.	Oboe, metal	8ft.	56 „

CHOIR ORGAN.
C C to G in alt. 56 notes.

9.	Lieblich gedact, wood & metal	8ft.	56 pipes.
10.	Salicional .... (Grooved to No. 9.)	8ft.	44 „
11.	Wald flute, wood	4ft.	56 „

PEDAL ORGAN.
C C C to F. 30 notes.

12.	Bourdon, wood.........	16ft. tone.	30 pipes.

COUPLERS.

Swell to pedals.	Swell to great.
Great to pedals.	Swell to choir.
Choir to pedals.	Hydraulic engine.

Two composition pedals to great organ.
Two composition pedals to swell organ.

Pedals parallel and concave, radial sharps. Stop handles at an angle of 45°. Blown by Blennerhasset's "Perfect" hydraulic engine.—E. FRANKLIN ROOK.

[60821.]—**Battery Work — Erratum.** — An error appears in my reply to this query last week. "Adding a little nitric each time," should be, "adding a little nitre."—BOBADIL.

[60827.]—**Photography.**—I do not think that any photographic process, no matter how successful it might be, could reproduce the book in question, except at very great expense. I believe, however, that there is a chemical process of reproducing such work more exactly than photography can do, and at a very small expense. This process is worked, I believe, in London. A friend of mine would be pleased, I know, to give information on this subject to "S. R. C.," and I have taken the liberty of advertising his address in this issue.—MAC.

[60842.]—**Flat Music.**—Send them a copy of the ENGLISH MECHANIC, No. 1,119, and mark the diagram on p. 21 with a blue pencil.—N. E. CHILD.

[60853.]—**Artificial Teeth.**—If it is the intention of E. W. Gough to try and manufacture the above for himself, I fear, even with all the information he can procure, that it will benefit him but little; however, if the following will help him, I give it with pleasure. The materials used, are kaolin (white clay), silex, and felspar; none of these materials are fusible at a low temperature, nor, when fused, are they acted upon by acids; hence their extreme utility for artificial teeth. The various colours and shades are imparted by means of metallic oxides, in a fine state of division. In the process of manufacture—which is by means of moulds—small platinum pins are fastened into each tooth, by which means a piece of metal may be attached to the tooth and thus hard-soldered to the plate.—MOLAR.

[60854.]—**F.C.S., F.I.C.**—The secretaries of these societies will explain, on application.—SAML. RAY.

[60854.]—**F.I.C., F.C.S.**—The fellowship of the Institute is obtainable by anyone duly qualified who passes the requisite examination; the admission to the Chemical Society can *only* be had by certificate signed by at least five Fellows, three of whom testify to *personal knowledge* of the candidate.—F.C.S., Liverpool.

[60855.]—**Pulleys.**—"Amateur" must give more particulars as to how he proposes driving the planing machine—the flywheel has very little to do with that. He cannot do better than secure the recent Nos., in which full details of a planing machine were given, with sizes of parts and various methods of driving.—T. C., Bristol.

[60857.]—**Electro-plating and Coppering.**—Doctor your solution as little as possible. If the silver strips, the solution probably has too much cyanide. You might try it a little weaker. Too high an E.M.F. will also produce same effect. Carbons do not require any preparation, so that they are clean. Do not put much copper on them; a thin coating will hold when a thick one will come off. Use an acid solution for this. You do not say what batteries you are using. I cannot answer your last query, as I never deposited any copper on steel.—OS.

[60857.]—**Electro-Plating and Coppering.**—(1) The cause of the deposit stripping from German-silver articles may arise, not from any fault in the solution, but from defective preparation of the articles before immersion. Silver is very liable to strip from German silver, unless the latter has been treated with the mercury dip, after being thoroughly cleaned. (2) When you can wipe the deposit of copper from carbons, there may be several causes at work; such as too strong battery power acting through a weak solution, or too weak a current acting on a strong solution. A loose, sandy deposit is the result of a deficient current in a strong solution. Carbons require no special preparation, beyond having a few scores cut in their surface to give the copper a grip, and being perfectly free from anything that would hinder a deposit, such as grease or dirt of any kind. (3) An alkaline solution of copper should be used with a battery strong enough to give off gas at the cathode or article. Ammonia and cyanide should be added from time to time to keep the solution in good order. The anode gets coated with a blue powder when these are deficient. Too much ammonia, however, will prevent the copper from depositing, as it is redissolved. Too much copper causes the metal to come down as a powder. A good adherent deposit is obtained by hitting a happy medium. This is the best solution for steel articles; but being expensive, it is best, having given them them a mere film of copper in the alkaline solution, to finish off with the cheaper acid solution.—BOBADIL.

[60858.]—**Income-Tax.**—The mortgagor had no right to demand repayment of the whole of the Income-tax payable on the rent, unless the interest on the mortgage and the rent of the house are of the same amount, which is not probable. He can demand a deduction on the amount he pays "C. J. W.," which is £5 per annum. If the income-tax is 7d. per pound, this deduction will be 2s. 11d. "C. J. W." can again claim repayment from the Commissioners of Inland Revenue, seeing that his income is less than the taxable amount. Apply at the Surveyor's office of your district.—B.Sc., Plymouth.

[60859.]—**Weight of Modern Steamships.**—"St. Aubyns" is wrong in the application of his terms, for "dead weight" capacity means the cargo weight in tons which the ship will carry when loaded to her proper trim. The weight of the hull and machinery is little more than 33 per cent. of the total displacement to load line, and this percentage varies according to the size of ship, her fittings, and her class.—J. W.

[60859.]—**Weight of Modern Steamships.**—Unfortunately, I cannot give the weights of hull and machinery of the following vessels; but have given the displacements, with the hope that it may be useful to "St. Aubyns":—S.S. *Britannic*: length, 450ft.; breadth, 45ft. 2in.; mean draught, 23ft. 7in.; displacement, 8,500 tons; area immersed midships section, 926. Paddle-steam or *Connaught*: length, 327ft.; breadth, 35ft.; mean draught, 13ft.; displacement, 1,900 tons; area immersed midships, 336. H.M.S. *Agincourt*: length, 400ft.; breadth, 59ft. 5in.; mean draught, 24ft. 2in.; displacement, 9,071 tons; area immersed midships, 1,185. S.S. *Garonne*: length, 370ft.; breadth, 41ft.; mean draught, 18ft. 11in.; displacement, 4,635 tons; area immersed midship, 656. Paddle-steamer *Mary Powell*: length, 286ft.; breadth, 34ft. 3in.; mean draught, 6ft.; displacement, 800 tons; area immersed midship, 200. S.S. *Africa*: length, 130ft.; breadth, 21ft.; mean draught, 8ft. 10in.; displacement, 370tons; area immersed midship, 148.—ENGINEERING, Manchester.

[60860.] — **Turbines.** — I have not critically examined the formulæ in this book; but if there are so many careless mistakes on two pages, one must use great circumspection in working from the formulæ given in it. (1) The first formula should be $60 \frac{Q\ H}{700}$ or $\frac{Q\ H}{11{\cdot}67}$ = H.P. at 75 per cent. (2) In the note on page 33 read $\frac{Q \times 60}{\sqrt{H} \times 2{\cdot}08}$ (3) $r = d \times 3{\cdot}6$, as is obvious from the examples. The "course I have adopted" since you have called my attention to these mistakes is to check them and alter. Mr. Cullen ought to be greatly obliged to you for writing to him to point them out.—GLATTON.

[60862.]—**Parallel Motion.**—If your measurements are correct, the links are not parallel, as their centres are 7ft. 4in. on top, and 7ft. 6in. on bottom; the parallel rods should be 7ft. 4in. long, the radius rods will then be 11ft. 5½in. long. This error is not, I think, enough to account for such a bad motion as you describe. When at half-stroke, the centre lines of beam, of parallel rods, and of radius rods should all be parallel. Is this so?—GLATTON.

[60862.]—**Parallel Motion.**—I presume half length of beam is 16ft. 8in., instead of as printed. If so, length of radius rods should be 11ft. 2½in.; but more probably the main bearing brasses of beam and brasses in each end of connecting rod are worn. Put piston to bottom and top of stroke, making a light scratch on rod, and find exact half-distance, and send piston down to this mark. Now see if centre of cross head, and also centre of radius rods, are in the same horizontal line; if not, adjust either brasses or the centre.—T. C., Bristol.

[60863.]—**Legal.**—C. Ensor should cut his hedges when he thinks proper. It appears he has a title to them, and if his neighbour also claims the ownership, it will probably turn out that the hedge is joint property, and can be cut by either party when necessary.—B.SC., Plymouth.

[60865.]—**Mathematical.**—Take the expression $y = \frac{1}{x-3}$ for an example. If we make $x = 3$, one might say that y ceases to exist, for the case of a divisor equal to 0 has no sense in itself. But if we suppose that x increases from 2 so as to approach 3 as near as we choose, then it is evident that y will increase without cease in absolute value, so that when $x = 3$ we find y has become equal to ∞; when x increases from 2 towards 3, then y can be said to tend towards $+\infty$; when x decreases from 4 towards 3 then y tends towards $-\infty$.—WIS.

[60865.] — **Mathematical.** — The equation $y = \frac{1}{x}$ is the simplest example of what is required. If all values were given to x from 0 to both positive and negative infinity, and the resulting curve plotted, we would get a double curve. First suppose we give all positive values to x; the smaller x becomes the greater does y become, and when $x = 0$ y becomes positive infinity. Again, give all negative values to x: as before, the smaller x is, the greater will y be; but this time y will be negative, and when x becomes 0, y becomes negative infinity. y is therefore said to pass through all values, passing through $\frac{1}{0}$ or $\pm$ infinity when changing its sign.—M.I.C.E., Bath.

[60867.]—**Photographic.**—I have not yet tried it; but I have been recommended to use citric acid for this purpose.—GLATTON.

[60867.]—**Photographic.**—Rub the fingers over with a saturated solution of citric acid, or a lemon may be used instead. For further particulars refer to back numbers, where I have given this same answer to query more consideration.—A. TREYER EVANS.

[60867.]—**Photographic.**—Cyanide of potassium is the best remover of photo stains, but it is a dangerous poison. I would recommend the use of the sodic sulphite developer, which does not stain either the plates or fingers. Many formulæ are given in back numbers. Beach's is as good as any.—B.SC., Plymouth.

[60870.]—**Horsehair.**—I should say that to make rope from horsehair (if this is what the querist means, as he says "rope hair") a rope-making machine would be required. This can be seen on any rope-walk.—OS.

[60872.]—**Wooden Chucks.**—The best wood for making chucks I find is beech or box, and as for getting the grain to answer your centres, I don't think it matters much if it is a little the one side. The best wood for turning speed-pulleys is *lignum vitæ*—it is the best wood I have found not to split.—YOUNG TURNER.

[60872.]—**Wooden Chucks.**—Boxwood chucks grain to run in line of centres, and woods with a long grain across lines of centres. Mahogany or any hard wood will suit for pulleys, and the speeds should be so proportioned for gut to fit all three speeds, unless you require one slow speed, in which case it should fit the other two.—T. C., Bristol.

[60872.]—**Wooden Chucks.**—Much depends on the size of chuck. Very often the "plankway" is a matter of necessity, but there is another matter of consideration, and that is the screw. This will be best plankway in such woods as beech, ash, elm, &c., but in box, for every reason the wood will be cut the other way, as the screw-thread will be excellent, owing to the close grain. Acacia, if dry, takes an excellent thread. Beech also will hold a thread good enough, but in this, and other cases, the chuck has to be trued up each time it is used. If a common wood-screw is inserted in the end—i.e., parallel with the fibres of soft wood, it has little hold, as it can often be pulled straight out, bringing the fibres with it; screwed in "plankway," it holds firmly. This shows us which way is best, but as a mandrel carries a coarse thread, the chucks can be made to answer either way. With a traversing mandrel and an inside V-tool, you can cut a good thread in such soft woods either way, and a good thread is the secret of a lasting fit; but few would take this trouble in the case of the above woods, because chucks do not need to last long. A hollow tap, sold by Hines, will cut good screws plankway in beech, but less satisfactorily the other way. One more consideration is the fact that if you make a plankway chuck to hold work to be driven into it, you will be likely to split it, unless you put on a ring outside. For my own part, in the case of small chucks up to 3in., I use all sorts of wood cut off the end of a log. For chucks four, six, or more inches, a bit of beech plankway, but probably on the iron face-plate. I made a dozen acacia chucks a few days ago, and the thread is excellent, but I always expect to true up chucks not made of metal or boxwood. Turn the speed pulley of beech or mahogany, and let gut fit all speeds.—O. J. L.

[60875.]—**Small Medical Coil.**—TO MR. BOTTONE.—The brass flange will affect the working of the coil very injuriously. But if the clapper vibrates at all, and the coil is properly made, a most violent shock would be given when joined up to two bichromate cells, provided they were all right. There must be something wrong besides the brass flange, either leakage or wrong connections.—S. BOTTONE.

[60876.]—**Bottling Cement.**—Melt gelatine or fine glue in a glue pot as for ordinary use, and add a very small quantity of glycerine, just sufficient to keep it from getting too hard when dry. A little aniline colour of some kind will improve it. Dissolve the colour in glycerine, add a little water, then mix this with the melted gelatine. Fine white glue will answer every purpose, soaked in water before being melted.—OS.

[60877.]—**Finishing Cast Steel in the Lathe.**—Cast steel frequently differs. You may have mild cast steel or hard cast steel, according to maker; but supposing it to be mild, then you could take a finishing cut without any water or oil, but dry. But supposing it to be hard, use water and soap; but if you have too much surface on your tool you will find that it will scratch, and if this should happen, you had better leave a very little on, so as you can file the marks out; but if you use oil, you will find that the cut will work off the job.—WALLACE NEWLAND.

[60880.]—**Boiler Supply.**—I think the water company will object to the proposed arrangement Your best plan is to have the usual tank above fitted with a ball-cock, and will be cheapest in the end, as the supply-cock would certainly be forgot to be used at some time, and at the very least burn your boiler for you.—T. C., Bristol.

[60880.]—**Boiler Supply.**—The chief objection I see is that the boiler would be almost absolutely certain to explode before it had been fitted a year. A frost might stop the inlet, the steam would have no outlet, and bang would go the boiler; a little fur in the pipe would supply the necessary stoppage without a frost. This arrangement is nearly identical with that often adopted for the supply of hot baths. Safety-valves are generally fitted by good plumbers; but explosions are not infrequent. Another objection would be that if the inlet was not clogged, the steam would probably drive all the water out of the boiler, and the latter would then burn through. If tap on supply was shut off, the effect would be an explosion, as before. Of course, in the above I am supposing you to mean that the boiler is watertight on the top, and the water is always turned on under pressure from the main, unless shut off for repairs to boiler, &c.—GLATTON.

[60884.]—**Textbook on Mechanics.**—Our own columns—viz., the "Amateur Workshop," giving full working instructions on making an engine and planing machine are as good as any I know; but Cameron Knight's "Mechanical Manipulation" gives good insiruction on lining-out work, which, if well done—and worked to—is about all you can expect to learn from books. Shelley's "Workshop Appliances" gives details of lathe gear, and, I think, slotting machine.—T. C., Bristol.

[60885.]—**Scissors Grinding.**—Grind only the one edge to about 70°. Make them "walk and talk"—that is, give a slight curve to the blades, so that—being riveted or screwed when open—as they are closed the edges keep in contact from heel to point, and give that peculiar, smooth grate noticed in a new pair of scissors.—T. C., Bristol.

[60890.]—**Master Keys.**—Chambers's "Etymological Dictionary" says of the word padlock, "a lock for a gate opening into a *pad* or path; a lock with a link to pass through a staple or eye, perhaps, from Anglo-Saxon, *paad* a path, and lock, according to Wedgwood, a lock hanging like a clog to an animal's foot—low latin *pedana*, a clog—Latin, *pes*, *pedis*, the foot." I may note that Spurrell, in his "Welsh Dictionary," gives "pad" as "what keeps together." May this be a clue?—ARTHUR MEE.

[60891.]—**Insulation of Battery Boxes.**—TO MR. BOTTONE.—The Post Office pattern is a teak trough, insulated with marine glue.—S. BOTTONE.

[60892.]—**Annuity and Estate.** — In your propositions you omit an important particular—viz., the rate per cent. the purchaser is to be allowed to make of his money. Taking, however, the rate to be 5 per cent., the workings and results would be as follows, assuming the annuity to be paid once a year:—

Let A = the annuity in pounds sterling.
r = the amount of one pound and interest for one year; or $1 + t$, in which t = the rate per cent. (in the present case $r = 1 + {\cdot}05$).
n = the number of years.
P = the present value.

Then, by formula, $P = \frac{1 - r^{-n}}{r - 1} A$

We have— $$P = \frac{1 - 1{\cdot}05^{-32}}{1{\cdot}05 - 1} \times 115.$$

First find the value of $1{\cdot}05^{-32}$

$1{\cdot}05^{-32} = \frac{1}{1{\cdot}05^{-32}}$; $\log. \frac{1}{1{\cdot}05^{-32}} = \log. 1 - 32 \log. 1{\cdot}05.$

Which we state as follows:

$$\begin{aligned} \log. 1 &= 0{\cdot}0000000 \\ 32 \log. 1{\cdot}05 &= 0{\cdot}6780576 \\ \log. 1 - 32 \log. 105 &= \bar{1}{\cdot}3219424 \\ \log. {\cdot}20956 &= \bar{1}{\cdot}3219297 \end{aligned}$$

Therefore, to five places of decimals $1{\cdot}05^{-32} = {\cdot}20986$. The fraction now takes the form—

$$\frac{1 - {\cdot}20986}{{\cdot}05} \times 115 = \frac{{\cdot}79014 \times 115}{{\cdot}05} = 1817{\cdot}3.$$

Therefore the present value of the annuity of £115 for 32 years, allowing the purchaser 5 per cent., is £1,817 6s. 8d. The question may be solved by Inwood's tables, almost by mere reference. We find in Table I. (p. 6 of ed. 1884) under the head "Years' Purchase at 5 per cent.," and on line with 32 years, the length of the term of this annuity, the figures 15·803. This is usually called the number of years purchase, and multiplied by 115 will give 1817·3 the value. The 15·803 is truly the present value of an annuity of £1 for that term. To find the value at 4 per cent. we will take up the calculations at the point—

$$\begin{aligned} \log. 1{\cdot} &= 0{\cdot}0000000 \\ 32 \log. 1{\cdot}04 &= 0{\cdot}5450656 \\ \log. 1 - 32 \log. 1{\cdot}04 &= \bar{1}{\cdot}4549344 \\ \log. {\cdot}28505 &= \bar{1}{\cdot}4549210 \end{aligned}$$

$\therefore$ to five places decimals $1{\cdot}04^{-32} = {\cdot}28505$

Our fraction then becomes—

$$\frac{1 - {\cdot}28505}{{\cdot}04} \times 115 = \frac{{\cdot}71495 \times 115}{{\cdot}04} = 2055{\cdot}5$$

Therefore the value at 4 per cent. is £2,055 10s. Taking the figures from Inwood's tables under the 4 per cent. column, we find 17·874 years purchase, which multiplied by 115 gives 2055·5. For your second question, as to the value of a freehold of £65 annual rental, we will refer to the formula above used: $P = \frac{1 - r^{-n}}{r - 1} A$. Here in a freehold the number of years is infinity, and, therefore, r^{-n} or $\frac{1}{r^n}$ becomes infinitely small, and may be disregarded, so the formula becomes $\frac{1}{t}$.A.

In the case of 5 per cent., therefore the value is—

$$\frac{65}{{\cdot}05} = 1{,}300 = £1{,}300$$

and in the case of 4 per cent.—

$$\frac{65}{{\cdot}04} = 1{,}625 = £1{,}625.$$

If you wish for the steps leading up to the formula I have used, I shall be happy to give further work-

ings out, or refer you to mathematical works on the subject of compound interest and annuities.—SURVIVOR.

[60892.]—**Annuity and Estate.**—Annuity at 4 per cent. = £2,058; freehold at 4 per cent. = £1,625.—BREAM'S BUILDINGS.

[60893.]—**Cement.**—I have seen a mixture of putty, white lead, and a little red lead used for this purpose. It ought to make a very good joint if properly used.—OS.

[60893.]—**Cement.**—The querist may use equal parts of resin, pitch, and plaster of Paris; or powdered clay three parts, oxide of iron one part, and boiled oil, to form a stiff paste.—A. TREYER EVANS.

[60894.]—**Varnish Brush.**—Soak it in methylated spirit.—OS.

[60894.]—**Varnish Brush.**—Varnish and paint brushes can be cleaned in a warm solution of washing soda and water.—W. S.

[60894.]—**Varnish Brush.**—Put the brushes in alcohol. If the varnish is a turpentine varnish, put them in turpentine. For ordinary cleaning of paint-brushes, &c., soap well, and put into strong hot solution of soda.—SAML. RAY.

[60895.]—**Dynamo.**—TO MR. BOTTONE.—The dynamo as described would do for either arc or incandescent. If shunt be desired, then wind the F.M.'s with 10lb. of No. 22. If you use the dynamo as a motor, you will most likely reverse its polarity, and ruin it as a dynamo.—S. BOTTONE.

[60896.]—**Coil.**—TO MR. BOTTONE.—Yes, to all questions. "W. P. W." will get good effects from his coil if he uses a condenser made from 50 sheets of tinfoil about 3in. by 5in.—S. BOTTONE.

[60899.]—**Chemical.**—The reaction between potassium bichromate and iron proto-sulphate in a solution containing sulphuric acid may be represented by the following equation:—$6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 = 3Fe_2(SO_4)3 + K^2SO_4 + Cr^2(SO_4)_3 + 7\,H_2O$. No reaction would occur without the presence of free acid in sufficient quantity.—F.C.S., Liverpool.

[60899.]—**To Chemists.**—

$$(1)\ aq + FeSO_4 + Ba(NO_3)_2 = Fe\,(NO_3)_2 + BaSO_4.$$

$$(2)\ \underbrace{5FeSO_4 + 2K_2CrO_4 + 3H_2S + 2H{\cdot}O}_{aq} =$$

$$\underbrace{5\,Fe\,(OH)_2 + 2K_2SO_4 + Cr_2\,(SO_4)_3 + S^2.}_{aq}$$

—WIS.

[60902.]—**Gas Furnaces.**—If "E. R. D." had written to me about his difficulty I could have told him at once that his foot-blower is much too small for the size of furnace he uses. He must of necessity have a blower of proper size and power if he wishes to succeed with his melting.—THOS. FLETCHER, Warrington.

[60903.]—**Motions of Earth and Moon.**—The statements in the *Encyclopædia Britannica* are quite correct, and follow from Newton's laws of attraction and reaction. The mass of the earth being forty times that of the moon, their common centre of gravity will be in the line joining their centres in such a position that its distance from the moon is forty times its distance from the earth. The moon's distance being 240,000 miles, the distance of common c.g. is found to be 6,000 miles from the earth's centre, and the diameter of the orbit double this. It is this common centre of gravity which revolves in an approximately elliptic orbit about the sun, and not the centre of the earth. At each full moon the centre of the earth is 6,000 miles within the orbital ellipse, and at each new moon 6,000 miles beyond it.—R. E. F.

[60906.]—**Lens.**—I have used the lens you mention (Wray's 5in. by 4in. rectilinear) for the purpose you require, and do not think a better instrument can be found for such work.—J. H. B., Penzance.

[60906.]—**Lens.**—"Enquirer" will find Wray's 5in. by 4in. rapid rectilinear answer his purpose well; with the exception of portrait lenses, it is the most rapid lens yet produced. I took some admirable pictures of cats at about 5ft. distance on half plates with one of these lenses last February on Edwards's most rapid plates and drop-shutter exposure. At 8ft. distance an object a yard long would be represented on the plate about $2\frac{1}{4}$in. in length, and at 6ft. rather more than 3in.—T. PERKINS, Shaftesbury.

[60908.]—**Boiler.**—This seems to be aiming too high for a beginning. I should advise you to make something smaller first. Say you buy a set of castings for a 1in. by $1\frac{3}{4}$in. engine, which you can get for about 4s., and when finished make a boiler 12in. by $4\frac{1}{2}$in., having a single tube 2in. diam. through centre. Lag the boiler and use a gas jet inside tube, and you will get plenty of steam. Make boiler of No. 20 sheet brass, and rivet and sweat the seams with solder, and work at 20lb.—T. C., Bristol.

[60909.]—**Mangle Rollers.**—The cause of roller-shafts working loose in machine must be badly-seasoned timber. Remedy: Go to the nearest smithy's shop and get an iron ring made about 2in. smaller than diameter of roller; insert this in the end of roller little under level, wedge carefully between this and shafts with about six wedges either of good hard English oak or iron, keeping a steady eye on shafts so as to keep them perfectly in centre of roller.—BLANKET.

[60909.]—**Mangle Rollers.**—Clean out inside of rollers, bind tightly round spindle rather thin twine, keeping it the same thickness throughout, till just large enough to enter rollers tightly; then heat rollers and spindle in an oven, and soak spindle with melted pitch; then, while hot, insert spindle by pushing and turning continually opposite direction to that of winding the string. For indiarubber or wooden rollers, tried 18 months ago.—A. J. E.

[60910.]—**Screw-Cutting.**—"O. J. L." is in correspondence about this apparatus. The inventor writes that he has simplified and improved it, and will be in a position to manufacture it for sale very shortly; the original apparatus on "O. J. L.'s" lathe never fails to work well, and if it is improved at all it ought to be a grand success, for it is excellent in its old form. The moment permission is given "O. J. L." will fulfil his promise gladly, as he is greatly interested in the contrivance.—O. J. L.

[60911.]—**Steam Engine.**—You must give particulars as to travel of valve, sizes of ports, and also if there is room in valve-chest to allow of more travel of valve. You can effect a cut-off to, say, $\frac{5}{8}$ of stroke by setting eccentric forward and putting lap on steam edge of valve, and travel of valve should be increased if possible. Can say no more without further details.—T. C., Bristol.

[60913.]—**Cheap Dynamo.**—TO MR. BOTTONE.—Full instructions have been given as to the construction of such a dynamo at pp. 1, 46, 94, *et seq.*, of the ENGLISH MECHANIC, Vol. XLIII. If you do not understand these, write to me again, and I will try to clear away your difficulties. The best way to drive is by a steam-engine: the next best water-power or a gas-engine; then a windmill. If you use an electric motor you must use a battery or another dynamo to drive the motor; and since you always waste some power in transformation, you would actually get less light out of your dynamo, driven from a motor and battery, than you would out of the battery if used directly with the lamps.—S. BOTTONE.

[60917.]—**To Mr. Wimshurst.**—"J. B." will find it safer to use wood for the top of the case. A glass top is liable to get broken, and its pieces in falling may injure the discs. The proper thickness of the discs depends upon their diameters, 13oz. glass, or not more than one sixteenth of an inch thickness glass, does very well for discs up to 20in. diameter. Mahogany will not answer for the handles. Thick brass wire will do for the collecting combs: it does not require shellac varnish—simply polish and lacquer it.—J. W.

[60918.]—**Screw-Cutting.**—In cutting odd pitches you should, when all ready for starting, make a chalk mark on bed of lathe at end of saddle, also a mark on top of face-plate, and one on top of change-wheel on leading screw. By bringing all these marks in same relative position at each cut, the thing is done.—T. C., Bristol.

[60918.]—**Screw-Cutting.**—"Chalk your bobbins." I mean to say, chalk-mark your mandrel and head-stock, and also the leading screw-wheel and its bearing. Do this when ready to take first cut, and also drop a piece of wood, cut to width, between carriage and tailstock. Now take your cut, run carriage back till it touches the wood, and run your lathe until the two pairs of chalk-marks coincide. Now your lathe is in the same position as in starting, and the half-nut will be again in position for grasping the right threads of the screw. By a little practice in watching the chalk-marks as they come into view, you will (if a power-lathe) be able to start the carriage at the right moment without stopping the lathe; but do not run any risks with so fine a screw—NEPHESH.

DR. A. FOTTINGER has found chloral hydrate to be a good medium for preserving polyzoa and the lower animals. In the case of polypa, when fully expanded, crystals of chloral hydrate are dropped into the water, and in the course of a short time the colony becomes insensible, when the specimen may be placed in alcohol without any contraction or change of form. Star fishes may also be treated in the same manner to advantage. The chloral seems to act as a narcotic from the effects of which the animals may recover.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

60338. Legal, p. 45.
60340. M.R. and G.N.R. Locomotives, 45.
60350. Large Field Eyepiece, 46.
60353. N.W. Drivers and Postal Trains, 46.
60355. Vitriols, 46.
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QUERIES.

[60919.]—**To Mr. A. H. Allen.**—(1) Could you please give a quantitative method of determining the borax and boracic acid in a mixture of the two? (2) Why in calculating the percentage of foreign fat present in a butter, do you direct (page 235, foot-note, Vol. II. of your admirable "Commercial Organic Analysis") to use the formula there given? Why multiply by 13·3?—E. G.

[60920.]—**Mangel Wurzel.**—Will some correspondent conversant with the chemistry of the root tell me if there is a particular time when sugar gets developed in it, or is sugar always present and develops concurrently with rest of the root? When is the most profitable period to give the root to cattle—fresh from the ground when the leaves are still on, or after the root has been stored for a considerable time?—AMATEUR.

[60921.]—**Petroleum Spray.**—Will any reader tell me how I can make an effective sprayer for spraying petroleum by steam, so that when the steam and petroleum mix they will burn? Some time ago, I saw the furnace of a small engine burning steam and petroleum in the form of spray, and I have since tried to make a similar sprayer, but, so far, not with success. Will any reader inform me how to make the best form of sprayer for the purpose?—ERNESTO.

[60922.]—**Albatross Skin.**—A fine specimen of the above has been given me pretty much in the condition it was taken off the bird—i.e., with a lot of grease about the roots of the feathers on inside of skin. Will someone tell me in detail how to dress or cure it, and suggest a few things it might be made into? It is much too large for a lady's muff. It is a sort of white elephant in my hands; still it seems a pity it should not be utilised in some useful or ornamental manner, inasmuch as the bird has been deprived of it.—RARA AVIS.

[60923.]—**Simple Screw-Cutting Apparatus.**—Would "W. E. D." (letter 26430) kindly say if this is made for sale, or, if the whole apparatus is not sold, where one could get the circular cutter. It seems an admirable notion, and would, I should think, be readily bought by amateurs, if advertised.—C. H. C.

[60924.]—**Portable Electric Light.**—Will any of "ours" inform me how many cells of the chloride of silver cell (silver and zinc plates, 4in. by 2in.) would light a 2-candle-power incandescent lamp, and how long it would last with one charge?—SEPTO.

[60925.]—**Violin Query.**—Will any reader of the "E.M." kindly tell me if there is any advantage in making the back of a violin in two pieces, and also if the usual grain of the wood of which violins are generally made is essential to good tone?—NOISE BOX.

[60926.]—**Hokey Pokey and Coker Nut Candy.**—Will any kind reader inform a poor widow-woman how to make the above?—POOR WIDOW.

[60927.]—**Re-cutting Chasers.**—Could any of "ours" inform me how to re-cut inside and outside chasers—the best method?—NOVICE.

[60928.]—**Reversing Gear to Motor.**—Will any reader kindly tell me whether I could reverse motion of a Cuttriss' motor at pleasure? I have tried changing poles of battery; but motion is in same direction—no matter how joined. Perhaps such a thing could not be done. Please help—A COUNTRY PARSON.

[60929.]—**Nickel Plating.**—Will someone kindly tell me how I can dissolve nickel and prepare it for electro-deposition in the bath? I have a book on silver electro-plating, but do not know if nickel is treated in the same way. Can aluminium be deposited on another metal, and will it prevent rust or tarnish when in contact with water?—DAVID.

[60930.]—**Triangular Tool.**—Will some reader please inform me how to make triangular tool for lathe, with sketch, if possible? Also parting tool?—BEGINNER.

[60931.]—**Bicycle Making.**—I am thinking of building a bicycle; but not being a rider, am doubtful as to the best size, &c. My height is 5ft. $9\frac{1}{2}$in., weight about 11 stone, and measure 2ft. $9\frac{1}{2}$in. in fork, standing upright, without shoes. I think I ought to ride a 54in. easily; but I am anxious not to get one too high. What is the best method of building driving hub? The modern ones appear to have the gunmetal hubs bored and then soft-soldered on the axle. I propose putting plain bearings in, but do not quite understand the cone principle as applied to them

Should the axle be hardened, and, if so, will it temper, or must I caseharden? Are hollow forks of real advantage? I do not see anything relating to this subject in the last few back volumes that I have, but shall be glad of other back references.—MIDNIGHT OIL.

[60932.]—**To Anyone who Knows.**—How is the inlaying done that is used to decorate the shelves of walnut whatnots, such as are frequently brought to the door in the country for sale? The inlay is white, and apparently let into real walnut, well faced and polished. The price asked may be 14s., or less, for four shelves supported by twelve pillars of stained wood. The inlay is not deep, nor is the walnut perforated, as in marquetry, where three or four veneers are cut, and each becomes the inlay of its fellow. Surely it could not pay to chisel out the matrix. Even the errors, such as badly-shaped curves, are repeated in each. The inlay is not paper, for I have picked out a chip.—O. J. L.

[60933.]—**Gut Driving Bands.**—Will "Hendon" please give fuller description, and how to make, if possible, the lathe band fastening mentioned by him in "E.M.," Nov. 8th?—BEGINNER.

[60934.]—**To Mr. Bottone or Mr. Eaves.**—I have an ordinary electro-magnetic machine. I am unable to obtain a current from it. It seems apparently short-circuited. I believe the spindle carrying the coils should be insulated one end. Mine is made as follows: the cross piece of iron carrying the coils is insulated from the spindle, and pivots of spindle work in insulating pieces each side of frame. What should the resistance of coils be, and how shall I connect coil ends? The magnets of this machine are good.—G. R. H.

[60935.]—**Aluminium.**—Can any reader inform me if there is a yellow aluminium leaf which can be substituted for gold leaf? Want something to come in cheaper than gold. Have tried Dutch metal, but it tarnished so soon. Want something that will not tarnish.—A. L.

[60936.]—**Oxygen.**—Will any reader kindly inform me what heat is required to make oxygen gas from oxide of manganese alone, and whether gas so made is as good for optical lantern work as that made from chlorate of potash? Also, does the gas require purifying in any way?—W. M. B.

[60937.]—**Photography.**—Could any reader of "ours" inform me how to copy lantern slides by the powder process?—AMATEUR PHOTOGRAPHER.

[60938.]—**Photography.**—What is the difference between burnishing machines and glazing machines? Which are the easiest worked, and which would be the best of the two for an amateur to purchase? Would some practical photographer advise?—B.

[60939.]—**Casting of Gunmetal upon Wrought-iron Shafts.**—I should be extremely obliged for information from anyone who has had experience in casting of gunmetal upon wrought-iron shafts. We have lately had to cast some sleeves, 20in. long and 5in. diam. outside, upon wrought-iron shafts that are 4in. diam. and 9ft. long. Two sleeves were cast upon each shaft; but we have not been very successful with them—there was always a number of air-holes in the gunmetal, caused, I believe, by air from the wrought iron. We have now some wrought-iron spindles to encase with gunmetal the entire length. The spindles are about 23in. long and 1¼in. square, with the corners flattened. The gunmetal to be cast on them will be 2½in. diam. I am afraid we shall have the same trouble with these, so should be glad to have some advice before commencing them. Our mode of casting this kind of work previously has been: after the mould is made and skin dried, the wrought iron is made hot, and at once placed in the mould. The metal is then poured in before the shaft has time to cool; but we have invariably found air-holes in the castings. These have had to be burnt afterwards by a continuous flow of metal in the usual way, but having to patch the castings is not satisfactory. I should be glad to have any practical advice from a brother mechanic how these air-holes may be prevented.—MOULDER.

[60940.]—**Oxalic Acid.**—I am desirous of making some oxalic acid on a large scale for commercial purposes, and shall esteem it a favour if any fellow reader will tell me the amount that may be produced from a ton of sugar, and how much nitric acid it will take. In what vessels (lead or iron) should the operation and evaporation be carried on, and are the nitrous fumes allowed to waste, or can they be converted into anything commercially profitable? Any information will be thankfully received. Are there any books published that will give particulars of manufacture from sugar and sawdust? How much can be produced from a ton of sawdust?—J. MONTAGUE JACQUES.

[60941.]—**Fire.**—My inquiry of 15th Oct. concerns two old people, both invalids, living alone in a small cottage house. The wife finds the cold of the kitchen, before the fire burns, very trying in winter, and I am anxious she should be able to keep it in during the night, if it be possible. I have been making inquiries about the Edford briquettes, but find they will not stand so long a journey. Ilkeston and Derby Brights are new names to me. I wonder if they resemble a kind of coal we know as Cannel. My old friends spend a good deal of time in bed. The fire might have to burn 11 or 12 hours without being looked to.—E. G., Liverpool.

[60942.]—**Spirits of Wine.**—Having a small still, can I make lamp spirit from sugar satisfactorily? Kindly give practical directions.—J. B.

[60943.]—**Power to Grind Coffee.**—I find I exert 1500 foot-pounds per minute in grinding my coffee every morning. Will Mr. Seal's hot-air engine do this work? I see he advertises a small one in the Sixpenny Sale Column. H.

[60944.]—**Copper Green.**—Will some chemical friend kindly tell me the quickest way to get a deep copper green into candle material?—PARAFFIN.

[60945.]—**Working Model.**—Will any reader kindly give dimensions and sketches of the working parts of model horizontal slide-valve engine—cylinder 1in. by 2in.?—F. BOTTOMS.

[60946.]—**Locomotives.**—Will any reader kindly inform me what the consumption of fuel per train mile of 7ft., 5ft. 3in., 4ft. 8½in., 3ft. 6in., 3ft., and 2ft. gauge locomotives, and if peat is used as a fuel on any of the Irish railways mixed with coal?—C. D.

[60947.]—**Chloride of Silver Cell.**—Will Mr. Bobadil kindly answer the following:—Why is unslaked lime used in this battery and 1oz. of chloride of silver? For how many cells will this do? The cells round inside 1 by 2½in. How many minutes will the cell keep a constant current?—HOLLAND.

[60948.]—**Electric Indicator.**—I should feel much obliged if any reader would kindly send sketch showing connections of an indicator with electric replacement for four rooms.—H. E.

[60949.]—**Repolishing Gun Stocks.**—Would any of "ours" versed in gunnery give me a few hints on doing the above in a satisfactory manner? Also the way in which the stock is cut, and what substance gunsmiths fill in the nicks or cuts? I have seen some where a kind of red substance seemed to have been run in. I would be very glad of an answer from "Armourer," if he would be so kind.—J. W. B.

[60950.]—**Tricycle House.**—I have a well-built house for tricycle made entirely of match-boarding, well fitted, including floor, and standing on bricks to allow current of air underneath. Not a particle of rain could enter anywhere, and the boards inside are always perfectly dry to the feel; but the machine, particularly the nickel parts, suffers from damp very much. Kindly say which is the best means of remedying this. Would a few holes drilled at either end or along one side be sufficient? Should also be glad to know what to coat the nickel with during the winter to keep it nice.—TRI.

[60951.]—**Electro-Deposition of Copper.**—Will some expert mention the cause of, and remedy for, the following? On cathode of bismuth 1, tin 2, no deposit takes place, and the surface is eaten away. The same solution, acid sulphate of copper, giving perfect deposit both before and afterwards on ordinary type metal. I should mention that connection was made with battery in each case before insertion. The first-named alloy takes a far higher polish, which makes it preferable for the purpose required.—A. B. COTTON.

[60952.]—**Lathe Matters.**—When examining an anti-friction chain connection between the treadle and crank of a lathe, it occurred to me that we might easily substitute an eccentric for the crank. This would be an advantage to amateur lathe makers, as no forging would then be needed, and the shaft could be made much lighter. I should like to know the opinion of "O. J. L.," or other of our lathe men, as to whether it will work well.—L. H. R.

[60953.]—**New Electric Machine.**—I very much like the looks of the machine described by "A., Liverpool," but as I do not quite see the theory of it, I should be obliged if he would enlighten me on a few points. Ought there not to be a piece of brass similar to A (Fig. 2) in front of the top rubber? What ought these to be connected to? What is lining paper, and what size and number of sparks per minute can be got from the machine described?—L. H. R.

[60954.]—**John Wilkinson, Iron Master.**—I have in my possession a copper coin or token, somewhat over an inch in diameter, on the obverse side of which is a bust of "John Wilkinson, Iron Master," in profile, the name and designation appearing around the head near the edge of the coin. On the reverse side is a representation of the old-fashioned tilt forge hammer and furnace, and a forgeman manipulating a "heat" on the anvil, the year 1787 being placed below. Around the edge of the coin are the names "Willey," "Snedshill," "Bersham," and "Bradley." I shall be glad if any of your readers can give some information regarding it, and the purpose for which it was struck.—OXIDE.

[60955.]—**Steam Hammer.**—I have a steam hammer. The piston, piston rod, and hammer head weigh 5cwt.; the dia. of cylinder, 10¾in.; stroke, 2ft.; and boiler-pressure, 40lb. What blow will this hammer strike? I wrote to you on the same subject a few weeks ago, and you referred me to some back numbers, where I found the formula for the weight of a falling body, which, if I apply it to my hammer, gives something like 20 tons, which I think far too great. The steam is, of course, admitted throughout the stroke, and I added this total pressure to the 5cwt. Am I right in doing so? I remember a condenser falling 2ft. which weighed 16 tons, and this shook the place. My hammer surely does not give a blow equal to that.—FORGE.

[60956.]—**Corn Thresher.**—I should like to know the proper way of balancing a corn threshing drum, so that it may run quite steady when at a very high speed.—J. P.

[60957.]—**Pitch.**—Supposing the pitch to be given to find the diameter line, how is diametrical pitch worked out? Where ought the pitch line of a V-thread pitch line to be—either top, centre, or bottom? Please give the best book on wheel gearing, and the price.—H. G. NURSE.

[60958.]—**Crutch Slipping.**—At the bottom of my crutch I use a piece of indiarubber for ease to the arm, and to prevent the thud when walking. In wet or greasy weather the crutch slips very much with the rubber on, as I do not use the crutch directly perpendicular. Can anyone suggest any material that would answer as well, but not slip when the flags are greasy, or assist me in any other way with a remedy?—MAGNET.

[60959.]—**Chuck.**—Would someone who has experience let me know which is the best kind of chuck for holding drills and studs up to 1in.? I have tried Cushman's, but the grip is weak, and it gets inaccurate when used some time.—J. P.

[60960.]—**Bearings Heating.**—I have a shaft, each end fits to wall box, and the centre to bracket shaft, is driven from one end, and from the centre drives a grindstone or buff as required; at other end also drives stone or buff. The centre bearings will get hotter than the hand can bear in less than an hour, whereas the outer ends remain cool after six or eight hours' works. The end which I should think has all the pull from engine does not get hot. I use sperm oil to lubricate as used for Otto. Length of shaft 13ft., dia. 1⅝, runs about 180 revs. There is a collar on shaft each side of centre bearing, I presume, to keep shaft in its place. Why are they placed there? Would not one collar at each end inside box bearings be better?—YOUNG CUTLER.

[60961.]—**Chemistry.**—Is there any sympathetic ink known which, after having been written, will be invisible when cold and a bright red or crimson when heated by a fire? Also an ink which will have the reverse effect to above in any colour—i.e., visible when cold and disappear on application of heat?—LETTER WRITER.

[60962.]—**Exhaust.**—What are the objections raised to exhausting steam into a brick chimney? Will it cause any serious injury to the brickwork through dampness, and if the exhaust pipe is put in the chimney, should the delivery end of pipe be highest?—STOKER.

[60963.]—**Terracotta.**—Is there any arrangement for burning articles, such as plates, vases, statuettes, busts, &c., modelled by an amateur in clay, into satisfactory terracotta in existence? It has struck me that there probably exists some sort of small kiln or furnace heated by gas. If so, I should be glad to have particulars.—ARCHITECT.

[We fancy Mr. J. J. Lish, the Vice-president of the Society of Architects, could give you some information. He is not a very distant neighbour, and has made many experiments with terracotta.—ED.]

[60964.]—**Rubber and Lead.**—I want to fasten vulcanised indiarubber on lead. I have three various kinds of cements, glues, &c. By the constant knocking of the stamp, the rubber comes off the lead. I have also roughed up the surface of them so that it would help it.—JAS. LOCKWOOD.

[60965.]—**Saxophone.**—Can any reader give me information about this instrument? I bought one, thinking the scale was like the clarionet, being similar in appearance to it, and blown with a clarionet reed, but I am unable to make anything of it. When overblown it sounds the octave above instead of the twelfth, as the clarionet does. It has two keys at top, apparently, to sound the overblown notes. Why two? Any information, especially the use of some keys that I can make nothing of, would be welcome. The instrument is of French make—Loisette and Quandieu, Valenciennes.—SAX.

[60966.]—**Accumulator.**—I have a 2-volt accumulator, which is out of order. I sent it back to the makers, but they informed me that they found it would retain its charge. It lit a small lamp after being charged by a dynamo; but the next morning the charge was vanished. Can anyone inform me where to look for the defect? I presume it cannot be short-circuited internally, or it would not light up at all. Perhaps the better plan would be to convert it into a De la Rue's battery. If so, will someone kindly give me full directions for making same? When this battery is exhausted, what salt of silver does the residue contain, and is it difficult to regain the metallic silver? I only want to use it occasionally to light a surgical lamp.—GRATEGOSH.

[60967.]—**Ferrous Oxalate Developer.**—I have heard of a method of revitalising used ferrous oxalate developer with, I think, tartaric acid. Will someone in the "know" kindly state what proportion to use, as I often use a half-pint only twice when enlarging?—GRATEGOSH.

[60968.]—**Bichromate Battery.**—I have an induction coil that gives 4in. sparks with 5 pint Bunsen cells, but wishing to avoid the use of nitric acid, and also the time lost in charging so many cells, I thought of constructing one large bichromate cell of the following size: Three carbons, 12in. by 6in., and two zincs between, also 12in. by 6in., the solution to be contained in a two-gallon jar. The questions I wish to know are: (1) Will one cell containing carbons and zincs of the size named work coil as well as two smaller ones containing carbons and zincs half the size? (2) Which is best to use in making solution—chromic acid or bichromate of potash?—J. W. J.

[60969.]—**Fulcrum.**—Would some kind mathematician give me dimensions of a malleable casting that would stand the strain of 30cwt., the casting to form a fulcrum? I want to insert a 2in. square hole in casting for stud to form fulcrum, I should think, 4in. from end, say; the lever would be of wood to the length of 8ft. from centre of fulcrum. Would the following dimensions be sufficiently strong enough, say size of casting 2ft. long, 1½in. thick, 3in. deep at ends, and 4½in. deep at the hole for fulcrum, and gradually reduce back to ends?—ONE IN THE DARK.

[60970.]—**Lathe Work.**—Would one of our kind friends state what is the usual rate of feed on an 8in. centre screw-cutting lathe, as I now travel saddle about 2ft. per hour? Also, please say what is a usual cut to take with roughing tool on a 1½in. or 2in. bar from 4ft. to 7ft. long, as I think it is rather slower and a lighter cut than is usually taken.—IRON TURNER.

[60971.]—**To Mr. Bottone or Mr. Eaves.**—I have one of Jones's shunt wound dynamos, 30c.p. It runs well with one lamp on. As soon as I put two on I can only get them red hot, and the engine runs away as though the belt had come off. As soon as I take one of the lamps off again, the engine seems to get its work again, and one lamp is fully lighted. The machine is nearly new. I run it six or seven hours every night with one lamp without any trouble. Any advice will greatly oblige—A THREE YEARS' SUBSCRIBER.

[60972.]—**Dewrance's Asbestos Packed Valves and Water Gauge.**—Could any of our readers give their experience in the use of Dewrance's asbestos packed valves and water gauges? Are they liable to leak or get out of order? If they do leak, do they require packing afresh, or can they be ground? Can a fitter repack them or put them to rights again?—S. C. W.

[60973.]—**Double Engine.**—Would any of the readers of the "E.M." tell me the power of a pair of engines 2in. bore, 3½ stroke, set at quarter stroke?—NOMINAL.

[60974.]—**Steering Apparatus.**—Would someone kindly give me any information as to the steering of torpedo boats? I mean the latest developments in the way of quick steering. I think there is something new within the last month or two. Also, are twin screws placed side by side?—OS.

[60975.]—**Paraffin Oil or Coal Gas.**—Information required respecting the paraffin oil gas-works now exhibiting at the Edinburgh Exhibition—mode of manufacture and the number of cubic feet of gas, and the cost per 1,000ft., which can be made from the various kinds of mineral oils now in the market. Which would be the cheaper and better gas for a village four miles distance from a railway station or coal depot—coal or oil gas?—JIMBO.

[60976.]—**Arithmetical Question.**—I wish to pay off a mortgage of £1,000 by ten equal annual instalments, the principal and each continuing balance carrying interest at 5 per cent. less tax of, say, 6d. in £. Will one of your readers show a simple way of arriving at exact amount of instalment required to extinguish principal and accruing interest by end of period? The only way I know of is by approximating amount of fixed instalment, and then experimenting to find exact sum required.—PUZZLED.

[60977.]—**Ventilation of Sewers.**—Would any reader kindly say what formula is generally employed in ascertaining the necessary amount of ventilation for sewers, and would he explain the formula by working an example?—SURVEYOR.

[60978.]—**Electric Lamp.**—TO MR. BOTTONE.—I have got one of the wonderful lamps from Messrs. Shippey Bros. It is labelled 12 volts, and should give 10 candle-power. I put twelve Fuller's cells on it, but could only get about 2-candle-power out of it. How many pint bichromates will it take, and how should they be coupled up?—DE BONNE FOI.

[60979.]—**Polishing in the Lathe.**—Will some of our experienced readers kindly tell me what tools are required for, and the method of, dressing the surface of ornamental brasswork in the lathe, such as gasfittings, &c.?—POL DOL.

[60980.]—**To Mr. Striffler.**—I want to light one 5c.p. lamp with the Daniell battery you mentioned in last week's "E.M." If you will tell me what size and how many calls I should want, and how long the battery would last without recharging, I shall be extremely obliged. Also what solution to use with the zinc, and if the zinc should be amalgamated.—ELECTRA.

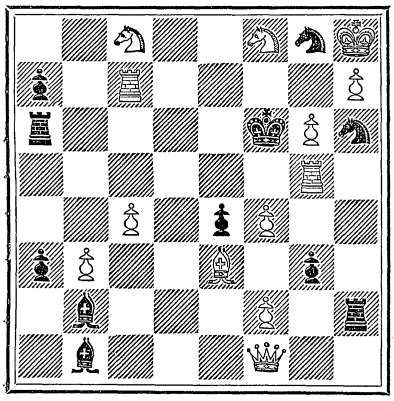
[60981.]—**Cracked Wheel.**—Have a corn-crushing machine with two crushing wheels, one 12in. diameter and one 3ft. diameter. The 3ft. wheel is cast iron, and by some accident is cracked through the main crushing-rim. The rim is about 1in. thick, 4in. wide. When first seen was only just visible, but is now open 1-16in. Would some kind reader of our most valuable paper say the best way to bring it together and keep it in place? Should it be made hot round to bring it up in place, and then riveted with straps under, or drill holes in the crack and put in studs?—FORCE PUMP.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXVIII.—BY J. PIERCE.

Black.



White. [13 + 11

White to play and mate in three moves.

SOLUTION TO 1,016.

White.	*Black.*
1. P-Q 3.	1. Anything.
2. P-Q B 4	2. K or B moves.
3. P-Q Kt 5.	3. K moves (disc. mate).

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,016, by G. A. A. Walker (very easy), A. Dean, A. Bolus (very simple problem), and F. Krassor; to 1,017, by Black Pawn (very neat and interesting).

J. THOMPSON should have been bracketed first with full marks in Tourney C.

R. PILKINGTON and E. F. Gerahty are thanked for games.

W. BIDDLE.—Thanks for the problem; it is neat, and seems quite sound.

A. TUPMAN.—You do not appear to have given Black his best defence. How if 1. $\frac{\quad}{\text{R-K 5}}$?

A. BEGINNER.—You have overlooked in 1,016 the defence 1. $\frac{\quad}{\text{K-K 5}}$ In 1,017, why not (after 1. $\frac{\quad}{\text{R-K 5}}$) 2. $\frac{\quad}{\text{B-Q 5}}$?

BLACK PAWN.—Thanks for inclosure. We have entered your name for the two Tourneys.

WE have pleasure in drawing attention to a new Chess Monthly, proposed to be started Jan. 1, 1887, styled the "Yorkshire Chess Magazine." It will consist of 16 pages, and will relate principally to the play and Chess news of the county which has always been distinguished for its Chess strength. There will also be a problem department.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 17, and unacknowledged elsewhere:—

WATT, WINNALL, AND CO.—T. B. Etty.—H. Milnes.—Foster and Williams.—Gilford Mills Reading Society.—H. H. Holt.—J. F.—Grantham Crank Co.—G. Yule.—B.—T. W.—Acier.—J. H.—S. Bottone.—Brick.—H. S. H.—A Poor Sawyer.—Welsh Hog Hair.—Lumsie.—A. B. C.—A Student.—Nil.—Gerard Smith.—Blacksmith.—An Engineer.—Country Parson.—Workman.—Chemistiana.—Oldham Chap.—Retlaw.—Puzzled.

LEVER. (The reason could have been found in any cyclopædia. When a day is added every fourth year, the "year" is made a trifle too long (it is 365d. 5h. 48m. 50·4s.), and it was arranged to make what is known as the "Gregorian correction," that is, to omit three leap years in four centuries, the years chosen being those which terminate centuries in which the first pair of figures is not divisible by 4. Thus 1800 and 1900 were omitted from the list, but 2,000 will be a leap year.)—WILLIAM HEATH. (The letter you sent was received, and an answer was duly inserted on p. 184, third col., "Transfer," in which you were referred to a reply which appeared on p. 90, this volume.)—W. S. M. (See several articles and replies in back volumes, and procure the work noticed on p. 123, "Photo-Engraving and Photo-Lithography," by W. T. Wilkinson, Otley, Yorkshire. Unless you have a good deal of the work to do, it will pay better to "give it out.")—JAMES HUNTER. (Mastic varnish is generally used on oil paintings. It is made by dissolving mastic in turpentine.)—JENEVA. (How can anyone say without examining the two watches? There is a large quantity of low-priced rubbish in the market now; but as a rule price is an indication of the value.)—CANNOT HEAR. (Take the pipes away from the noise—that is the only remedy.)—W. R. (It is a question for the "Wanted" column of advertisements; but you will find some information in back volumes. As a matter of fact, any tough paper will answer.)—NOVICE. (What do you mean by "renaming a child"? Consult a lawyer. The question is of no interest to our readers.)—FENDER. (The best thing, perhaps, is to cover the parts with a thin smear of black lead and pure grease. When metals are plated and parts become uncovered, corrosion or rusting goes on apace. The only radical cure is to replate.)—R. C. B. (Consult the advertisements. Such a query is unsuitable; but we should think you would obtain what you require from any of the large stationers in Leeds.)—SCRIBENDUS. (Sufficient directions have been given over and over again in our columns; but Zaehnsdorf's "Art of Bookbinding" will help you.)—U. BEATON. (You will find a sketch of a coil-winder in No. 917, p. 166; but all that is necessary is a spindle having a crank attached to one end. The bobbin is placed on the spindle, and the latter mounted in movable bearings.)—TEKE-LI-LI. (The choice depends on local circumstances. There are plenty of gas-engines double the size you mention. See p. 145, No. 891.)—MALLEABLE IRON. (We can only refer you to the Directory.)—AN AMATEUR. (Do not understand what you mean by "japeing." If japanning, see indices of recent volumes.)—W. A. T. (It must be left in the acid for some time, and be well scoured with sand and washed. Then it is immersed in dipping acid until the colour is bright, when it is washed and dried off in hot sawdust. 2. Amber is a fossil mineralised resin, found in various beds, but it mostly comes from the Baltic shores of Germany.)—CALEB TILLEY. (Suppose you read some elementary work on astronomy before setting out to criticise. Your nine questions are answered, so far as they can be, in any elementary manual of astronomy. For the present it will be sufficient to say that the sun "as" a "rotarey" motion, but does not "revolve around an orbit"; it has an atmosphere. It is amusing to learn from you that Prof. G. H. Darwin's address to the British Association contains "some very grave errors connected with the theory of the universe.")—G. M. S. (No pamphlet on the subject; better take a few lessons from a laundryman if you cannot refer to back volumes. Put a little wax in the starch.)—A. STACEY. (Use tin-lined pipe, or see that only steam comes over. If either of these suggestions does not provide the remedy, try a glass retort.)—H. HARPER. (Yes, by unconscious—sometimes conscious—muscular movements of the operators. See indices for Table-turning.)—DRIVER. (Not that we are aware of; but there are friendly societies bearing such names all over the country.)—DUPLEX. (Answered many times; see indices. For nickel-plating, refer to Nos. 993, 994, 995. 2. Mr. Sprague's book on "Electricity" is published by E. and F. N. Spon, 125, Strand, W.C., price 15s. 3. Procure fresh solution when the old becomes dead; but recover any valuable metal which the latter may contain.)—AMATEUR, W. L. (Procure an iron box or piece of pipe, and imbed the screws and nuts in clippings of leather, filling up with animal charcoal dust. Lute the box air-tight with a lid or clay, and bring all to a soaking red heat for a couple of hours, say; then immerse the contents in water.)—LEROY. (It would be well to keep to one until he is old enough to discriminate between the two languages.)—W. P. (That query is suitable only for the advertisement columns. See Hints No. 4.)—AJAX. (For polishing black marble see p. 456, No. 1088.)—PLATO. (Todhunter's, Newth's, and others. Lower priced works are published by Collins and by Chambers. Perhaps Gregory's "Mathematics for Practical Men: Pure and Mixed Mathematics" would suit you. That is published by Lockwood and Co., Stationers' Hall-court, E.C., price a guinea.)—HARRISON. (Chavasse's "Advice to a Mother"; Day's "Treatise on the Diseases of Children"; Ellis's "Practical Manual of the Diseases of Children"; Goodhart's "Student's Guide to Diseases of Children," all published by J. and A. Churchill, New Burlington-street, W.)—J. M. C. (You mean an hydraulic motor. A simple one is to have two high-pressure taps (two-way) at each end. These are connected by a link, and the motion of the piston rod is made to "tap" that up and down. See catalogues of makers or indices of back volumes.)—T. C. SMITH. (The art of electrotyping is described in such books as "Watt's Electro-Metallurgy," published by Lockwood and Co." Stationers' Hall-court, E.C. It has been frequently described in back volumes, and unless you have power and a dynamo you can have electrotype blocks made for you much cheaper than you can do the work yourself. A mould is taken in gutta-percha or composition from an engraved wood-block or type, and a thin shell of copper is deposited on that by means of the electric current. The shell is then filled up with metal and mounted on wood. See p. 559 last volume, and the indices.)—R. W. (Several have already been given in recent volumes. See Nos. 1026, 1027, 1029, 1041, for a series of illustrated articles on electro-motors.)—AMATEUR. (The hardening of mill bills and picks has been described many times. No chemical at all is required, though many pretend to have some secret preparation. See pp. 152, 174, 196, Vol. XLI.)—E. S. MORLEY. (What are they to answer when you give no description? Why not apply to the designer?)—G. M. S. (It is known as Oleum aurantii, and consists to the extent of 95 per cent. of a terpene and of an oxygenated oil having the composition $C_{10}H_{16}O$. The terpene is known as hesperidene. Nothing remarkable in the fact that the oil ignites at once when a piece of orange peel is squeezed near a candle flame. Almost any oil would do that if thrown into a flame in drops so minute.)—A. L. (We do not know of any books on lacquering; but details have been given many times. You must clean and polish the metal, which is perhaps best done by scouring well and immersing in "dipping acid." Wash in hot water, dry off in hot sawdust, and apply the lacquer. The article must be quite as hot as can be conveniently held, and the brush should be a broad flat camel hair. Don't go over the same part twice. Lacquering is very simple, but requires a lot of practice to do it well.)—POLO. (It is essential to destroy the germs in the air and to exclude oxygen, both of which have no doubt an influence in breaking down animal tissues to the putrid state.)—AL. DE HYDE. (See indices, or No. 898, p. 313, No. 885, pp. 15, 16. 2. No instrument of the kind. You want an ammeter, a voltmeter, and a resistance instrument. 3. Rather too antiquated. It is simply a little electromotor, which drives a steel point through the paper, making a series of minute holes. The paper can then be used as a stencil for making copies of the writing.)—FREDERICK. (Kindly look through back volumes, or procure an elementary textbook.)—FRITZ. (Dissolve sealing wax in methylated alcohol, or make it at once by proceeding as if about to make sealing-wax, as described in No. 1073. 2. Brunswick black generally.)—CLOTH. (The nap is raised by means of "teazles," the heads of the teazle plant, which contain a number of very fine hooks.)—R. M. K. (1. Yes; a weekly tenancy makes no difference. 2. No, not until the Stock Exchange grants a quotation. Any stockbroker will buy or sell for you; but you had better exercise caution with regard to the numerous new companies which are just now being promoted. Not one in ten have the faintest chance of success.)—ARTHUR MEE. (They were received, but we could not spare space, and besides, the drawings really would not reproduce well—best thanks all the same.)—RACKRENT. (You had better pay the money. It will cost you more to defend the action, and the judge is quite as likely as not to allow the costs of the two writs after all.)—KITTY. (Yes.)—MISERY, M.M.I.SC.S., HARRISON. (In type.)

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OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, **Photo Apparatus**, wet or dry, cameras, sundries, &c., in exchange for Microscopic or Magic Lantern Slides.—Apply, PIGGOTT, Chemist, Huddersfield.

"English Mechanic," 500 numbers, from 593 to 1093, with indices, clean and perfect. What offers in exchange?—STUBBIN, Buckshorn Oak, Alton.

"Knight's Mechanical Dictionary," first 18 parts, quite new, cost 2s. each. Will exchange for Engineering Books, cash, or offers.—T. BATCHEN, Inness-street, Inverness.

"English Mechanic," Vols. XXXVII. and XXXVIII., for Microscopic Slides, stained or injected.—JONES, Duke-street, Settle.

Photographic.—Half-plate or larger lens wanted; will give 12in. plate electric machine, or small electro-motor, suitable for driving sewing machine.—B. D., 40, Sandbourne-road, Brockley, S.E.

Tricycle, Coventry lever, double steering, two track, adjustable pedals, cushioned seat, good condition, newly painted, Offers.—FORD, 75, St. Paul's-road, Camden, N.W.

Electric Bell, 4in., 3-cell battery in box, indicator 6 holes, 6 china pushes, 1 barrel push, all new. What offers?—M., 11, Victor-road, Holloway, London.

Steam Gauge, Bourdon's patent, equal new, 6in. dia. Exchange for smaller, or offers.—T. H., 5, Kingsley-street, Sunderland, Durham.

Unbound Vols. XIV. to XVII. **"Electrician"** for Sale, or Electrical Books accepted in exchange; back vols. "Electrical Review" preferred.—ELLIOT, Gennaro Serra, Naples.

What offers for complete **Parts of Six Tricycles,** rear steering, partly made, rims drilled, hubs drilled and tapped, 6 wheels made, all lugs brazed on, cranks finished; when completed eminently suitable for hiring out; good winter occupation ready for next season. Wanted, one horse-power Gas Engine, suitable for dynamo. Other offers requested.—BLACKFORD, Machinist, Windsor.

What offers for good 5-keyed **Piccolo**? Small Slide Valve Engine or Electro-Motor preferred.—A. PAYNE, 36, Brunswick-street, High Town, Luton.

Steam Engine, powerful one-horse, Washing and Wringing Machine combined, Hand Sewing Machine, small Boiler on wheels, Shop Stove. Exchange.—MILLER, 1, Melbourne-square Brixton-road, S.W.

Camera, Lancaster's ¼-plate Instantograph, complete, only been in use three months, 6 dark slides. What offers?—LAING, Bridge of Earn, N.B.

Saw Bench, planed iron beds and frame, rising and falling spindle, 36in. saw, band saw attachment, nearly new, first-class order, for good Screw-cutting Lathe, or good Piano, or offers.—NEWMAN, Mill, Stanstead, Essex.

Splendid **Cardboard Model** of Buckingham Palace, in glass case. What offers in exchange? Anything useful.—W. C., 49, Mill-lane, Leicester.

Kelly **Orchestral Harmonium,** 21 stops, walnut, 6 rows, percussion, cost 68 guineas. Want small Gas Engine and Dynamo.—INWOOD, 74, Chestnut-avenue, Forest Gate.

Lathe, back motion, expanding chuck, 10in. centres, slide-rest, no bed; for Vertical Engine and Boiler, 3 H.P.—WM. SKINNER, 26, High-street, Elgin, Scotland, N.B.

"Comparative Anatomy," by Gegenbaur, 8vo., 645 pages (Macmillan), bought three months ago by mistake, never used. Offers.—A. MITCHELL, Sutton-on-Hull.

Wanted 1 or 2-man **Gas Engine.** Will exchange a Cruiser Tricycle (makers, Hillman, Herbert, and Cooper), in first-class order, cost last year £22 nett.—GREENWOOD, 76, Manchester-road, Rochdale.

Lathes.—Turning, Polishing, Scratchbrushing, Tools, and chucks, cheap. Giving up business.—CATON, 60, Ludgate-hill. Third floor.

Stamping Press, with chucks and dies, also Dynamo, cheap. Giving up business.—CATON, 60, Ludgate-hill. Third floor.

Wanted, 2½ or 3 H.P. Vertical **Engine and Boiler** combined, in good working order, cheap. Exchange Black Oats, mixed, few white, and some cash.—H. ROGERS, Bassett's Farm, Mayfield, Sussex.

Flute, Blackman's patent, 4 keys, German silver mounts, cost 15s., nearly new. Joiner's tools or offers.—R., 22, Marlborough-road, Dublin.

Exchange 36 numbers **"English Mechanic,"** for ½lb. No. 24 Silk-covered Copper Wire, or offers.—PRITCHARD, 5, Sloan-street, Lisburn, Co. Antrim, Ireland.

Wanted, **Magic Lantern,** 3½ or 4in. condenser. Exchange 4in. centre Lathe, 3-speed wheel.—HOULT, 28, Westville-road, Shepherd's Bush, London, W.

Old **Watch and Clock Works,** suitable for experiment. Exchange small Printing Press and Type.—ROBERTS, 50, Menzie-street, Liverpool.

"English Mechanic," 5 Vols., Nos. XXXVII. to XLI., inclusive, for sale or exchange. Should like Mr. J. T. Sprague's "Electricity," latest edition.—J. GRAY, 10, Pancras-road, N.

A 10-stop Pipe **Finger Organ** for an American Organ. Space required.—Address, EXCHANGE, No. 83, Stanhope-street, Newcastle.

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Wanted, small **Rolling Press,** suitable for zinco-transfers. Offers.—BEAVEN, Warminster.

Wanted, small **Litho. Press,** suitable for amateur. Exchange Lenses, &c.—BEAVEN, Warminster.

Wanted, a really well made Model Vertical **Engine** and BOILER, about 1in. stroke, for good scientific exchange.—W. S. HOW, 75, Great Portland-street, London.

50 **Microscope Slides** in exchange for small Printing Press, Unmounted Objects, or anything useful.—P. LINTIN, 170, Freedom-road, Walkley, Sheffield.

Model **Vertical Engine,** cylinder 2¼in. by 1½in. Would take a Slide-rest, or anything useful for a 2½ centre lathe.—W. MARTIN, 25, Willow-grove, Plaistow, Essex.

New double **Vertical Engine,** 2 cylinders, 2in. bore, 3½ stroke, suitable for boat or anything. Exchange for good Telescope. Stamp for particulars.—SEDGLEY, 22, Ryding-square, West Bromwich.

Electro-Platers.—Brass Moulds for casting Britannia-metal Cruet, handle, feet, supports, weight 30lb. Samples sent. Exchange for Gramme Armature (Dynamo Castings, Xero), value 70s.—HEMMING, 165, George-street West, Hockley, Birmingham.

Tricycle, nearly new, part exchange; also 50in. Bicycle, nearly new, Bown's ball bearings, cowhorn handle bars.—F. GRIFFITHS, Wednesfield Heath.

Chaff Machine for hand or steam power, by Bentall, good condition; also Oat Crusher, nearly new, by Bentall, for hand or steam. Offered exchange, anything useful.—F. GRIFFITHS, Wednesfield Heath.

6-ton **Weighing Machine,** in good condition, lever 4ft. long, part cash and exchange.—F. GRIFFITH, Heath Town, Wolverhampton.

54in. "Fleet" **Bicycle,** ball bearings throughout, latest improvements and accessories, new last season, cost 19 guineas. Exchange for 1½ H.P. Engine.—W. J. CROFT, Highclere, Marlborough-road, Merton.

Large tourist **Telescope,** Bottle Jack, Hand Sewing Machine, good condition, for small Lathe Heads, Bar Lathe, or offers.—A. T. INSKIP, Shefford, Beds.

Wanted, good half-plate **Camera Lens,** Lancaster's Instantograph preferred. Good 2½in. centre Clockmaker's Bench Lathe in exchange.—HEWETT, 14, Melson-street, Luton.

Wanted, a small **Plating Dynamo** in exchange for Assay Balance and a Fletcher Crucible Furnace, Vice, Water Still and Condenser, or Field Glass.—Address, W. C. REID, 7, Graingerville, Newcastle-on-Tyne.

"English Mechanic," Vols. XXXIX. to XLV., unbound, clean, 4 Nos. short, also ditto for years '71-2, bound, '71 incomplete. Take anything useful, optical line or offers.—Address, R GIBSON, 3, Gulistan-terrace, Rathmines, Dublin.

Bichromate Battery, Dressing Case. Exchange for Lathe Heads, Rest, Wheel, Crank, and few Tools or offers.—7, Russell-street, North Shields.

Electric Motor and an Edison Electric Pen for exchange. Offers invited. Value 15s. and 42s. respectively.—BRAUN, 1, Kilburn-square, N.W.

Exchange Howe's 6-guinea treadle lockstitch **Sewing** MACHINE, very little used, and part cash, for Lathe or Piano.—T STEVENS, 4, Princes-street, Clerkenwell.

Magic Lantern, 8ft. discs, 24 coloured 3¼ slides, in grooved box, screen, aphengoscope. Wanted, "Bottone's Dynamo," "Watts' Electro-deposition," "Hospitalier's Domestic Electricity," Sprague's, &c.—Above.

Copper Boiler, 18in. long, 9¼in. diameter, with flue through, working pressure 40lb. What offers?—A. B. WALKER, 245, Kensington-street, Girlington, Bradford, Yorkshire.

Wanted, **Launch Boiler,** Engine, Propeller, &c., for 16 by 5ft. boat. Can offer lot new Hammers, Axes, Planes, Ironmongery, Cutlery, &c.—HARRISON, Devoran, Cornwall.

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Wanted, good portable bellows **Camera** and Lens. Exchange first-class 20 candle-power Dynamo, in perfect working order.—LOWE, 11, Wills-street, Lozells, Birmingham.

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Will exchange 48in. **Bicycle,** cost £10 of few months, for 3½in. centre back-geared Lathe and Slide-rest.—W. A. COBB, Diss.

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"English Mechanic," 280 numbers, for Magic Lantern, Telescope, or offers.—Address, H. O. W., 17, Penford-street, S.E., London.

48in. **Bicycle,** Æolus balls, cone back, coil spring, cost 150s., quite new, splendid machine. Part exchange, anything useful. Camera, &c.—LEONARD WRIGHT, Hall-street, Willenhall.

Wanted, **Microscope** and Accessories, second-hand, by good maker, in exchange for Dynamo to light two 5 c.-p. lamps, or Electro-Motor to drive heavy sewing machine, &c. If microscope in thorough working order, would exchange both before-mentioned machines and a smaller motor for it.—A. W. MORGAN, 7, Railway-street, Chatham.

Look here!—Pair of Irish's Loud-speaking **Tele-**PHONES, new; 4 hole Electric Indicator, good; new 4-stop Pipe Organ, nearly finished; C.-D. V. Embossing Press; Gem Camera, 12 Lenses, good; Victrix Camera, 2 lenses, good; 12 by 10 View Lens, good; Cabinet View Lens, good; Set of Bagpipes; several large Photographic Porcelain Dishes; 8-day English Case Clock, splendid case; several hundred Negatives. All must be cleared out. What offers?—CLARK, Photographer, Spennymoor.

Youths' **Tricycles,** Meteor pattern, 3 machines, part finished; 1 cwt. loose fitting. Exchange good Lever Watch, offers.—Letters to W. SMITH, Bilston-road, Wolverhampton.

Sliding Resistance Box, Galvanometer, cost £9. Offers in Ruby Lamp, scales, 1-1 W. A. Landscape Lens, to value £3.—194a, Mare-street, Hackney, E.

Model **Boiler,** 10⅜ long, 6½ wide, all copper, tubular, Locomotive shape, with internal firebox, safety valve, taps, &c. Offers in exchange.—H. BUDD, Stoke-road, Gosport.

Mathematical Instruments.—Wanted, a thoroughly good set, in exchange for a first-class capped English Horizontal Watch, in good condition, cost £7; mutual approval—Below.

Ship's **Telescope,** worth 25s., offered for good Violin, with case and bow, or offers. Approval.—R. MILNE, 13, Observatory-road, Redhill, Surrey.

Pair best 10½ **Acme Skates,** half set Joiner's Hollows and Rounds. Exchange either for Cylinder Casting above 3in. bore.—H. L. See Sale Column.

Wanted, 120c.p. **Gramme Dynamo** and Arc Lamp. Exchange for 30 c.p. Laminated Armature and Incandescent Lamp.—A. POOL, Chipstaple, Taunton, Somerset.

Several new **Gas Bags,** to hold 6, 8, and 10 cubic feet, also some 6 and 8in. Lenses. Exchange for jewellery and part cash.—F. SWIGG, 159, Drummond-road, Bermondsey, London.

Leading Screw and **Change Wheels,** suitable for 5in. Lathe, and set suitable for 7in., in exchange for anything useful.—R. SMITH, Fazackerley-street, Chorley.

Blocks and Rope, three sheave, 1¼ rope, very good condition. Exchange good Opera-glass or offers.—R. SMITH, Fazackerley-street, Chorley.

"Ure's Dictionary of Chemistry," with plates, What offers? (or "Electrics.") Requires rebinding.—C. TARR, 5, Providence-place, Ayliffe-street, New Kent-road, London.

What offers in exchange for 18in. plate **Electrical** MACHINE, lock-up mahogany case; also 4½in. compound slide-rest; singly, or together; lantern, microscope, or photo apparatus preferred.—VARDEN, Boundary-road, Notting-hill.

Exchange Thomas's Lockstitch Treadle **Sewing** MACHINE, in good order, for lathe, model engine, or 50in. bicycle.—MARTIN, 45, Brunswick-road, Gravesend, Kent.

Fine 12 by 10 **Double Dark Slide,** fitted complete with focus and reversing frames, ready for fitting up camera. Offers.—See below.

44in. **Bicycle,** bent handle bar, by Davies and Co. Offers.—W. SAUNDERS, Dickleburgh, Scole.

Wanted, **Lathe,** 3in. centre, 3ft. bed, cheap, or exchange dynamo, motor, and batteries.—CHARCOAL WORKS, Hodson-street, Liverpool.

Six candle-power **Dynamo,** on mahogany base, also two Electromotors, 6 powerful Batteries (constant), and several Incandescent Lamps. Offers.—Address above.

Don't fail to find it.—See "Hope for the Unemployed," Sale Col., this issue.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Economic Cookery.—Patent Heat Conductors for roasting, 2s. 6d.; baking, 2s. 3d.; boiling, 2s. per pair, carriage paid. See ENGLISH MECHANIC, Oct. 15, 1886, page 147.

The Patent Heat Conductors save a family pounds a year.—Agent, TALLACK, 28, Hatton-garden, London.

New Illustrated Price List of **Screws, Bolts, and** NUTS for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

Wimshurst Influence Machine.—Sole manufacturers of new and improved pattern. 12in. from 30s.—KING MENDHAM, and Co., Bristol.

Deposition of Smoke.—Complete Apparatus to perform this never failing experiment, with static electricity, 5s. 6d and 10s. 6d.—As above.

Standard Ohm, in boxwood cylinder, guaranteed correct to ten thousandth of ohm, 18s. 6d., with copper poles, 21s.—As above.

Galvanometer Cards for tangent and ordinary combined, vertical, astatic, reflecting, and unmounted compass cards.—As above.

Variable Resistance Incandescent Lamp STAND, invaluable for battery power, vide ENGLISH MECHANIC, Oct. 16, 1885, price 3s. 6d.—As above.

Write for **King, Mendham, and Co.'s** large new and reduced Price List, post free, 4 stamps.

"Beginner's Guide to Photography," one shilling. Wholesale of the publishers, LEJEUNE and PERKEN, Hatton-garden, London.

"Beginner's Guide to Photography," one shilling. Free from abstruse technicalities. Retail of Opticians and Booksellers.

Electric Depot, 10, Deansgate, Manchester. Handiest shop in the trade. Largest stock. Greatest variety. Lowest prices.

Catapults, 7d., 1s., 1s. 2d. Square Elastic, 2d., 3d. 4d. yard. Round, 6d., 9d.—MOODY BELL, Cheltenham.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 26, 1886.

HAND-PLANING MACHINE CONSTRUCTION.

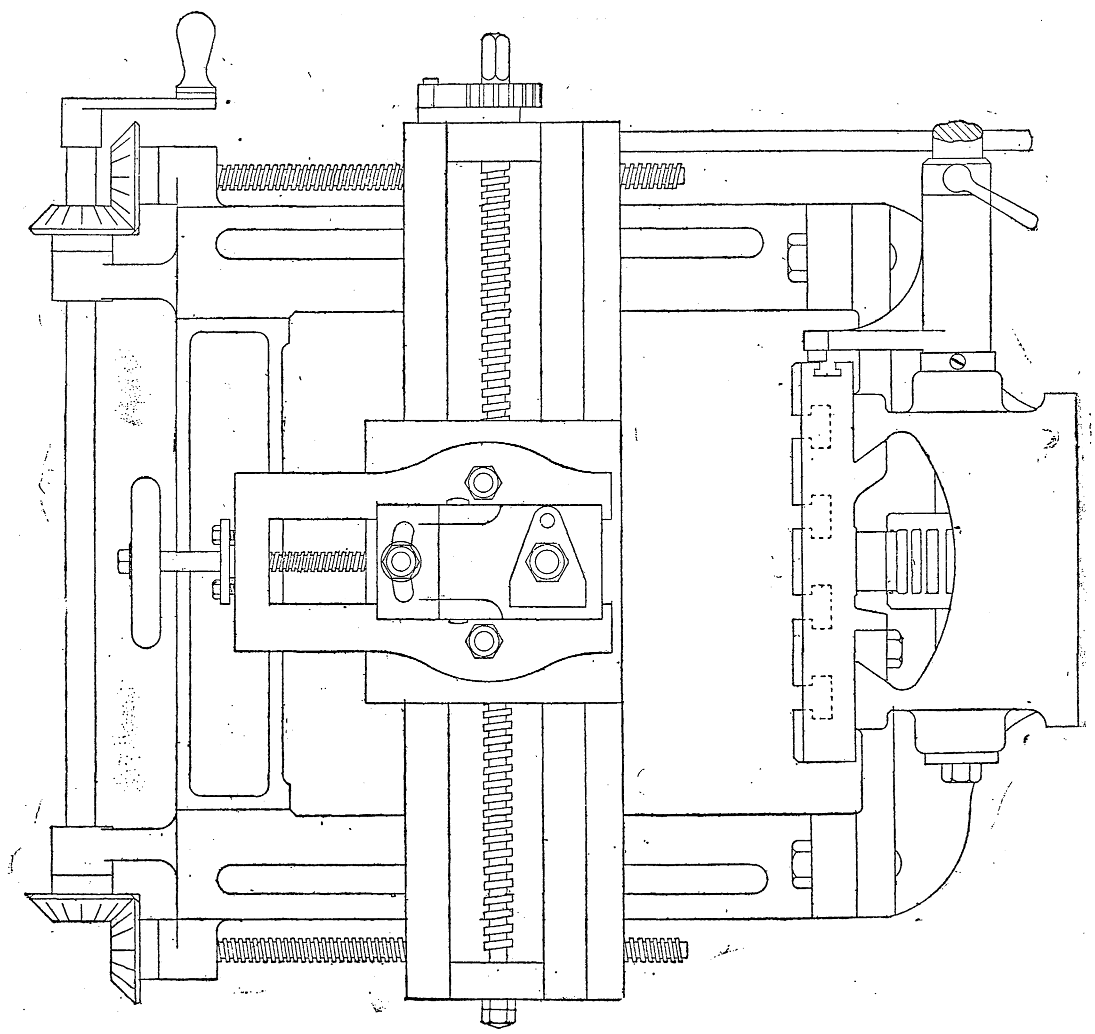
THE machine illustrated by accompanying engravings is capable of planing any object within the following dimensions :—30in. long. 13in. wide, and 12in. deep. A rectangular block of iron of those dimensions could be operated upon in the machine. The illustrations show three views: side, end, and top of the machine drawn to scale. In each view there is some slight modification in arrangement of the parts to better show the details of construction. In the side view, the screws for elevating the cross slide and the cross spindle with their mitre wheels, are removed. The central casting, which unites the four arms of the handle, is removed, but shown apart. One arm of the handle is drawn exactly in the position it would occupy if the central cross-piece were on the main spindle. In the end view the projecting part of the main spindle, and with it the handle, are not shown; the spindle is drawn broken off to economise space. In other respects this view is complete, and the dimensions of many parts may be got from it by measurement. The top view has all the cross slide and its belongings, including the mitre wheels, removed so that the dimensions of the bed, the table, and the standards may be clearly shown.

The general construction of the machine may be inferred from a brief description of its parts. The bed is a rectangular frame, 33in. long, 8in. wide, and 6in. deep, somewhat like a box without top and bottom; end and side views of it are given. The frame is braced together by three cross stays, which divide the box into four compartments. The sides have a strengthening bead along the bottom; the tops have the dovetail ways, which carry the table. Brackets to carry the upright standards are cast on the sides as shown. There are also bosses, one on each side, near the middle of the bed, to form the bearings for the main spindle.

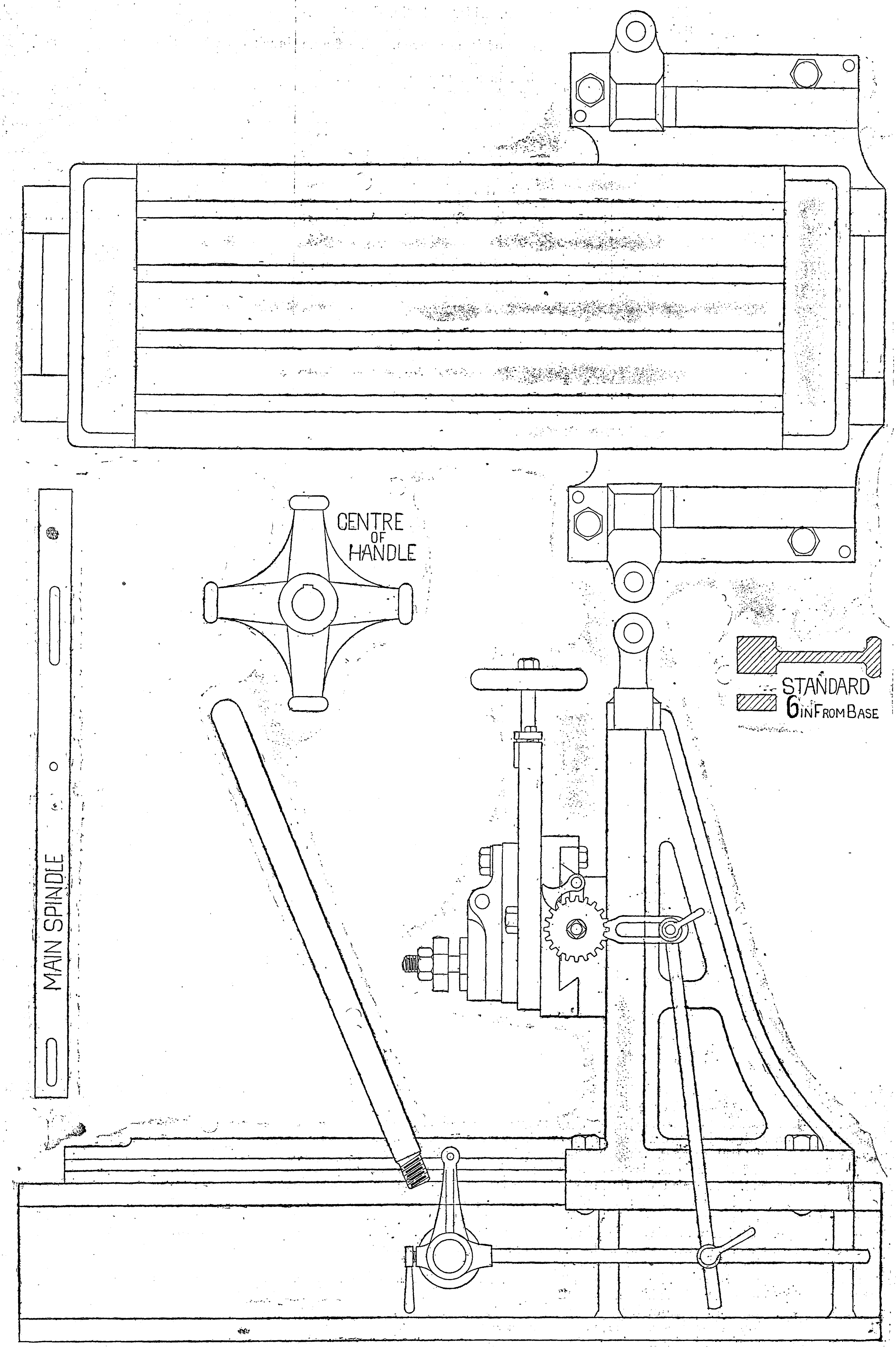
The table which slides on the bed is 30in. long, having 25in. of its middle part planed on the top and grooved with four ⊥ slots. To this part any work is fixed for planing. The parts at the ends beyond the planed part form trays to catch the chips planed from the work. The shape of the table may be seen on reference to the front view. It is fitted to slide on the bed, and has the loose strip fixed with six $\frac{3}{8}$in. bolts; the head of one of these is shown. The rack is fixed along the middle of the table by three screws. This rack projects $\frac{1}{2}$in. beyond each end of the table, so as to allow the pinion on the main spindle to traverse the table its full length.

The main spindle, shown apart, is simply a rod of mild steel, $1\frac{1}{4}$in. diam. and 22in. long, having a keyway sunk where the pinion comes, and another at the end where the handle comes. The other end has a hole, tapped to take a $\frac{3}{8}$in. bolt. The small circle near the middle of the spindle shows the position of a countersink, which takes the point of a grub screw, fixing the collar shown in the front view. The handle for the main spindle is made by screwing four rods into the central casting, which is shown apart in the side view, and so forming a cross, the four arms of which stand out 22in. from the centre.

The two standards that support the cross-slide are each fixed by two $\frac{5}{8}$in. bolts to the brackets cast on the frame of the bed. The shape of the standards will be seen by the front and side views, also by the sectional view shown apart. The two standards form a pair right and left—that is to say, they are not cast from the same pattern, but are reversed: the front and top views show this. The height, from the base to the centre of the cross spindle, is $20\frac{1}{2}$in.; the planed parts against which the cross slide fixes are 17in. long and $2\frac{3}{4}$in. wide, including the space for the bolt. The two standards are braced together at the top by a cross-bar fixed with bolts. Bosses, to form bearings for the axes of the mitre wheels, are shown cast on in convenient positions.



The cross slide is 23in. long, and may be moved vertically by the two square-threaded screws shown in the front view just beyond each standard. It is clamped at any required height against the standards by nuts at the back. The saddle sliding on this main slide is a plate $7\frac{1}{2}$in. by 7in., having a large hole in the centre to take the back of the fiddle-piece, which swivels upon this saddle, and is fixed at any angle by the two nuts shown in the front view. The fiddle-piece is 10in. long, and has a piece sliding vertically, moved by the left-handed screw and the handwheel shown. On the face of this sliding piece is fixed the cradle, in which what is usually called the tool-box swings; tool-box in this case being, perhaps, hardly the correct term to apply, as this machine is fitted with a tool-holder of the style known as Prof. Willis's. The cradle has a slight angular motion to allow of its adjustment when planing sides, so that the tool lifts clear of the work. The segmental slot in the front view shows this.



The tool-holder has for its base a plate, swinging on the cross-pin shown in both front and side views, and allows a tool to be clamped in any position to suit the work. This is such a great advantage over the confining limits of the usual tool-box that the latter is condemned by most people when the facilities afforded by the tool-holder shown on this machine are really understood.

The self-acting motion to the cross-slide, shown chiefly in the side view, a detail missed in the foregoing general description, remains to be noticed. The leading screw has fixed to it, by a cross pin, a wheel of 20 teeth; on

the boss of this wheel, and between it and the slide is fitted a two-armed flat piece, having a reversible pawl attached to its short vertical arm, and a light rod 15in. long attached to its longer horizontal arm. The lower part of the rod is attached by a swivel coupling to another rod centred on the main spindle and shown in a horizontal position. The motion for this arrangement is derived from a sliding bar on the edge of the table. This bar may be fixed at any desired place, and it rides over the upright arm of the cannon on the main spindle. This cannon has the end of the horizontal bar clamped to it by the screw shown; consequently, any motion of the upright arm is communicated, increased in amount, to the upright rod, and so moves the arm carrying the pawl. This moves the wheel and screw of the cross-slide, and as much as half a turn of the cross-screw can be got at a time by suitable arrangement of the levers. The complication of adjustments at the various joints may be all done away with by making the arm on the cannon adjustable; so all the joints and levers might be incapable of alteration without affecting the machine, provided that the horizontal and the vertical arms of the cannon could be adjusted angularly.

Having got the general construction of the machine illustrated and described, and its principal dimensions enumerated, an account of how the machine was made, involving, of course, some description of its details, are deferred for another article.

The accompanying illustrations, printed exactly one-fifth full size, may be carefully studied meanwhile.

ASTRONOMICAL NOTES FOR DECEMBER, 1886.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 49 15·74 AM	16 30 20	21 51 7	16 41 3·81
6	11 51 16·66 „	16 52 3	22 31 58	17 0 46·60
11	11 53 30·10 „	17 14 0	23 1 49	17 20 29·38
16	11 55 52·88 „	17 36 5	23 20 16	17 40 12·17
21	11 58 21·40 „	17 58 16	23 27 3	17 59 54·95
26	0 0 51·43 PM	18 20 29	23 22 4	18 19 37·74
31	0 3 18·15 „	18 42 39	23 5 23	18 39 20·52

The method of finding the Sidereal Time at Local Mean Noon at any other Station will be found on p. 353 of Vol. XLII.

Spots and faculæ in greatly diminished numbers may still be seen at distant intervals on the sun's disc.

At 9 p.m. on December 21st the Sun is technically said to enter Capricornus, and Winter is supposed to commence. It is the so-called "Sign," however, and not the constellation, which he enters, as at the instant specified he is at the right angle of a rudely right-angled triangle which he forms with λ and μ Sagittarii.

This is the shortest day, as the Sun is only above the horizon in London for 7h. 44m., and is, of course, 16 hours and 16 minutes below it.

The Moon

Enters her First Quarter at 2h. 25·0m. in the afternoon of the 3rd, and is Full at 9h. 30·2m. a.m. on the 11th. She will enter her Last Quarter at 6h. 39·1m. in the early morning of the 18th, and be New at 9h. 54·7m. a.m. on the 25th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	5·7	4 41·8 p.m.
6	10·7	8 18·2 „
11	15·7	12 28·7 „
16	20·7	4 16·1 a.m.
21	25·7	8 34·1 „
26	1·1	0 56·3 p.m.
31	6·1	4 47·4 „

The Moon will be in Conjunction with Saturn at 5 p.m. on the 13th; with Jupiter at 3 p.m. on the 20th; with Mercury at 2 p.m. on the 23rd; with Venus at 10 p.m. on the 25th; and lastly with Mars at 7 p.m. on the 27th.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
3	h^1 Aquarii	5½	5 8 p.m.	Dark	127	116	6 30 p.m.	Bright	282	286
5	14 Ceti	6½	†4 52 „	S.S.E.	25	358				
10	48 Tauri	6	5 52 a.m.	Dark	68	105	‡6 38 a.m.	Bright	305	339
10	B.A.C. 1526	6	10 29 p.m.	Dark	95	78	11 44 p.m.	Bright	289	292
14	3 Cancri	6	1 42 a.m.	Bright	112	100	2 46 a.m.	Dark	231	237
14	B.A.C. 2731	6½	†6 54 „	N. by E.	167	207				
14	54 Cancri	6½	9 26 p.m.	Bright	126	85	10 9 p.m.	Dark	222	181
19	γ^1 Virginis	2½	1 50 a.m.	Bright	112	74	2 34 a.m.	Dark	205	170
19	B.A.C. 4277	6	2 55 „	Bright	134	100	3 21 „	Dark	180	148
28	29 Capricorni	6	6 31 p.m.	Dark	127	159	‡7 34 p.m.	Bright	270	307

† Near approaches. ‡ The stars have set.

Greenwich Mean Time of the Greatest Eastern Elongations of the Five Inner Satellites of Saturn.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
1	Mimas	9·7 p.m.	13	Enceladus	12·6 p.m.	22	Enceladus	5·8 a.m.
2	Mimas	8·3 „	14	Rhea	9·4 „	22	Dione	9·7 p.m.
3	Enceladus	1·6 a.m.	15	Tethys	8·3 „	23	Rhea	9·9 „
5	Enceladus	7·3 p.m.	16	Mimas	1·0 a.m.	24	Enceladus	11·6 „
5	Rhea	8·8 „	16	Enceladus	6·3 p.m.	25	Tethys	6·7 a.m.
7	Enceladus	4·2 a.m.	16	Mimas	11·6 „	27	Tethys	4·0 „
9	Dione	5·4 „	17	Mimas	10·2 „	29	Tethys	1·3 „
9	Enceladus	9·9 p.m.	18	Enceladus	3·2 a.m.	29	Enceladus	2·2 „
11	Enceladus	6·8 a.m.	18	Mimas	8·8 p.m.	30	Mimas	4·1 „
11	Dione	11·0 p.m.	19	Mimas	7·4 „	30	Tethys	10·6 p.m.
12	Tethys	1·7 a.m.	20	Dione	4·0 a.m.	31	Mimas	2·7 a.m.
13	Tethys	11·0 p.m.	20	Enceladus	9·0 p.m.	31	Dione	2·7 „

Mercury

Is for all practical purposes a Morning Star throughout December, as he comes into inferior conjunction with the Sun at Noon on the 3rd. He attains his greatest elongation West of the Sun (21° 52′) at 2 p.m. on the 22nd; but he is very badly placed for the observer during the entire month. His angular diameter diminishes from 9·8″ on Dec. 1st to 5·6″ by the end of the year.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	16 50·9	21 50·6	0 9·8 p.m.
6	16 23·8	19 26·9	11 23·2 a.m.
11	16 8·4	18 7·1	10 48·1 „
16	16 10·4	18 18·1	10 30·5 „
21	16 25·2	19 25·0	10 25·6 „
26	16 47·7	20 50·2	10 28·3 „
31	17 14·7	22 10·3	10 35·6 „

The pendulum-like path indicated by the above Ephemeris commences in Ophiuchus, extends into the narrow northern strip of Scorpio, and returns to the Constellation in which it began. Mercury will be in conjunction with Venus at 1 p.m. on the 3rd.

Neither

Mars

Nor

Jupiter

will, for the purposes of the ordinary amateur observer, be again visible this year.

Venus

Is a Morning Star at the beginning of December; but at 5 a.m. on the 3rd she comes into superior conjunction with the Sun, and, subsequently, Souths after him. Even towards the end of the month, though, she only presents a tiny circular disc of 9·8″ in diameter, and from her great Southern Declination is miserably placed for the observer.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	16 28·6	21 36·2	11 47·6 a.m.
6	16 50·1	22 27·1	11 54·7 „
11	17 22·6	23 23·2	0 2·1 p.m.
16	17 50·1	23 50·5	0 9·9 „
21	18 17·6	23 59·2	0 17·7 „
26	18 45·2	23 49·4	0 25·5 „
31	19 12·6	23 21·1	0 33·2 „

As in the case of Mercury, the path of Venus this month begins in Ophiuchus, but it is described directly, or in the order of the Signs, and so extends into Sagittarius, where the planet will be found when the year terminates. On the 10th she is rather more than 1° North of θ Ophiuchi, and on the 22nd about 1½° North of λ Sagittarii. Neither of these stars, however, is visible under the circumstances. The conjunction of Venus with Mercury at 1 p.m. on the 3rd has been referred to above.

Uranus,

Continues invisible for the purposes of the ordinary observer; but

Neptune

May be seen, practically, all night long.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 36·7	17 33·5	10 53·8 p.m.
6	3 36·1	17 31·7	10 33·6 „
11	3 35·6	17 30·0	10 13·4 „
16	3 35·1	17 28·5	9 53·3 „
21	3 34·6	17 27·0	9 33·2 „
26	3 34·2	17 25·7	9 13·0 „
31	3 33·8	17 24·6	8 53·0 „

This retrograde path lies to the south, and very slightly to the west, of the Pleiades, in a very blank region in Taurus.

Saturn

Although, in so far as his Southing is concerned, he is a Morning Star, yet is fairly visible during the major part of the working hours of the night. His angular equatorial diameter increases quite insensibly from 18″ on December 1st, to 18·4″ by the 31st of the month. His ring system, as we remarked last month (p. 187), is slightly less open than it was last year, although this makes little or no difference in the amount of detail perceptible.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 34·1	21 26·9	2 54·7 a.m.
6	7 33·2	21 29·2	2 33·9 „
11	7 31·9	21 32·5	2 13·0 „
16	7 30·5	21 36·0	1 52·0 „
21	7 29·0	21 39·7	1 30·8 „
26	7 27·4	21 43·5	1 9·6 „
31	7 25·4	21 48·3	12 44·0 p.m.

Hence it will be seen that Saturn is travelling towards δ Geminorum.

Shooting Stars

May be watched for, with the greatest probability of success, from the 11th to the 13th inclusive, and again on the 24th.

Greenwich Mean Time of Southing of Seventeen of the Principal Fixed Stars on the Night of December 1st, 1886.

Star.	Souths. h. m. s.
ε Pegasi	4 56 44·54 p.m.
α Aquarii	5 18 1·60 „
Fomalhaut	6 9 18·65 „
Markab	6 17 1·61 „
ι Piscium	6 51 56·34 „
α Andromedæ	7 20 16·66 „
α Cassiopeiæ	7 51 45·57 „
Polaris	8 35 46·16 „
α Arietis	9 18 13·09 „
α Ceti	10 13 38·09 „
α Persei	10 33 28·78 „
γ[1] Eridani	11 9 52·09 „
Aldebaran	11 46 26·88 „
Capella	12 25 15·12 „
Rigel	12 26 0·63 „
α Leporis	12 44 36·00 „
α Columbæ	12 52 23·77 „

The method of finding the Greenwich Mean Time of Southing of either of the Stars in the above list for any other night in December; as also that of determining the local instant of its Transit at any other station, will be found on p. 355 of Vol. XLII. It must, though, be noted that the rules there given are not rigidly accurate when applied to Polaris, or any other close circumpolar star; though they will probably be found quite sufficiently so in practice.

PROF. S. P. THOMPSON'S IMPROVED DYNAMO.

About four years ago Prof. S. P. Thompson obtained a patent for improvements in connection with simple dynamo-electric machines, in which the field-magnet is in one piece without joint. A short time back he obtained another patent (No. 7860, 1886), which embodies some improvements in the armature, the object being the obtaining of a more efficient machine, having greater electrical output in proportion to its size and cost, less liable to wasteful heating in the electro-magnets or in the polar surfaces thereof, and having in general better magnetic and electric conductivity. Prof. Thompson prefers to employ a single core to receive the field-magnet coil, and makes the core shorter and thicker in proportion than in the older form of machine. He also prefers, for convenience of winding, to make it straight rather than arched. The core which receives the coil may be made in one with the pole pieces by casting or otherwise, or it may be of wrought iron, the pole pieces being cast upon it, or screwed or riveted to it. The field-magnet itself serves as a framework for the machine, and its pole pieces or either of them may constitute the bed-plate of the machine, the magnets themselves being of great solidity and mechanical strength, and presenting the advantage of a magnetic structure without joints. The field-magnets may be wound and excited in any of the ways known in the construction of dynamo machines, the coils being joined either in series with or as a shunt to the external circuit, or they may be separately excited, or they may be excited in any combination of these ways according to the circumstances in which the machine is to be used.

Fig. 1 and Fig. 2 illustrate the two ways of

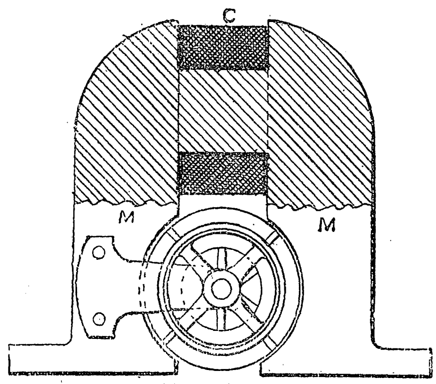
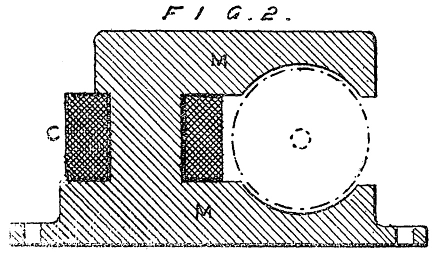


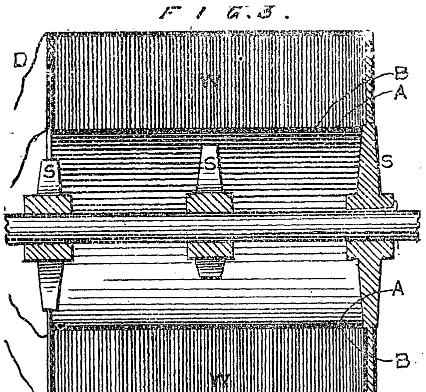
FIG. 1.

FIG. 2.



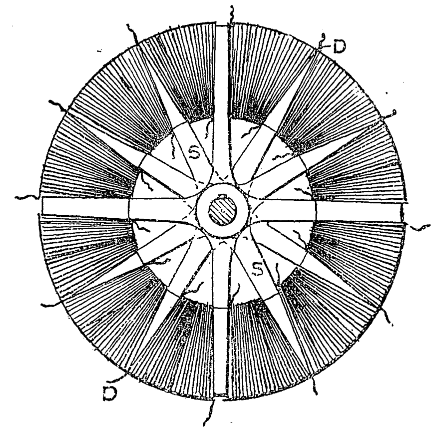
forming the field-magnets of the improved machine, the magnets themselves M M being of great solidity, having great mechanical strength, and possessing the advantage of a magnetic structure without joint. The coils are shown in position at C C. The armature is constructed upon spiders of suitable material, such as a non-

FIG. 3.



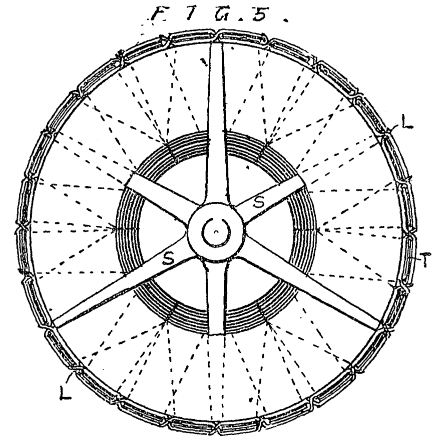
magnetic metal, keyed, or otherwise suitably fixed upon the driving-shaft, the spiders being formed with shoulders to receive and support a thin supporting cylinder or mantel, preferably made of thin sheet iron, well insulated from the spiders. The cylinder or mantel may be of some strong insulating material, such as hard vulcanised fibre or dermatine. There may be one or more such cylinders or mantels, each being borne at its ends upon the shoulders of a spider. The cylinders or mantels support and keep in place a number of thin iron washers, which are either plain or toothed externally. The process of construction of the armature frame and core consists in fixing one spider on the shaft by its key or other convenient and suitable mechanical means, then placing upon it one of the cylinders or mantles, then outside this the washers to a suitable number, preferably insulated from one another by sheets of varnished or paraffined paper, or asbestos, or other non-conducting material; then the next spider is fixed in position on the shaft, thereby securing the cylinder and washers in their proper places, and so on until the requisite number has been provided. Instead of washers of thin iron, iron wire, preferably varnished or oxidised on its surface, may be wound upon the

FIG. 4.



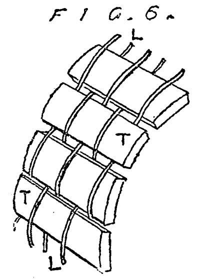
cylinder, as in the armature known as Gramme's, to serve as a magnetic core. Outside the core, whether constructed of washers or of wire, a layer of varnished paper or other insulating material is placed. The end washers may for greater strength be made thicker, and be secured to the spiders by screws. The core and frame so constructed secure great strength, requisite magnetic properties, proper insulation, and simplicity of construction. The armature coils are then wound over the core, which may,

FIG. 5.

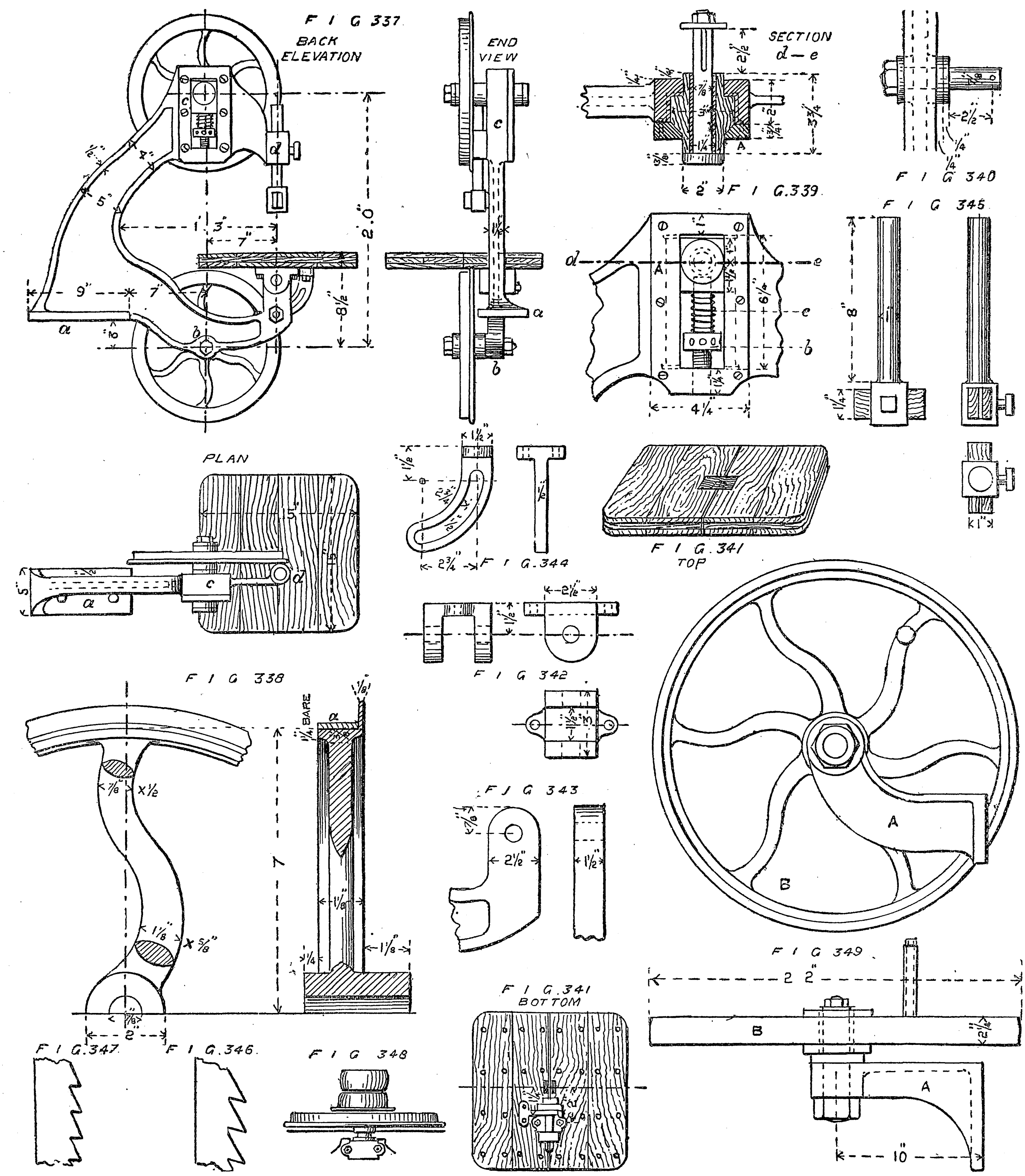


if so desired, be effected in any ordinary way, either ring-fashion or drum-fashion, but the patentee prefers the ring method of winding When armatures of low resistance are required (such as for electro-plating) he prefers to make the coils of thin copper tape, two, three, four, or more pieces of which are laid upon one another to form a single laminated conductor, which, after securing the usual insulation, is

FIG. 6.



wound over the core. This is more flexible than solid copper conductors. In some cases the patentee binds or weaves together the portions of the wires or tapes which lie on the external periphery of the armature by means of a peripheral lacing of thongs, or straps of leather, catgut, or dermatine, or other similar or suitable material, such as thin metal wires covered with suitable flexible insulation, the thongs or straps passing over one conductor



and under the next one, and so on after the manner of wickerwork, thereby holding the wires or tapes firmly in place, and preventing flying.

Where only one external layer of conductors is used, this layer may be woven before the ends of the conducting tapes or wires are drawn through the interior of the ring. Or if more layers than one are wound upon the core frame, the outer layer only of conductors may be thus woven or laced. Figs. 3, 4, 5, and 6 illustrate a method of carrying out the improved construction of armatures, S S being the spiders, A A the supporting mantles or cylinders, W W the iron washers, B B the outer layer of insulating material, D D the conductors.

In Figs. 3 and 4, these are shown as of ordinary insulated wire. In Figs. 5 and 6, they are shown as constructed of copper tape, T T. The method of securing the outer conductors by lacing or weaving with thongs or straps, L L, is shown at Fig. 6.

THE AMATEUR WORKSHOP.—XXX.

Band Saws.

THE advantage of a band saw over a jigger is that the cutting action is continuous, and, therefore, economical, and that the line of cut is only slightly obscured by the accumulation of sawdust. The attachment of the band saw to the table of a circular saw is convenient for two reasons—first, because very much labour is saved thereby—the labour of making a separate standard and self-contained mechanism for driving; secondly, because three wheels are readily applied to carry the saw, which wheels can be smaller in diameter than if two wheels only were employed. Thus the minimum diameter for a two-wheeled saw is usually fixed at from 20in. to 24in.; but where three are used, we may go as low as 14in. or 15in. On the other hand, the band saw framing crowds the table of the circular, and is in the way of cutting wide stuff. But this, though objectionable in a large shop, is not so, or at least, not to the same extent, where amateur work alone is concerned. If, moreover, we put the band-saw frame upon the side of the circular-saw frame instead of on the top, in order to gain a little room, we make too much depend upon the bolts themselves, the overhang of the frame putting excessive leverage upon them. But bolting it on the top, it is impossible for it to become shifted.

There are a number of important particulars to be regarded in the designing of band saws, and these we will note as they arise in succession. But first we will commence at the main framing (Fig. 337). The chief essential in this is rigidity, and the frame here dimensioned is stiff enough for the size of saw. In larger saws the box type of framing is usually adopted, but this would be too heavy in this instance. Note that the frame is carried backwards at a little below the level of the table in order to give room for cutting wide stuff. The pattern is made by halving together two horizontal pieces, one for the top arm, and the

other for the bottom, into a back upright piece, each being wide enough to allow of cutting the outline of the frame. These are glued and pegged, and when dry are struck and cut to outline. Fillets are fitted in—short pieces round the curved portions, in the manner described in previous articles, and a flange, *a*, for bolting to the table. A boss, *b*, is fitted at the lower end of the frame to receive the stud upon which the bottom saw pulley runs. The top, *c*, is thickened up and cored out to take the sliding block which carries the spindle of the top pulley. The end of the upper arm is formed into a boss, *d*, for carrying the sliding saw guide. The portion of the frame immediately underneath the table is thickened up to receive the hinge pin for canting movement.

When attempting to make a saw of this kind it would be better to buy the pulleys ready made of the saw manufacturers. They would then be already turned and balanced, and covered with indiarubber, without the trouble of making a pattern. If they are to be constructed, the patterns must be properly proportioned, preferably have curved arms, and be cast in moderately soft metal. The proportions given in Fig. 338 will insure a safe pulley. When cast, it is to be turned on the outside of the rim, around the flange, and inwards as far as the arms will permit, and the allowance for turning should be as little in amount as will permit of the tool getting under the skin, because the removal of much metal from any portion of a light casting of this description alters the conditions of tension, so that a pulley which would not break when first cast will often break when an excessive amount has been turned off the rim; and conversely, a pulley which would be correctly proportioned supposing it were turned, will break across the arms as a rough casting through too excessive an allowance of metal in the rim. The space between the arms which cannot be turned should be filed to merge into the turned portions. The boss will be bored and turned in the same chuckings as the rim. It is important that the pulleys should be truly balanced, on account of the high speed at which they run. Insert a spindle temporarily into the bored hole, and pivot on a pair of machine or other centres, and note if one portion of the circumference is heavier than the rest. If so, the excess of weight must be removed from the heavier side by filing.

Some manufacturers prefer to make the pulleys without flanges, on the ground that they have a tendency to break the saws. But it is, nevertheless, the usual practice to retain the flanges, and appears to me to be the safer course —at least, in the case of saws whose spindles are not provided with a set screw for correct adjustment. In ordinary machines, when the spindle bearings wear, there is trouble experienced by the saws running to front or back of the pulleys. To prevent them from running off at the front, taper is given to the rim, for the same reason as convexity is given to a belt pulley, and the flange prevents them from running off at the back. Of course, if the pulleys wabble, and the packing pieces and guides are not properly adjusted, the saws must break under the unequal strains to which they are subject.

The covering on the pulleys (Fig. 338, *a*) is sometimes made of guttapercha, but usually of indiarubber, or of leather. Its purpose is to form an elastic cushion for the saw, and so diminish the risk of fracture which would result if the saw ran on a hard, unyielding surface. The coverings are bought as rings, ordered to any length, and stretched over. An indiarubber ring will last for an almost indefinite time, certainly for six or eight years in constant use. It requires to be scraped from time to time in order to remove the resinous accumulation which clings to it. The objection to guttapercha is that it becomes partially melted with accidental overheating of the saw. Neither guttapercha nor leather is nearly so elastic as rubber, and therefore the last-named is to be much preferred.

What is termed the tension arrangement refers to the mode of adjustment of the top pulley. The bottom pulley centre is always fixed, but in order that saws differing in length within moderate limits, as, for instance, saws which have been broken and re-brazed not exactly to their original dimensions shall be used, the bearing of the top pulley is made to slide in vertical guides in the frame of the machine, and the amount of range will vary from 1in. to 4in. with the size of machine. The tension proper is an arrangement by which an elastic spring of some kind or other is interposed between the sliding bearing and the frame, so that the bearing rests on, or is supported by, the spring, in order that when the length of the saw alters by reason of expansion or contraction due to the heat generated in cutting, its fracture will be prevented by the elasticity of the spring allowing the bearing to accommodate itself to the altered length of the saw in a manner both sensitive and automatic, and which could not be effected by the mere operation of a screw and hand wheel. How many different kinds of tension arrangements there are I cannot tell, since each maker seems to have his own mode of construction, and several are the subject of patents. In a limited number of machines the tension is given by means of a lever, which is so weighted as to counterbalance the weight of the wheel, and to impart besides the elastic tension necessary to maintain the saw taut. The end of the lever is in some cases cut into the form of a segmental rack, engaging with straight rack teeth on the sliding block which carries the top wheel. In some, again, the lever is attached to a stirrup fastened to the top of the slide; in others, it lifts against the underface of the slide, being pivoted to the main framing. Lever tension was formerly universally employed, but is now generally superseded by the spring. The principle of the latter is, that while the slide is moved vertically up and down by means of a screw and hand wheel actuating a nut fastened to the slide, a certain amount of vertical movement is possible to the whole combination—hand wheel, screw, nut, and slide at once—quite sufficient to compensate for the various alterations due to temperature in the length of the saw. In some machines the spring is a thin plate arched like a carriage spring, but differing therefrom in comprising a single lamina only, and the pressure of the spring is capable of adjustment and regulation within moderate limits, and bears either against the boss of the hand wheel or the end of the screw. But in the vast majority of cases the ordinary coiled spring is employed, and this is what I have adopted, though not in the combination in which it is usually found. In fact, this machine is not an orthodox design in all matters of detail, but about as simple an affair as can be, without sacrificing efficiency. The top part of the frame is, as we just now noted, cored out to receive the sliding block which forms the bearing of the saw spindle, and into this recess the block is fitted closely, yet freely; by shaping when practicable, and if not, by filing. Note that near the ends of the sliding ways (Fig. 339) the metal is cored out for a width of about ⅜in. to a depth a trifle below the sliding surfaces. This is done to save the unnecessary trouble involved in shaping right into the sharp angle. Both faces of the block are not alike, but while the front one is square, the hinder one is vee'd like a machine slide. Then the plate A, which is screwed on the face of the slide, allows of the introduction of the block, and affords a means of adjustment for wear against the faces, and so prevents the tipping of the spindle out of the horizontal which would result from a slack fit. The block is prolonged beyond the plate to give sufficient length of bearing, and is also brass bushed and provided with an oil hole or a proper lubricator. The block itself has a vertical range in its slides of about 1in. upon the end of the screwed pin *a*; the circular nut, *b*, provides the means of adjustment; the spring, *c*, which becomes the elastic cushion for the wheel and block, intervening. When it is desired to alter the centres of the wheels, the weight of the upper one is lifted by one hand, and the circular nut run up or down by the fingers of the other until the proper height for the pulley is obtained, then two or three turns of the nut by means of a podger against the spring imparts the requisite tension to the latter. A hand wheel, screw, and nut would mean more work than this, and though slightly more convenient, is hardly worth the trouble for an amateur's machine. Fig. 340 shows the bottom pin *b*, in Fig. 337. The table may be of cast iron of about ½in. in thickness, stiffened with a rib about ½in. × ¾in. deep carried around its lower edge. But I have shown one of wood (Fig. 341) made by crossing three thicknesses of ⅜in or $\frac{7}{16}$in. thoroughly dry mahogany, the whole being glued together and screwed from the under face. The canting motion is provided for by a simple hinge, the casting (Fig. 342) being screwed to the bottom of the table (Fig. 341), and embracing the lug on the main framing (see Fig. 343.) A turned pin connects the two. The table is clamped in any position through the medium of the quadrant plate (Fig. 344) and pinching screw, and when the end of the slot in the plate is checked by the stud, the table is in a horizontal position. The saw groove in the table is bevelled downwards and backwards to right and left of the actual saw faces to prevent pinching of the table against the saw while canting.

We now come to an important section of the work—the adjustable guides for the saw blade. When material is being cut there is pressure of the material tending to force the saw backwards; and when cutting curves there is also the twisting action bending the blade out of its proper plane; and the heavier the work, and the quicker the curves, the more injurious is this action. To prevent the first, many makers place a small hardened cast-steel wheel or roller immediately behind the saw, and running in bearings on the adjustable guide shown at Fig. 345, so that there is rolling friction set up between the saw and roller. Instead of the roller a plate of steel is sometimes substituted, and rubbing friction is allowed to take place. A hard wood roller is also used, and has this advantage—that it can be readily replaced when worn. I have shown neither of these plans, preferring the simple arrangement of Fig. 345. The guide (Fig. 345), adjustable vertically, carries a socket, and into this fits a block of hard wood, having a kerf cut in it just wide enough to receive the saw blade, and brought up and set by the screw to bear against the back of the saw. This can be readjusted or replaced as it wears, and is perfectly efficient. Two slips (Fig. 341) are fitted into the table top for a similar purpose, and these also can be replaced at intervals as they become worn.

Very little lubrication suffices for a band saw if it is not forced overmuch. The usual mode of lubrication is to place a wad of tow saturated with tallow behind the saw, and resting on the upper wooden guides. If the saw is kept in trim, and not overstrained or forced, this should prevent immoderate heating, which is the source of frequent breakages.

The repairing of broken band saws is done by filing a scarf joint of 1in. or 1½in. in length, binding it together first with iron binding wire and then with brass wire. The saw is moistened with spirits of salts or with water, powdered borax is sprinkled over it, and the joint put into the clear heat of a smith's, or better still, of a charcoal fire, until the brass runs into the joint. The saw is then immediately removed to cool. Some use a pair of red-hot tongs in preference to the fire. When cold, file the joint to the same thickness as the rest of the blade (this is an important point), and file the teeth ready for use. A well-brazed joint is as strong as any other part of the saw, and is, I think, even less apt to break. Burning of the blade should be guarded against as a source of after-fracture.

The teeth of band saws are variously modified according to the work which they have to do. When discussing circular saws we remarked in effect that teeth whose shapes are theoretically incorrect will nevertheless do good work. In hand saws and pit saws this is not the case, but each description of timber, dry, wet, fluffy, hard, or harsh, requires some corresponding modifications in set, angle, rake, &c., because there being no excess of power, any want of adaptability in the saw for its work at once asserts itself. Band saws occupy an intermediate position, because, though driven by power, they are fragile, and liable to break when forced to their work. Hence the conditions which we laid down when speaking of circular saws should be regarded in the case of band saws. For soft woods the teeth will be coarsely spaced and set, and have forward rake. For hard woods the spacing and set should be finer, and the teeth have no rake at all, or very little. Fig. 346 shows a typical tooth for soft, Fig. 347 one for hard wood.

In conclusion, there is the question of driving power. Since this saw is designed specially to go on the bench of the circular figured in our last, it is driven from the pulleys on the

circular saw-spindle, the latter being lengthened beyond the dimensions there given (Fig. 323, p. 232) to receive the third band-saw pulley (Fig. 348.) The question of motive power does not affect the relative arrangements of the band and circular saw pulleys which are shown in Fig. 348, the band-saw pulley being keyed on the spindle. When the circular saw is running, and the band saw not required for a considerable time, the latter should not only not be allowed to run, but the tension should be removed. This is done by lowering the top saw pulley, and either removing the saw altogether, or by letting one lap rest on the table, and the other on a pin or peg at the side of the circular saw pulleys. Or as an alternative, the band-saw pulley on the circular-saw spindle could be made a free fit thereon, that is without a key, and temporarily held to the driving pulley of the circular-saw spindle when required by means of a turned pin passing through a boss on one of the arms of the former into a hole in the body of the latter, but the former arrangement is equally efficient.

If the saws are to be driven by power our task ends here, but if by hand, a wheel and bracket must be designed. The bracket may take the form of Fig. 349, A, and be bolted at that end of the table opposite to the band saw. A suitable wheel is shown in Fig. 349, B, but the design is quite arbitrary, and any wheel approaching to this in dimensions can be utilised.

HYGIENIC MEDICINE.

OUR readers are familiar with the opinions of Dr. Allinson as they have appeared in our columns. The second edition of his "Hygienic Medicine" lies before us; in it are many questions of vital importance. The doctor discusses man's place in nature, and says we ought to be placed among the Frugivora or fruit eaters. He is of opinion that our civilisation is the cause of many of our diseases. He blames the close confinement of our houses with the production of respiratory diseases; and also that the artificial warmth due to fires, clothes, and hot foods and fluids is injurious. Many civilised men, he thinks, do not get sufficient exercise, whilst others bring on disease by not keeping their skins clean. On the question of food, Dr. Allinson is very particular. He argues, from man's structure, that men should live on fruit, grain, green vegetables, nuts, and other vegetable products. He says that three meals a day, about five hours apart, are enough, and that the food and fluids should be taken only lukewarm, and not scalding hot. He points out, and justly, that we do not eat enough fruit, but take it as a luxury instead of an essential article of diet. We eat it at the end of a meal instead of making a meal of it with bread. He denounces alcohol and tobacco as unphysiological. To bad air he blames all our respiratory diseases and chest complaints, from influenza to consumption, and that infectious diseases are worst where there is least pure air, as amongst the poor. According to Dr. Allinson, "all diseases are one with different names, according to the locality where they manifest themselves." He has only one disease, and that is a wrong or unhygienic state of the system. He says, "It matters not of what disease you die; if you die above a certain number per thousand" we are doing wrong. Having only one disease, he has only one remedy, and that may be summed up in the term "Hygienic living"—i.e., in proper food, at proper intervals, pure air always, regular exercise, and clean skins. When he writes of drugs, he declares that they are useless as curative agents—in fact, instead of helping cure, he believes they retard it. He allows the use of drugs for two or three purposes; to kill or expel parasites that are on the skin, as the itch, or in the intestines, as various worms. Also to produce anesthesia during surgical operations, and occasionally to allay pain in incurable cases, such as cancer. Otherwise he objects to their use in ordinary diseases, and banding all the drugs together, he brands them as poisons and life-destroyers. How he would treat a case of ague without quinine we do not know. He objects to the free use of the knife, and says that many surgical diseases would be best treated by hygienic treatment alone, and not by surgical interference. This is the outline of the book, and though we cannot agree with all he writes, yet he makes out a good case for himself. We should advise all our readers to buy a copy of this book, and study it for themselves. The price is 1s.; it can be got from the author at 29, Charlotte-street, Portland-place, W., post-free for thirteen stamps; or from Pitman, Paternoster-row, E.C., the publisher. It will repay perusal.

HALF A CENTURY OF RAILWAY WORK.

ALTHOUGH the past half-century has witnessed a great change in railway work it is not a little remarkable that in all the chief characteristics there have been no essential changes in the practices which were adopted after a few years of practical experience. Improvements there have been, it is true; but they followed the onward march of progress and invention; and if modern engineers had to do what was done by the pioneers of railways, and with only the resources available at the time, they would act much in the same way. Those who were old enough to take an intelligent interest in the work of the early railway engineers more than half a century ago are becoming fewer every year, and it is only occasionally that they refer to the work of former years. Mr. Edward Woods, the President of the Institution of Civil Engineers, took occasion, in his inaugural address at the opening of the session, to refer to some matters which are within his personal cognisance, and are not without interest to railway men of the modern school. Thus, his connection with the profession dates from the time when he entered the service of the Liverpool and Manchester Railway Company — a line which was the example and pattern of its immediate successors. That line was originally laid with the so-named fish-bellied rails of 35lb. to the yard, resting in iron chairs supported on stone blocks wherever solid ground permitted their use—wooden sleepers being used only as temporary supporters. Stephenson himself took advantage of the rocky bed of the Olive Mount cutting, near Liverpool, to form a bed on which the chairs should directly rest. Owing mainly to the enormous traffic which rapidly developed—it is said that loads of 250 tons were hauled by locomotives like the Samson—the rails were frequently broken, and it was quickly seen that the "road" was too rigid, and it was, therefore, relaid, piecemeal, with rails of 50lb., 62lb., 72lb., and latterly with still heavier metals, while stone blocks were discarded for the more elastic wooden sleepers and the compressed wooden key in preference to the iron wedge which was formerly deemed necessary for holding the rail in the chair. Nowadays steel sleepers are coming into vogue in place of wood, especially in India, but they are so formed that they give a maximum of elasticity and avoid that fatal blunder of the early railway engineers—a rigid road-bed. Steel rails have supplanted iron, and can now be bought for £3 10s. per ton, whereas in 1870 iron rails, which have a life of only about one-third of steel, cost £7 10s., the price of the better quality being then about £10 per ton. Mr. Woods, referring to the locomotives, remarked that the present advanced type retained the essential characteristics of those which held the field at the commencement of the half-century. There is the water-surrounded furnace chamber, the multitubular boiler, the wheels on crank or straight axles, single or coupled, driven by a pair of horizontal or inclined cylinders, the smoke-box, and the steam blast. Great improvements have no doubt been effected in most of the constructive details —probably as great as in the external appearance of the engines,—but the essential features of the locomotives of fifty years ago are still to be seen. The modern engines possess at least four times more steaming power, coupled with six-fold weight, which means adhesion—an important factor in calculating their hauling power. From 1832 to 1836 the "Planet" was the approved type; but, compared with a modern locomotive, the weight appears as 7½ tons to 45 tons, the fire-grate area as 7 sq. ft. to 20 sq. ft., and the heating surface as 300 sq. ft. to 1,400 sq. ft. As to the consumption of fuel, the economy that has been effected almost passes the bounds of credibility. Thus, about fifty years ago the consumption of coke on the Liverpool and Manchester line amounted to 12,600 tons per annum; but a few years later 3,100 tons sufficed for a traffic of greater volume. The expansive working of the steam and the use of higher pressures—now up to 180lb.—had much to do with effecting the economy, and since 1852 coke has been supplanted by coal, an increased area of firegrate, permitting of slower rate of combustion, and a larger capacity of furnace, with appliances therein for maintaining high temperature of evolved gases, having solved a problem which must have puzzled the early railway engineers. The tractive power has increased five-fold, and inclines which at one time were considered too severe to be worked by locomotives are now readily surmounted. The recognised limit of gradient is about 1 in 20, for beyond that the weight necessary to be given to the engine to secure adhesion absorbs, by reason of the gravity of its own mass, the greater part of the power it is capable of exerting. Increased speed, so far as the bulk of the traffic is concerned, is another feature, though as regards express and special trains there is little advance to chronicle; but in all the accessory details of railway work, such as signalling, switching, braking, &c., there is a great and important advance. Referring to the growth of railways in the Colonies, Mr. Woods spoke of the question of gauge, and mentioned a fact which the Australians will regret some day. Instead of profiting by the experience of the mother country, we find that in New South Wales the gauge is the standard 4ft. 8½in.; in Victoria, 5ft. 3in. (in some places 3ft. 6in.); and in Queensland, 3ft. 6in.; South Australia has two gauges, 5ft. 3in. and 3ft. 6in.; while Western Australia, like Queensland, has a gauge of 3ft. 6in. This mixture cannot but have a retarding effect on the development of the railway system in Australia, and whatever may be said in favour of this or that gauge, the President of the Institution of Civil Engineers might have spoken with more severity than he did of the folly of a young and growing country mixing its railway gauges. The experience of the Old Country and of America should have warned the Australians that in course of time they will either have to put up with increased cost of working or make the gauge uniform. The next fifty years is scarcely likely to witness so much improvement as has taken place in the last half-century; but there is still much to be done before railway working can be considered as perfect as it is possible to make it.

RECENT IMPROVEMENTS IN MICROSCOPE OBJECTIVES.*

SCARCELY ten years have passed since Professor E. Abbe, of Jena, presented to the scientific world his theory of vision with the microscope, which resulted from a long series of investigations conducted mainly by Helmholtz and himself. It is not my intention to enter upon a general discussion of this theory, but rather to present, as briefly as possible, an account of the practical results to which it has led.

Did time permit, I would be pleased to review the progress that has been made during the last twenty or thirty years, but I must refrain. The microscope is capable of separately defining lines or markings as close together as the 1-115,000 of an inch. This is about the limit of resolution with white light, the theoretical limit being somewhat higher. The length of a vibration of red light is about 1-39,000 of an inch. How is it possible to resolve a band composed of lines ruled so much closer than a wave-length of light? Obviously, such minute spaces cannot be imaged by the dioptric method illustrated in the textbooks in explanation of the action of the microscope. The effect of such a band is to break up the rays by diffraction, and Professor Abbe has shown that, in order to resolve a band of lines as close or closer than 1-39,000 of an inch, it is necessary that the several diffraction spectra produced by the illuminating pencils be taken up by the object-glass. These spectra are imaged back of the objective, in its upper focal plane, and may be seen by removing the ocular and looking down the tube of the microscope.

By the combination of the spectral images, which are images of the source of light, or of the diaphragm, opening, in the conjugate focal plane

* By ROMYN HITCHCOCK, F.R.M.S., in the *American Monthly Microscopical Journal.*

of the object, the image of the refracting elements is produced, by interference.

The closer the lines the greater will be the number of diffraction spectra. When we observe a lighted candle through a diffraction plate the closer the lines the more images will be seen. It will be obvious, therefore, that since the portrayal of the structure depends upon the gathering in of the diffraction spectra by the object-glass, it is important that all the diffraction spectra should be so taken up, for each series of spectra will produce a definite number of lines in the image, and no more, independently of the structure of the object. The number of spectra that an objective will collect, the successive spectra being formed further and further from the optic axis, will depend entirely upon the angular aperture of the lens. We are thus able to understand the value of angular aperture, and we see at once why it is that resolving power increases with angular aperture.

The spectral images portray only the minute structure of an object. In addition to this we have the images of grosser parts formed by the ordinary dioptric action of the lenses. The skill of the maker is severely tested to bring the dioptric and diffraction images into the same plane. In the resolution of a diatom frustule, such as you will see this evening, we have the dioptric image of the outline and the central longitudinal line and the diffraction images of the cross markings. In the case of Nobert's bands of lines ruled on glass there is no dioptric image.

It results from the facts stated above that the images of minute structures seen in the microscope are interference images, and are, to a certain extent, independent of the details of the structures under examination. In other words, whatever elements will give identical diffraction spectra will be portrayed as identical structures. Moreover, in the case of bands of lines, by excluding certain spectral images and admitting others, the number of lines in the image, supposing the object to be a band of ruled lines, may be doubled. Various other modifications may be made in the image, which time does not permit me to mention.

Having thus reviewed the present theory of microscopic vision in a very superficial manner, it remains to consider the improvement in the construction of microscope objectives which the theory has led to. The greatest improvement of late years has been the adoption of a system known as homogeneous immersion, in which the front lens of the objective is brought into optical contact with the object or the cover-glass by means of an immersion fluid having an index of refraction the same as glass. It is assumed that rays from the object pass without refraction from the object to the objective. With such lenses the angular cone of rays entering the front lens is much smaller than that entering a lens without an immersion medium; nevertheless, a greater number of diffraction spectra will be taken in by such a lens.

Owing to the effect of the immersion media, it is evident that while increase of angular aperture in any medium gives greater power of resolution, the same result may be attained by reducing the angular aperture and the use of an immersion medium of higher refractive power.

Therefore, the term angular aperture is not sufficiently definite for practical purposes, and Prof. Abbe has introduced the term numerical aperture, which is the product of the index of refraction of the medium multiplied by the sine of half the angular aperture in that medium, *n* sin. *u*. It expresses the resolving power of an objective, of whatever kind it may be, dry or immersion. A table of numerical apertures, with the theoretical power of resolution corresponding to them, is published in the microscopical journals. From such a table I have selected some figures to illustrate the subject.

N.A.	Air Angle	Water Angle	Oil Angle	Resolving Power (Line *e*.)
	° ′	° ′	° ′	
1·52	—	—	180	146,521
1·33	—	180	122 6	128,212
1·00	180	97 31	82 17	96,400
·94	140 6	89 56	76 24	90,616

It will be seen that a numerical aperture of 0·94 gives a resolving power equivalent to a dry objective of 140° 6′, angular aperture, a water immersion of 89° 56′, and a homogeneous immersion of 76° 24′. The highest possible numerical aperture in air is 1, in water, 1·33, but in a homogeneous medium 1·52.

The resolving power of an objective is calculated by the formula $\delta = \frac{\lambda}{2a}$ in which λ = the wave-length of the light, and a = aperture. According to this formula, the number of lines that can be resolved by an objective of the highest possible numerical aperture is with white light ($\lambda = 0{\cdot}5269$) 146,543 in an inch, with blue light ($\lambda = 0{\cdot}486$) 158,845, and with the actinic rays which may be used in photography ($\delta\ \lambda\ 0{\cdot}4000\ \mu$) 193,037. Practically the limit is considerably lower. The homogeneous immersion lenses made by Mr. Zeiss do not generally have a numerical aperture above 1·30.

The greatest resolution yet made, so far as I am aware, with any lens is the 19th band of Nobert's plate, having about 112,000 lines to an inch. It is probable, indeed, almost certain, that this limit can be exceeded with the fine objectives now made, but authentic records that it has been done are as yet wanting. Ambitious amateurs have reported resolutions of 120,000 and more, but the results cannot be accepted without question, particularly when they are in excess of the theoretical limit. As an indication of how easily observers are sometimes deceived in such work, I have a photograph of *A. pellucida* showing spurious lines which were supposed to be an indication of longitudinal markings.

It may be incidentally remarked that the resolving power is a function of angular aperture, independent of magnification. Sufficient magnification is required to cause the markings resolved to subtend an angle such as will enable the eye to distinguish them. Beyond this point no possible increase of magnification can disclose additional structural details.

The question of resolution of close lines or particles is entirely distinct from that of the visibility of isolated lines or particles. A line one millionth of an inch in diameter may be seen, but a space of 1-175,000 of an inch between such lines will probably never be seen.

A subject closely connected with the discussion of the aperture of microscope objectives is the consideration of mounting media. The optical character of the substance in which an object is examined is of great smportance as regards the visibility of the object. The visibility of an object is proportional to the difference between the index of refraction of the object and that of the medium in which it is mounted. Canada balsam has been universally used, and is certainly a very useful and convenient medium, but more highly refracting media are now demanded, and quite recently Prof. H. L. Smith, of Hobart College, has published several formulas for preparing compounds with refractive indices of 1·7 to 2·4. The best of these is probably a solution of antimony bromide in boro-glyceride dissolved in glycerine. This medium was first described in January of this year, and is but little known. The very highly refractive medium mentioned above is realgar, arsenic sulphide, which may be used alone or dissolved in arsenic bromide.

Dr. Morris, of New South Wales, has used sulphur for mounting and also selenium, the latter having an index of refraction of 2·6. Prof. W. H. Seaman has prepared an excellent medium by dissolving sulphur in anilin.

So great are the advantages of these media that a few persons have been led to believe they in some way increase the resolving power of an objective, and enable one to do as much with a lens of low angular aperture as can be done when balsam is used with another of greater angle. Obviously this is not true. The distinction between visibility and resolution should be clearly drawn.

RECOVERING SILVER FROM PHOTOGRAPHER'S WASTE.

THE following hints on recovering silver from photographer's waste are by Mr. A. C. Hopkins, in *Anthony's Bulletin*:—In common with most photographers, I have a small dark room, but because there is a sink and waste-pipe in the room I do my toning there. At the end of the sink I had, until recently, a large barrel into which I poured the first two or three washings from my prints, and to which I would occasionally add a handful of salt. When the barrel became full (which took a week or ten days), I put in more acid to clear it up, as directed in a circular issued by the refiners. But I found that it did not clear well, either because I used too much salt or not enough acid; and, drawing off the water before it had settled, I knew that I was wasting a great deal of silver. Then, too, a barrel of stagnant water, standing in a small room, is not conducive to health or comfort. So I decided to dispense with mine, and found a substitute in the following simple process:—

After soaking my prints for five minutes in water made slightly acid by acetic acid, I remove them to another dish, and add to the water from which I have just taken them about a teaspoonful of salt, and stir it rapidly for a moment with the hand, when it becomes as white and thick as milk. This solution I then pour into a common wooden pail, which will hold enough water for the first washing of a hundred prints, and the next day, when I am ready to tone again, I find that my solution has become perfectly clear, and in the bottom of the pail I have a clear white sediment—pure chloride of silver. I then pour off the water to within an inch of the bottom, and the pail is then ready to be filled again. I find that by adding salt to the second water in which I washed the prints, there is hardly a trace of silver, and it is not worth saving. About once a month I pour the settlings from the pail through a fine cloth to filter, and throw the cloth and contents into the silver paper clippings. In this way I save more than half of the silver used in making the print.

REMOVAL OF SUPERFLUOUS HAIRS BY ELECTROLYSIS.*

By JAMES STARTIN,

Late Surgeon and Lecturer at St. John's Hospital for Diseases of the Skin, Consulting Surgeon to the Sheffield Public Skin Hospital.

UNTIL the last two years, in England the removal of superfluous hairs from the face has been an unsatisfactory operation. Superfluous hairs that grow on the face, upper lip, and chin of women, and sometimes on the noses of men, are always a source of annoyance, and very naturally they desire to have them removed.

In the summer of 1884 my attention was turned to the removal of superfluous hair from the face by reason of several cases coming under my notice, the patients in most instances complaining of the very unsatisfactory results obtained from the use of depilatories. In the autumn of that year, in answer to an inquiry in the *Lancet*, I recommended the process of destruction by electrolysis, having then had several successful cases. In consultation with my friend, Dr. W. Kilner, electrician to St. Thomas's Hospital, I devised the apparatus required—that is, I had made for me by Mr. Groves, of Bolsover-street, a nice portable case containing a small twenty-cell bichromate battery, which can be regulated to three powers at will, two ordinary sponge electrodes, two yard-and-a-half wire conductors, and a needle-holder, devised much like an ordinary pen-holder. I found, after considerable trial, that toughened gold, well sharpened, was the best material, and wore the best.

Now, with regard to the operation. The application of the needle electrode cannot be made without more or less pain, varying much in different patients, no matter how the sponge electrode is applied. I then, after a prick or two of the needle electrode, brush over the part a 5 per cent. solution of hydrochlorate of cocaine, with good result, almost invariably deadening the pain. In one or two instances I have had an anæsthetic administered; but I find this is seldom necessary, as the pain is slight. The operation can now be proceeded with. The negative needle electrode is plunged into the root of the hair for about $\frac{1}{16}$in., and the positive electrode sponge is applied in the immediate neighbourhood. The needle should be kept in for about the space of five seconds, then the sponge electrode should be removed, and afterwards the needle electrode. To know that the operation is effectual, the needle should produce slight frothing of the tissues. The hair destroyed can now be easily epilated with an ordinary pair of dressing forceps, and it should come out without the slightest adhesion. This operation applies more especially to hairs that are noticeable to the naked eye. Fine downy hairs can always be destroyed by the application of a properly made depilatory. A slight inflammation of temporary character occurs for an hour or two after the operation in the destroyed follicle; this can be controlled by the use of a soothing lotion. The operation, if carefully done with a battery in good working order, is invariably successful, especially if the hairs are few and of good size—from $\frac{1}{4}$in. to $\frac{1}{2}$in. long. If many hairs have to be removed, then several sittings will be required at intervals of about ten days. A hundred hairs can be removed at a sitting. The following cases may serve to illustrate the operation.

1. A young woman, aged thirty-two, consulted me on March 15th, 1884, with superfluous hair on the upper lip and chin; she had pulled them out herself, and there remained about a hundred short, dark, stumpy hairs. I removed in two sittings as many as I could see; for the removal of the remainder I prescribed a depilatory for her to use. I recently saw this patient, showing the result of the operation to be successful.

2. In August, 1884, a young lady, aged thirty, was sent to me from the north of England, who had had a superfluous growth of hair on the upper lip and chin for about five years. I removed all I could see in two sittings. I heard recently that the operation was successful.

3. I removed a patch of superfluous hair from the neck of a young lady last August, and I received a letter from her mother last week to say the operation was successful.

4. In October a young woman came to me to have a large quantity of hairs removed from the chin and upper lip. This was the worst case I have had, both from the numbers of the hairs, their depth of growth, and the extreme sensitiveness of the patient to electricity. I used the electrode with

* From the *Lancet*.

difficulty after painting the skin with a 5 per cent. solution of hydrochlorate of cocaine, and could only remove about fifty at a sitting. After seven sittings I have nearly accomplished their removal.

5. A gentleman consulted me in the summer of 1885 for a few superfluous hairs on the tip of the nose. I removed these at one sitting, the result being successful.

6. In July, 1885, I removed about fifty hairs 1in. in length round the nipples of the breast of a young woman, also some from her upper lip. One operation proved successful.

Since I wrote this paper I had the honour to show my battery and electrodes in the museum, and demonstrate the process in the surgical section to the president and members, at the meeting of the British Medical Association in August last, in connection with the destruction of the lupus nodule, moles, warts, and nævi, in a paper on the "Surgical Treatment of Lupus and Acne" I read at Brighton.

Sackville-street, W.

CROSS-CUT SCREW CAMS.*

THERE are various methods of changing a rotary motion into a reciprocating motion, but not all are equally adapted to similar situations and to the same purposes. The crank, the eccentric, pinion and racks, heart-wheel cam, worms, gear wheels and chain and other devices will develop a reciprocating movement from a rotary motion, but they are not all suited to all requirements. Perhaps no one of them is entirely satisfactory in some circumstances. In the writer's active mechanical experience it became necessary, after tests of the crank and heart-wheel cam, to resort to a cross-cut screw to produce a thoroughly equal motion that would instantly reverse and instantly return.

This peculiar cam is less used than its merits deserve, partly from a belief that it wears out rapidly, and partly, mainly, because it is thought to be difficult of production. These objections are neither of them valid; the cross-screw cam will last forty years if properly cared for, and any machinist who can cut a thread in a lathe, and who wears a common-sense head, can make the cam.

It is a cylinder threaded with a square thread screw, right-handed, and one of the same pitch left-handed; the thread of one direction crosses that of the other direction, so that when it is finished the screw presents a series of "lands" of a diamond-shaped area separated by crossed threads.

Of course it is quite easy to cut a single thread; but to cut another thread crossing the first requires some care. This necessity for care is increased from the fact that neither of these threads "run out"—are cut to the end of the blank—but at each end they join together, so that when finished a shot or other round pellet can be made to traverse the grooves, back and forth, simply by turning the screw as though on its axis. In fact, a follower does thus traverse these grooves. The follower is a crescent-shaped blade, conforming to the diameter of the screw or cam at the bottom of the thread, and pointed at each end. It is pivoted to a slide so as to turn freely. Now it follows that if the screw cam is turned on its axis, the engaging blade, or crescent-shaped follower, will move along in the grooves, carrying with it the slide to which it may be attached, and when it has reached the thread in one direction it will swivel or turn in the other direction, retracting its course. The follower may be swivelled to a fixed object, and the rotating screw cam be forced to slide on long journals, and thus become the reciprocating movement. There are instances when this adaptation would be desirable and preferable to the other; in many cases there would be less friction attending the sliding of the rotating screw cam than in the sliding of a bar.

The length of the screw cam or the distance of its stroke is not material; it may be adapted to the conveniences of the machine, and the length of stroke of the slide or other piece to be reciprocated may be determined by a lever pivoted to the slide to which the crescent-shaped follower is swivelled.

To make a cross-cut screw cam the diameter and length of the blank should first be determined, under such limitations as the character of the machine will permit; but an outer diameter of less than 2in. is not advisable, and the pitch of thread should be governed largely by the diameter of the blank. For a blank of 2in. diameter a pitch of $\frac{1}{4}$in. is not too fine; the coarser the pitch the larger must be the turn or curve where the right and left threads connect at their ends. The groove of the thread should be less than the lands; thus, in a pitch of four to the inch let the total of the width of the grooves at the surface be $\frac{13}{32}$in., and that of the lands $\frac{19}{32}$in. The grooves should be slightly inclined, making the sides of the threads tending slightly to the V form.

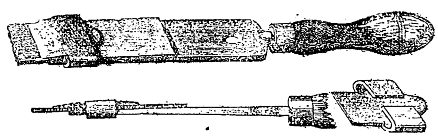
To cut the threads, the blank, after having been turned true and finished, should be dogged in the lathe, and the dog wedged to the face-plate to prevent all back lash. Calculate the number of revolutions of the screw cam required to make the traverse desired. In the case of the 2in. blank and the four-threaded pitch, 4in. traverse will be got by sixteen revolutions, and $3\frac{1}{2}$in. traverse will require fourteen revolutions. Draw a line longitudinally across the face of the blank, as it is on the centres in the lathe, by sliding the tool carriage along, with a pointed tool in the tool post. Turn the blank half way around and make another longitudinal mark. Then with the same tool make a mark around the blank at the starting point near the end, and another at the other end, the two being exactly so many inches and fourths of inches apart, as each entire revolution makes one-fourth of an inch in this case. Now drill two or three holes just inside the circumferential line, close together, and of the same diameter as the width of the score of the contemplated screw. The first of these holes should have its outer edge just on the circumferential line, the next a mere trifle inclined to the direction of the proposed thread, and if a third is made the same instruction is applicable. Similar holes are to be drilled at the other end (half way round) of the blank, with an opposite slight inclination for the return, or left-handed thread. These holes are the starting and the ending points of the screw-cutting tool. They are drilled the same depth as the scores of the screw are to be, as they are but continuations or connecting portions of the score. As the cutting-tool approaches the end at each chip it may be necessary to bring up the cut by hand-pulling the lathe belt. When the right-hand thread is completed cut the left-hand in the same way; the joinings will be where the holes were drilled, and will be slight curves on a radius corresponding with the pitch of the threads.

For these screw cams cast iron is greatly to be preferred to wrought iron. Larger blanks and coarser pitches than named above may be used, but a pitch of more than two to the inch is too rank to permit an easy turn at the ends.

* By JESSE H. LORD, in the *Manufacturers' Gazette.*

WRIGHT'S SCRAPING TOOL.

IN the annexed illustrations is shown an invention, patented by Mr. J. Wright, of Torrington, Connecticut, which gives a peculiar elasticity to the scraper, and allows of the smooth working of the tool. Secured to a suitable handle



is a bar of uniform width throughout its length, but diminishing in thickness from the end next the handle. Fitted to the bar is a clamp, shaped as shown in the enlarged view. The thin end of the bar is inserted between the arms and body of the clamp, and a hardened and tempered scraping bit is placed between the clamp and the bar. When the clamp is driven on the bar, the latter causes the clamp to draw tightly against the bit, which is held firmly in position for use. By means of this improvement, the bit may be made of uniform temper throughout its entire length, and may be moved forward as fast as it is worn away by grinding.

The "Air Telegraph."—The Edison-Gilliland-Smith system of telegraphing to and from trains without a direct connecting wire—the system described by Mr. Edison as the "air telegraph"—is now in use on the Chicago, Milwaukee, and St. Paul railway, only a few months after the first test at Staten Island. One car on each train is furnished, it appears, with an inexpensive instrument, and induction is relied upon for carrying the electric current from this instrument through the air to the ordinary Morse wires at the side of the track. Construction trains on the St. Paul road are provided with these instruments and operators to work them. A construction train frequently has 70 or 80 labourers aboard, and must get out of the way of all regular traffic along the line. Accordingly, such a train has to be constantly moved on to sidings, in order to leave the road free for passenger and freight trains.

IF a fragment of potassium hydroxide be placed in some ferric-chloride, a few drops of bromine added, and if necessary gently heated, the mass dissolves in water, yielding a fine red solution of potassium ferrate resembling permanganate in its tinctorial power. A fine red solution of calcium ferrate is obtained by adding ferric chloride to bleaching powder and boiling with water. Manganous sulphate destroys the colour, and filtration through paper discharges it; barium chloride produces a purple precipitate of barium ferrate.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE first meeting of this Society for the present session was held on Wednesday evening, the 17th inst., at the Institution of Civil Engineers, 25, Great George-street, Mr. W. Ellis, F.R.A.S., President, in the chair.

The following gentlemen were elected Fellows—viz., Mr. B. A. Dobson, Mr. T. Gordon, Mr. H. Mantle, Rev. J. Watson, and Mr. F. Wright.

The papers read were:—

(1) "The Gale of Oct. 15th-16th, 1886, over the British Islands," by Mr. C. Harding, F.R.Met.Soc. The storm was of very exceptional strength in the west, south-west, and south of the British Islands; but the principal violence of the wind was limited to these parts, although the force of a gale was experienced generally over the whole kingdom. By the aid of ships' observations, the storm has been tracked a long distance out in the Atlantic. It appears to have been formed about 250 miles to the south-east of Newfoundland on the 12th, and was experienced by many ocean steamers on the 13th. When the first indication of approaching bad weather was shown by the barometer, and wind at our western outposts, the storm was about 500 miles to the west-south-west of the Irish coast, and was advancing at the rate of nearly 50 miles an hour. The centre of the disturbance struck the coast of Ireland at about 1 a.m. on the 15th, and by 8 a.m. was central over Ireland. The storm traversed the Irish Sea, and turned to the south-east over the western midlands and the southern counties of England, and its centre remained over the British Isles about 34 hours, having traversed about 500 miles. The storm afterwards crossed the English Channel into France, and subsequently again took a course to the north-eastwards, and finally broke up over Holland. In the centre of the storm the barometer fell to 28·5in.; but, as far as the action of the barometer was concerned, the principal feature of importance was the length of time that the readings remained low. At Geldeston, not far from Lowestoft, the mercury was below 29in. for 50 hours, and at Greenwich it was similarly low for 40 hours. The highest recorded hourly velocity of the wind was 78 miles from north-west at Scilly on the morning of the 16th, but, on due allowance being made for the squally character of the gale, it is estimated that in the squalls the velocity reached for a minute or so the hourly rate of about 120 miles, which is equivalent to a pressure of about 70lb. on the square foot. On the mainland the wind attained a velocity of about 60 miles an hour for a considerable time, but without question this velocity would be greatly exceeded in the squalls. In the eastern parts of England the velocity scarcely amounted to 30 miles in the hour. The force of the gale was very prolonged. At Scilly the velocity was above 30 miles an hour for 61 hours, and it was above 60 miles for 19 hours, whilst at Falmouth it was above 30 miles an hour for 52 hours. The erratic course of the storm and its slow rate of travel whilst over the British Islands were attributed to the presence of a barrier of high barometer readings over Northern Europe, and also to the attraction in a westerly direction owing to the great condensation and heavy rain in the rear of the storm. The rainfall in Ireland, Wales, and the south-west of England was exceptionally heavy. In the neighbourhood of Aberystwith the fall on the 15th was 3·83in., and at several stations the amount exceeded 2in. Serious floods occurred in many parts of the country. A most terrific sea was also experienced on the western coasts and in the English Channel, and the number of vessels to which casualties occurred on the British coasts during the gale tell their own tale of its violence. The total number of casualties to sailing vessels and steamships was 158, and among these were five sailing and one steam ship abandoned, five sailing and one steamship foundered, and 42 sailing and two steamships stranded. During the gale the lifeboats of the Royal National Lifeboat Institution were launched 14 times, and were instrumental in saving 36 lives.

(2) "The Climate of Carlisle," by Mr. T. G. Penn, F.R.Met.Soc. This is a discussion of the observations made at the Carlisle Cemetery. The mean temperature for the 23 years 1863-85 was 47·5°; the absolute highest was 95·0° on July 22nd, 1873, and the lowest 55° on January 16th, 1881. The mean annual rainfall was 29·80in.; the greatest monthly fall was 7·84in. in July, 1884; and the least 0·30in. in January, 1881. The average number of rainy days was 174.

(3) "Results of Hourly Readings Derived from a Redier Barograph at Geldeston, Norfolk, during the four years ending February, 1886," by Mr. E. T. Dowson, F.R.Met.Soc.

(4) "Results of Observations Taken at Delanasan, Bua, Fiji, during the five years ending December 31st, 1885, with a summary of results for the years previous," by Mr. R. L. Holmes F.R.Met.Soc.

SCIENTIFIC NEWS.

THE scheme for making a photographic atlas of the starry heavens, originally suggested by Dr. Gill to Admiral Mouchez, is taking a more definite character, and some time next spring accredited representatives of each nation willing to take a part in the work, will meet in Paris, probably. The idea is to make photographic charts of the heavens by the aid of telescopes of large aperture, and it is hinted that the atlas will contain, when completed, from 1,500 to 1,600 maps. A labour of such magnitude will, of necessity, take a long time; but now that the Brothers Henry, Mr. Common, and others have shown us what can be done by photography towards the advancement of astronomy, there will not be any lack of help in accomplishing the work. Prof. G. P. Bond may be said to have been the "father of stellar photography"; but the first photographic image of a star was, we believe, obtained by Mr. J. A. Whipple, under the direction of the late Prof. W. C. Bond, at Harvard College Observatory, Cambridge, Massachusetts, on July 17, 1850, when a sensitive daguerreotype plate was placed in the focus of the 15in. equatoreal, and the latter by means of the driving clock, was kept pointed to Vega (Alpha Lyræ). Nowadays we are far in advance of Mr. Whipple and his daguerreotype plate, but the record may be interesting to many.

Old pupils of the Royal Military Academy, Woolwich, will be sorry to hear of the death of John Fry Heather, M.A., for many years mathematical master at that establishment, and the author of several really valuable works which were issued in Weale's series. His "Drawing and Measuring Instruments," "Optical Instruments," and "Surveying and Astronomical Instruments" are probably the most useful works of the kind—certainly they are at the price charged for them.

The death is announced of Prof. Paul Morthier, of Neuchatel, a pupil of Oswald Heer and the founder of the Swiss Botanical Society. Dr. Morthier was an acknowledged authority on sponges.

The Royal Society medals have this year been awarded as follows:—The Copley Medal to Franz Ernst Neumann, of Königsberg (For. Mem.R.S.), for his researches in theoretical optics and electro-dynamics; the Davy Medal to Jean Charles Galissard de Marignac, of Geneva (For.Mem.R.S.), for his researches on atomic weights. Prof. Samuel P. Langley, of Allegheny, Pennsylvania, is awarded the Rumford Medal for his researches on the spectrum by means of the bolometer. Mr. Francis Galton and Prof. Guthrie Tait are nominated for the Royal Medals, the former eminent for his statistical inquiries into biological phenomena, and the latter for his various mathematical and physical researches. The medals will be presented at the anniversary meeting on Nov. 30.

From the report of the prize committee of the Royal Scottish Society of Arts we learn that Complimentary Keith medals have been awarded to Daniel William Kemp, J.P., Vice-President, for his "Unwritten Chapter in the Early History of the Iron Industry in Scotland: Iron Smelting in Sutherlandshire and the North of Scotland"; to Ernest William Moir, engineeer, Forth Bridge Works, for his paper on "The Pneumatic Caissons at the Forth Bridge Works"; and to William Hume, instrument maker, for his "Historical Demonstrations in Photography, with Illustrations and Specimens." The following prizes have been awarded:—1. To Nicol Arthur, shipbuilder, for his "Improved Machine for Bevelling Angle Iron" (the Keith prize, value £20); 2, to Walter Macdowall Hardie, printer, for his "Fluid Prisms of Novel Construction" (the Reid and Auld prize, value £10); 3, to John Greig, jun., engineer, for his "New Anti-friction Bearings, requiring no Oil or other Lubricant" (a Keith prize, value £10); 4, to James Watson Johns, law agent, for his "Automatic Shrapnell Shell" (a Brisbane prize, value £5); 5, to Alexander Fraser, M.A., optician, for his paper on "Recent Improvements on Freezing and other Microtomes" (a Hepburn prize, value £5); 6, to Alexander Fraser, M.A., optician, for his "Improved Centring and Focussing Nose-Piece (4523) and Self-Centring Turn-Table (4525) for Microscopes" (a Brisbane silver medal); 7, to John Miller Turnbull, photographic chemist, for his "Improved Sliding Nose-Piece and Adapter for the Microscope" (a Hepburn silver medal; 8, to Magnus Finlayson, carpenter, for his "Adaptation of Roller Gearing to Wringing Machines" (the Society's Honorary silver medal).

Steps are at length being taken at Cambridge University to provide Prof. Michael Foster with additional accommodation for the teaching of physiology. Dr. Foster found himself confronted this term with a class of nearly 100, who were to receive practical instruction in a room capable of containing about 80. He accordingly laid before the University the alternative of diminishing his class by about half, or providing fresh room. Naturally the latter alternative was adopted, and the Museum Syndicate has recommended the erection of a large lecture room on the east side of the Museum of Comparative Anatomy, at a cost of about £450.

Among the papers to be read during the session of the Society of Arts before Christmas, we note that Major-General Webber is to describe the use and manufacture of glow-lamps on Dec. 8, and on Dec. 15, Mr. J. B. Marsh will have something to say about "Cameo-cutting as an Occupation." Five courses of Cantor Lectures will be given during the session—viz., "Principles and Practice of Ornamental Design," by L. F. Day; "Diseases of Plants, with special reference to Agriculture and Forestry," by Dr. J. L. W. Thudichum; "Building Materials," by W. Y. Dent, F.C.S., F.I.C.; "Machines for Testing Materials, especially Iron and Steel," by Prof. W. C. Unwin; "The Structure of Textile Fibres," by Dr. F. H. Bowman, F.L.S. Two juvenile lectures on "Soap Bubbles" will be delivered by Prof. A. W. Reinold, F.R.S., on Jan. 5th and 12th next.

The City and Guilds Institute have arranged for a course of technical instruction for teachers of public elementary schools at the Central Institute, Exhibition-road, W. The course comprises lectures on the construction and manipulation of wood-working tools and practical instruction in the workshop. The applications for admission to this course far exceed in number what was anticipated, and the committee have accordingly arranged that the class shall meet three times a week instead of once.

"Degrees of heat" is a common error in the newspaper press; but "parallels of longitude" are the invention of a writer who endeavours to explain to his readers how a vessel sailing eastwardly gains on the sun.

The London Ornithological Society has signalised its first year of existence by holding a great cage-bird show in St. Stephen's-hall, at the Westminster Aquarium. It seems that for the high-sounding "ornithological" we should really read "bird fanciers." Let us hope for better things from the society in future.

An International Exhibition of Railway Appliances and Industries will be held in Paris from May to October of next year, when the jubilee of the fiftieth anniversary of the introduction of railways in France will be celebrated. The exhibition will comprise the various industrial and professional branches connected with railways, such as engineering and mechanics, locomotives, machinery, passenger carriages and freight trucks, hoisting and wrecking apparatus, apparatus for heating and lighting, apparatus for inter-communication, couplings, and other railway appliances, building, furnishing, and conveyance material, metallurgical and electrical apparatus, &c. At the same time an International Railway Congress will be held by delegates from railway companies, chambers of commerce, scientific and professional societies, for the discussion of important questions of management, working, maintenance, rolling-stock, security, traffic, &c.

An idea of the cost of electric light when supplied in the same way as companies distribute gas may be obtained from the schedule rates of the Edison Company at Middletown, Maryland. For a 10 candle-power lamp to burn all night in a factory they charge 5s. 7½d. per month, and for two 10-candle lamps in a private house one dollar (4s. 2d.) per month; but in the latter case the current is presumably switched off at 10 p.m. Five 10-candle lamps are supplied for 8s. 4d. a month, which would not be expensive, considering the advantages, if the current could be used during the whole of the dark hours.

Lecturing recently before the Edinburgh Health Society, Dr. Stevenson Macadam said that cocoa-nut oil soap contained about three-fourths of its entire weight of water, so that when his hearers purchased this soap they were paying for a good deal of water. Toilet soap was represented very well in what was known as "old brown Windsor soap," provided it was really old. In many cases transparent soap was not good, lots of sugar being added to produce the transparency. Good yellow soap was usually better than toilet soap. There was one which he would exempt from the rest of soaps prepared roughly, or which did not possess the quality attributed to them, and that was an over-fatted soap which contained an excess of fatty matter, so that it could be used with great advantage on tender skins. The price of this soap, however, he thought, was much too high. He deprecated very much the use of soap powders, and producing a 6d. packet of this compound, on which a label was affixed stating that while possessing every beneficial quality, it had not the pernicious effects of washing soda—he observed that he had examined the packet and found that it was nothing but washing soda—2lb. of which could be bought for 1½d. He excepted borax powder from this catalogue, remarking that a little of it might be found beneficial for washing purposes. In conclusion, he showed by experiment that bleaching powders, while of assistance to cleansing, destroyed coloured fabrics, and also destroyed the fibre.

A Greifswald correspondent reports to the *Kölnische Zeitung* a beautiful lunar phenomenon seen there some evenings since. The crescent clearly defined was in the south-western heavens, when suddenly at its right side an enlarged reflection of the crescent appeared, just as sharply defined, and shining as clearly as the original crescent which it gradually seemed to embrace. After some minutes there appeared on the left side a further reflection of this original image, but less bright and distinct. Both images remained visible for a considerable time, and then faded gradually away with the deepening darkness, leaving the crescent moon shining brightly as before.

The Belgian Société des Ingénieurs et des Industries will open on Dec. 3rd at the Brussels Bourse an exhibition of the practical applications of indiarubber, guttapercha, and similar substances. Lectures will be given during the exhibition.

The San Francisco Microscopical Social held its annual reception on October 16 last, and a very enjoyable evening was spent by the members and their friends, no fewer than forty-five microscopes being tabled,—the largest number ever exhibited at one time on the Pacific Coast. At the regular meeting on Oct. 27, Dr. Harkness reported that the "reception" was unsurpassed in three respects—viz., the quality of the instruments used, the skill shown in regard to methods of illumination, and the very attractive selection of objects shown. The President exhibited the new "Zeiss" microscope ordered some months ago. The workmanship of the stand was critically examined by the members, and was greatly admired. The instrument was specially constructed for biological research, and is equipped with a complete outfit of accessories. The battery of objectives contains two specimens of the recently perfected "apochromatic" lenses, constructed of the new optical glass made under the direction of Prof. Abbe and Dr. Schott. These two lenses are of 1-12in. and 1-18in. focal distance respectively, and their performance over some slides of pathogenic bacilli left nothing to be desired. Their definition is very crisp, and both the spherical and chromatic aberrations have evidently been corrected to a degree closely approaching absolute perfection. No trial of their resolving powers has yet been made here, but it will soon be done. Both lenses have ample working distance, that of the 1-18, being 2mm., or nearly a twelfth of an inch. They are also provided with what are termed "compensating oculars." These have been specially constructed with a view to correcting the colour-aberration caused by the

front lens of each objective, this front glass being a single lens and therefore unachromatic.

Mr. C. E. Stretton, the Consulting Engineer A.S.R.S., has lately taken a northern lecturing tour in the interests of the society, and given lectures on locomotive engineering and railway safety at Edinburgh, Glasgow, Carlisle, Liverpool, Leeds, Leicester, and Birmingham.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

**** In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

SIRIUS.

[26520.]—THERE must be some mistake, probably in the printing, in the mass of the Sirius system, as obtained by Mr. Gore, given on page 258 of the ENGLISH MECHANIC. Auwers found with a Gyldén's parallax of 0·193", and his own orbit period 49·4 years, that the mass of Sirius was equal to 13¾ times the sun's mass, that of the companion being equivalent to 6¾ suns, the mean distance being 13 times the earth's orbit. Gyldén's value was obtained from a discussion of Maclear's Cape declinations, and is, therefore, an *absolute* parallax. Gill found from heliometer measures at the Cape that the parallax of Sirius relative to a star of the 7th magnitude was 0·370"—Elkin finding 0·47" and 0·39" with the same instrument—a small heliometer of 4in. aperture. Of course, to get the absolute parallax from these figures the actual parallax of the small star observed, whatever such parallax may be, must be added. The distances of the comparison stars were, however, so large—in Gill's case 1° 1', in Elkin's case 1° 24'—that errors of considerable magnitude may very conceivably have arisen. Henderson found from his own meridian observations a parallax of 0·23"; Abbe, from Maclear's later declinations, 0·27"—both being, of course, absolute values. The report in the ENGLISH MECHANIC does not mention the parallax employed by Mr. Gore. Elkin's of α Centauri is relative; he found a much smaller one on discussing Henderson's declinations.

Nov. 21. **H. Sadler.**

FINLAY'S COMET.

[26521.]—FINLAY'S comet was observed here by my assistant at 6.30 p.m., Nov. 16. Position R.A. 20h. 3m.; Decl. 23° 9' S. The comet is a bright nebulous body, with a very condensed centre and no tail. Instrument used, 6in. o.g., power 25.

C. E. Peek, M.A.

Rousdon Observatory, Lyme Regis, Nov. 21.

IS JUPITER SELF-LUMINOUS?

[26522.]—PERHAPS some of the readers of the "E. M." may be willing to explain the value of the comparisons made by Mr. Biggs as set out in the extract from his paper ("E. M.," Nov. 19, page 255). At first blush they do not seem to prove more than what has never been questioned—that Jupiter is brighter than ruddy Mars. One has always been led to think that the surface of Mars was not possessed of good reflective powers. Redness in light one associates with impaired brilliancy. The difference between the apparent sizes of Jupiter and Mars have also to be reckoned with, and more complicated still must be a comparison of the white spots, or polar snow, on Mars, with the surface of Jupiter, if the comparison is to be anyway accurate and, consequently, useful as evidence. These and other points leave one as far as ever from the impression of there being as yet any known reason, let alone proof, that Jupiter shines by any other than borrowed light. Questions of interest might be asked as to the relative reflective powers of the four satellites, and the relative density of their atmospheric surroundings. The bright planets, Venus and Jupiter, I believe, are considered to have dense vaporous envelopes, while from observations and drawings it would seem that the eyes of our astronomers are able to penetrate the atmospheric surroundings of Mars.

Since jotting down the above difficulties, I have found a paragraph in Lardner's "Handbook of Astronomy" (fourth edition, by Mr. Dunkin, F.R.A.S., page 234) bearing directly on the subject. It would be interesting, I think (if space will admit) to insert the paragraph:—

"The apparent splendour of a planet depends conjointly on the apparent area of its disc, and the intensity of the illumination of its surface. The area of the disc is proportional to the square of its apparent diameter, and the illumination of the surface depends conjointly on the intensity of the sun's light at the planet, and the reflecting power of the surface. On comparing Mars with Jupiter, we find the apparent splendour of the latter planet much greater than it ought to be, as compared with the former, if the reflecting power of these surfaces were the same, and are, consequently, compelled to conclude that the surface of Mars is endowed with some physical quality, in virtue of which it absorbs much more of the solar light incident upon it than that of Jupiter does. When the apparent diameter of the latter is twice that of the former, its apparent area is fourfold that of the former. But the intensity of the solar light at Jupiter is at the same time about thirteen times less than at Mars; and if the reflective power of the surfaces were equal, the apparent splendour of Mars would be more than three times that of Jupiter. The reflective power must, therefore, be less in a sufficient proportion to explain the inferior splendour of Mars, unless, indeed, the very improbable supposition be admitted that there may be a source of light in Jupiter independent of solar illumination."

Hendon, Nov. 20. **P. E. Duke.**

METEOR.

[26523.]—WHILE observing on Wednesday, the 17th, at 7.15 p.m., I was startled by the sudden apparition of a brilliant meteor or fireball. It appeared to commence its course in the neighbourhood of Andromeda, and after crossing the sky at a distance of about 20° from the zenith in a north-westerly direction, finally disappeared in Cygnus. Its brilliance was many times greater than Venus when at her brightest, and the nucleus was followed by a luminous trail. Of the precise position and brilliance of the celestial visitor I could not be absolutely certain, as the part of the sky in which it appeared was, to my great annoyance, just then veiled by a passing cloud of mist; but I believe the above rough estimates are, as far as they go, accurate.

Coming, as it did, from the direction of the constellation Andromeda, had its appearance been a few days later, I should have concluded it to be a stray remnant of the unfortunate comet Biela, which favoured us last year with so brilliant a display of its former substance in the shape of a shower of "falling stars."

Handsworth, Birmingham. **B. A.**

[26524.]—A SPLENDID fireball was seen here on November 17th, 7h. 12m. G.M.T. Owing to trees, I could only get a rough determination of its apparent path, which was:—

	α	δ
From	10°	S. 8°
To	320°	S. 12°

Its diameter was fully one-third that of the moon, and it lit up the surrounding sky in a beautiful manner. It was followed by a short train, and its colour was bluish-green. Its disappearance was not accompanied by any detonation. Duration, three seconds.

Crawshawbooth. **C. L. Tweedale.**

ABNORMAL TELESCOPIC DEFINITION.

[26525.]—I AM much obliged to Mr. Franks (letter 26444) for the reference to the *Phil. Trans.* I had referred, however, to that volume before, as it contains H's observations on telescopic definition. There is nothing whatever said there about the *triangularity* of star discs. I have read many times with attention all that Sir W. Herschel has written in the *Phil. Trans.*, and I have also been over many of his MSS. works with great care; but I never remember having seen any reference to this in any of his writings. **H. Sadler.**

EGYPTOLOGY.

[26526.]—"PONTO" (26542) must remember that the "whole earth" is of exactly the same size as when Genesis was written. If the writer only knew a part, and called it the whole, it shows he was imperfectly informed. Whatever Genesis may be responsible for, there were multitudes of seas, islands, mountains, &c., before the time of the deluge, or the advent of man, as geology amply proves. During that long period we find innumerable traces of great rivers which could not be fed with water if abundance of rain did not fall. Even in old rocks, as Geikie in his "Textbook of Geology" says, at page 485, "The familiar effects of a heavy shower upon a surface of moist sand or mud may be witnessed among rocks, even as old as parts of the Cambrian system." I am afraid "Ponto's" theory is not tenable, as it appears to ignore the reliable information derived from geology, which proves that the surface of the world has changed over and over again, and that all the time sunshine, rain, frost, and storms were as now.

As to "E. L. G.'s" remarks (26510), I must say that the expression "Abraham was gathered to his fathers," may be taken in more ways than one. The books it occurs in are, by "E. L. G.'s" showing, much later than the time of Abraham or Moses, so the phrase may be late. But then it may simply mean that he had gone to the grave. We know that in late time "the bosom of Abraham" meant (according to Josephus) "A subterraneous region where the light of this world does not shine." Is that "E. L. G.'s" opinion?

The Sadducees could not hold any such view, and unless it can be pointed out in the official law that some promise or threat regarding the next world is to be found, we cannot set aside the great omission by such arguments as "E. L. G." offers. His curious remark about Italians is entirely beside the point. If all Englishmen had spoken and written in Italian at the time of Lord Beaconsfield's grandfather, I rather think Italian would now enter largely into the English language.

The stories of Abraham and Isaac referred to appear to be the same, with trifling differences.

"E. L. G." should quote Scripture with more care. He says, "It is never said of them; but only of Abraham that God blessed him in all things." He forgets Gen. xxvi. where God says to Isaac, "Sojourn in this land (Canaan), and I will be with thee, and I will bless thee; for unto thee and unto thy seed I will give all these countries." It may be the story of Abraham told under the name of Isaac; but "E. L. G." should not forget it.

His answer about the name Jehovah is curiously weak, as is also that of "Ramases." "E. L. G." says it was most natural for God to say to Moses, "By my name Jehovah was I not known," and then for Moses to sit down and write the words of Eve, "I have gotten a man from Jehovah," and to put the same name in the mouths of the particular persons named as those who did not know it. Such conduct does not seem to me to be reasonable or likely, and if really used deliberately, how can we rely on any word or name? It did not seem easily explainable or natural to the translators of the English Bible, or the Roman Catholic translators of the Douay Bible, for they both omitted the name Jehovah, and used for it the words "the Lord," apparently wishing to hide the fact from their flocks.

I cannot agree with "Ramases" that the theory of two writers, at least, being responsible for Genesis *is upset*. If so, will he kindly give the particulars on which he relies? It is usual for writers, especially theological ones, to suppose that their opponent's arguments are upset. Copernicus and Galileo were both supposed to be put down, and so were the geologists till lately, when it was found they had won the day. I have asked "Ramases" for particulars often, and do not get them.

The value of Josephus is not as great to orthodox writers as "E. L. G." supposes, as Josephus considers the Shepherd Kings to be the ancient Jews, which, if true, proves the account in Exodus to be quite wrong.

There is no really good testimony to the so-called historical Flood. The Egyptians knew nothing of it. The Assyrians had such a story, but as they were intimately related to the Hebrews, that is not wonderful. What is odd is that the two accounts differ so much. The Assyrian story makes the Flood last for seven days only, while that in Genesis lasts for a year or more, which, if true, would have killed nearly all trees and plants, as well as all animals not contained (together with their food for a year) in an ark the size of the Great Eastern steamship.

The reason why stories of floods in a few old nations occur is that the surface of the earth has been over and over again under the sea, and that fossil sea shells occur in many places, though how they got there was not known till quite recently. They are of immense antiquity, but used to be supposed to be deposited by the Flood about 2,000 years B.C.

Again, many seas—such as the Caspian Sea—are shrinking. It covers much less ground than it used to do, so that the surface of much land near it shows the action of water at no great distance from the historic period. In old times all remarkable occurrences were ascribed to the direct personal action of God, wishing to speak directly to man through them; but now such things are supposed to be merely specimens of the action of God's general law and to have no moral meaning. We know that by the action of law the present surface of the earth, its plains and valleys, its hills and mountains, were many times below the surface of the sea—so need no miraculous flood to

explain the marks of water or the presence of shells; neither need we suppose any mass of water was added to the world 4,000 years ago. Where "E. L. G." supposes it came from or went to I cannot imagine. If marvellous miracles are easily accepted, anything may be so proved; but more evidence is needed to prove them than is forthcoming. Such wonders generally occur in remote places and in uncritical ages; never in our own experience, or in presence of a critical audience, who would cross-examine.

The same remarks apply to the assertion that the sun stood still. "Ramases" says that in reality it was the earth that went slow; but, in saying so, he overlooks the plain words and evident meaning of the writer. Joshua spoke to the sun, and also to the moon, and both obeyed him. If the earth went slow, it would not have affected the moon. The stoppage of the moon was not necessary for the business in hand, and yet required the suspension of the law of attraction, as if it stopped it would have come down plump on to the earth if that law had not been suspended. It is singularly improbable that such a miracle should occur to enable the Jews to exterminate some of the people of Canaan, whose land they wanted to take; and, moreover, it is unaccountable how, with the aid of such great miraculous power, they conquered the land so imperfectly. The Jebusites and others were too many for them; and concerning the Jebusites, it is written in Joshua xv. 63 that "the children of Judah could not drive them out."

If such a marvellous miracle really happened, it would be known and noted all over the world, and would settle the question of date at once. This would especially be so in Egypt and Babylonia—both old States, where the study of the heavenly bodies was carefully carried on. There is no such record known in either of them.

These great miracles are also discredited by the fact that the early Jews seemed to be little affected by them, lapsing over and over again into idolatry; yet the same nation became steadily monotheistic when once the story was well written down and taught to them when young, after the Captivity.

They seem not to have relied on the so-called facts when they saw them—at least, the children did not believe what their fathers are said to have said; but they firmly believed in it as soon as it was written down. As to "Dens's" remark (26514) about Samuel, he will find it hard to prove he wrote Deuteronomy, or various parts of the other books, such as Gen. xxxv., where kings are promised as a reward to Jacob. Compare that with Samuel viii., where we find kings looked on with horror, their rights and powers being opposed to those of God. The Elohim documents are probably of about Samuel's time; but the Jehovistic ones are more likely to be of Solomon's, as they were written after the expulsion of the Canaanites, as is shown from Gen. xii. 6, and xiii. 7, "The Canaanite was *then* in the land"; "The Canaanite and Perizzite dwelt *then* in the land." And also after Saul's victory over Agag, Numbers xxiv. 7, "and his king shall be higher than Agag."

It must not be supposed that because Genesis is first in order at present that it was written first. Some parts *may* have been; but certainly not the book as it stands.

I cannot see why the Pentateuch is implied because Samuel was high priest and judge. Priests and judges are by no means uncommon amongst people who know not the Pentateuch. Moses probably wrote the Ten Commandments in a short way on stone, urged the worship of one God on an idolatrous people, and left general traditions, which later writers took up and added to, considering they were thereby carrying out his intentions. Little can be known with certainty as to what Moses did or said; but I cannot imagine that the wild tribes—idol worshippers mostly—exhibited to us in Judges ever had been in the highly-civilised condition implied by the Pentateuch. That a people should be at one time noble theists, with a clear law, good literature, and the ever ready help of tremendous miracles, and yet should immediately descend to the condition of a loosely-knit collection of wild idolatrous tribes, I cannot suppose. It is more likely that these highly-coloured pictures of antiquity were painted to urge them to improve, and aim at theism and virtue rather than to represent what had actually occurred. **Memnon.**

EGYPTOLOGY, &c.

[26527.]—In fourth line of p. 264 the omission of a short pronoun has made me appear very foolish. What I asked "Memnon" in that clause was whether a patriarch "losing his wife, and her being taken into the king's harem," was "the same as having it accidentally discovered that she was not his sister." The two ways Abraham and Isaac got into scrapes by the same fault, in ch. xii. and xxvi., are so entirely unlike that no reader would ever have called them "ascription of the same story"; but for a confusing of both with the unlucky ch. xx., that I said gives us the utmost measure of error we detect in these writings honestly scrutinised. We have no ground to suspect any deed or word is ascribed wrongly to the Almighty. In ch. xii. it was simply said that He "plagued Pharaoh and his house with great plagues," which implies it was somehow revealed who sent the misfortunes, and why. Now, ch. xx. seems a fuller account of the same event, though misdated and ascribed to another king and place. The dream there related was doubtless a real one, divinely sent, though not to Abimelech, but to Pharaoh 25 years earlier. Both Pharaohs of Genesis were plainly of the Hyksos dynasty, Asiatic, and probably Shemite, no idolators, and nearly as divinely honoured as the Hebrew patriarchs. Joseph's Pharaoh was the most so of any monarch hitherto, because he established socialism; and xlvii. 26 assures us that socialism succeeded for at least six or seven centuries, if we allow the book to date from when it professes to have been written (or professes to have been "forged," if "Dens" will have this word so applied); but if it is all preternatural and mystic, and anything but what it seems or claims to be, it cannot assure us of this, or anything else of use.

Having quoted "Dens," let me apply his own rule about credible miracles; that "they just supply the exact amount of help for the work to be done and then cease." The chief work in the rout of these Amorites, verse 11 says, was done by hail in the night. "They were more which died of hailstones than they whom the children of Israel slew with the sword." If the hail needed sunlight for its work, then the sun plainly did not stay long enough. But if "Dens" will have the hailstorm to be mythic, and that the work was mainly done by the Israelites, he merely contradicts the non-miraculous part of the story to bolster up the other, or rather abandons Scripture to support the inspiration of Jasher, a book never accounted Scripture, and now lost. That true miracles are "in strict harmony with the narrative" is just the reason why this, being in no harmony, but flatly inconsistent therewith, must be rejected, though the son of Sirach, and apparently even the LXX. misinterpreted it, and our Revisers (with a big R, as they always give themselves) dare not differ. No New Testament allusion to it occurs, even in Hebrews xi., where it seems as worthy of mention as stopping the mouths of lions, waxing valiant in fight, &c. And when Christ told men to be as their Father, who maketh his sun to shine on the just and unjust, why did none object, and ask, Nay, Rabbi; if the Lord had always so ruled His sun, even in Father Joshua's time, should we have had the Amorites' land?

As for topography, it is so extremely doubtful whether any other of the places than Gibeon can be identified, that whether Joshua marched 20 miles or 60 is unknowable. But, in this matter, neither "Ramases" nor "Dens" has searched Scripture enough, though their main fault, and that of us all in these discussions, is insisting too much that "the Bible says" this or that, and attending far too little to what the facts of nature say. This applies equally to the Bible's friends and enemies. The principle, barely 40 years old, if so many, that the more a thing opposes Scripture, the more likely to be valuable, is not a safe one. Poor Sir C. Lyell, who originated it, found it pay commercially; but all real progress in geology since then has been by foreigners, who were uninfluenced by it. All the British views that, in the absence of a Bible to kick, would have occurred to nobody, seem sterile or getting disproved.

Meanwhile the old and opposite misuse of Bible still clings to us non-Lyellists. Though nobody dreams now, like the Mediævals or Burnet, of the "Theory of the Earth," that science can be got out of Scripture alone, we get notions that some things the Bible is vulgarly supposed to say may help scientific theory, or even that versions thereof for us non-Hebraists may do so. Thus I got misled, though not so much as "Ponto" and the Duke of Argyll, and nearly all reasoners about the Deluge are still, when treating that event some years ago, in Vol. XVII. I then drew from the clause in Gen. vii. 11 that "all the fountains of the great deep were broken up," a notion of large seismic disturbance of the earth's crust, leading to submergence of lands, and their remaining submerged, mostly even longer than Noah was afloat. But the late Prof. Challis, a Hebraist as well as astronomer, did not take, in this text, the abyss (or the boundless) for the earth's interior, nor the ocean, but for the sky, and understood the clause merely as parallel to what follows, that cataracts fell from heaven. We have no warranty, I now think, for supposing any submergence (a non-Biblical word) of places now above sea-level; though large previously habitable lowlands became and continue sea-beds, as the English and Irish Channels, German sea, much of the Mediterranean, &c., not by sinking, but by the addition of so much water to our globe as to raise the ocean level about 100 fathoms. The time when all "hills under the whole heaven were covered," I now think was only during the actual downpour, which all fell in some hours, at the most in less than the week remembered in the Assyrian tablet. There was no time that our hills were covered with *standing* water, but only with rushing torrents. Though on all land (that was then land) new valleys were scooped out, and vast gravel-beds laid, the crust was not moved up or down, of most continents, or certainly not of Western Europe. All our strata kept their form unmoved. Whether there was submergence anywhere, depends on whether Armenia and Northern Syria were land or sea before the catastrophe. They may, for aught that travellers have yet said of them, have been a sea-bed that it caused to be, in a few months, upheaved for the first time. But if they are ancient land, that part of the crust sank and rose again, as we formerly fancied all continents had done. Noah's voyage was so contrived, unknown to him, as to give the whole vegetable world (and the few wild animals that drift-timber and other natural accidents saved) twelve clear months' start of him and his cattle. The upheaving Ararat, newest mountain, hoisted them in their prison into a pure air, above the clouds and the pestilential miasma of the rotting world, under the hottest summer it can have known; and then they descended into plains duly prepared for them.

Poor Darwin, the most famed—Evolution Darwin—contrived so well to forget the following bit of his early travels, not reprinted, I believe, since 1845, that for such youths as "Memnon" it is needed:—

"It is impossible to reflect on the changed state of this [American] Continent without the deepest astonishment. Formerly it must have swarmed with great monsters; now we find mere pigmies compared with the antecedent allied races. If Buffon had known of the gigantic sloth and armadillo-like animals, and of the lost pachyderms, he might have said, with a greater semblance of truth, that the creative force in America had lost its power, rather than that it had never had great vigour. The greater number, if not all, of the extinct quadrupeds lived at a late period, contemporaries of the existing sea shells. Since they lived no very great change in the form of the land can have taken place. What, then, has exterminated so many species and whole genera? The mind at first is irresistibly hurried into the belief of some great catastrophe; but thus to destroy animals, both large and small, in Southern Patagonia, in Brazil, on the Cordillera of Peru, in North America, up to Behring Straits, we must shake the entire framework of the globe. It appears from the character of the fossils in Europe, Asia, Australia, and in North and South America, that those conditions which favour the life of the larger quadrupeds were lately co-extensive with the world. It could hardly have been a change of temperature which, at about the same time destroyed the inhabitants of tropical, temperate, and arctic latitudes on both sides of the globe. Did man at his first inroad into South America, destroy, as has been suggested, the unwieldy megatherium and other edentates? We must, at least, look to some other cause for the destruction of the little Tucutuco, and of the many fossil mice, and other small quadrupeds in Brazil. No one will imagine that a drought, even far severer than those which cause such losses in the provinces of La Plata, could destroy every individual of every species, from Southern Patagonia to Behring Straits. What shall we say of the extinction of the horse? Did those plains fail of pasture which have since been overrun by thousands and hundreds of thousands of the descendants of the stock introduced by the Spaniards? Certainly, no fact in the long history of the world is so startling as . . . . [this] wide . . . . extermination of its [late] inhabitants."

I alter a word or two in that last clause, which ran, "the wide and repeated extermination of its inhabitants." But where had he found, or even hinted at, any other extermination for this recent one to *repeat*? No fact can be "startling" but one that we find as a fact; not things, "repeated" or not, that you infer to have perhaps happened because this did once! **E. L. G.**

[26528.]—In reply to "Memnon" (26513) respecting the testimony of the book of Joshua to the authenticity of the Pentateuch, "Memnon" says: "As for Joshua quoting Deuteronomy, that is rather against the age of the former, as the latter is supposed to be the book found in the Temple in the time of Joshua (Josiah?) by Hilkiah—who, it is likely, wrote it and placed it there." I again say, suppose "Memnon" offered a statement like this built upon "suppose," and "likely," as evidence in a court of justice, what would be thought of it?

When "Memnon" gave his list of great Egyptologists, he (very rightly) based them on Manetho, whom, as a matter of fact, they followed as regards great lengths of time. But what is the value of these authorities? Take the greatest of them, Baron Bunsen. With him, reigns and dynasties are made successive or contemporaneous on no internal or external evidence; kings are transplanted from one dynasty to another, and the result is an

arrangement which not only was never registered in an Egyptian temple, but never entered the thoughts of any Egyptian writer—a "German Manetho" in short, with whom it has been justly remarked that "names go for little and numbers for nothing." And nothing is more common with these great Egyptologists than to arrange the hieroglyphics so as to produce a different name or to slide a thousand years up or down the scale of time, for no other reason than to fit it better into their hypothesis. While quoting authorities in this connection, it should be mentioned that Champollion considered that he had demonstrated that no existing monument is older than 2,200 B.C.

The remaining portion of "Memnon's" letter is devoted to the argument derived from the length of time demanded, according to certain authorities, for the rise of Egypt and the erection of its great monuments. Here a great fallacy has been erected by following the imagination and neglecting the facts of nature and of history. Darwin and Spencer have shown that while for very long periods of time small changes have frequently been going forward among organisms, yet the vast variations have come to pass in relatively short periods of time. History exhibits the same phenomena. Nations rise rapidly, and their most important works are compressed into a relatively short space of time. Rome was changed from mud to marble in a single emperor's reign. Look at the signs of these present times. Men have been dabbling in science since the Great Pyramid was laid four square, yet more progress has been made in the last thirty years than in all the centuries which have gone before.

Thus, then, the facts of nature and of history are on the side of the Pentateuch, and they set aside entirely these *conjectures* of men.

As to Moses' alleged ignorance of Menes, I would ask what was there to know? since of that dynasty there are no monuments. As to the record of the death of the great Lawgiver, it could very well have been written by a scribe employed by him to write the book of Deuteronomy. Except to prejudice there is no difficulty here whatever.

To say that kings promised to Jacob is a proof of the lateness of the book of Genesis, is to beg the question in dispute.

Finally, be it remembered that I have given right evidence, traditional and historic, for the authenticity of the Pentateuch. "Memnon" has none whatever to give; he relies only upon objections, and these objections are either wholly without proof, or are easily shown to consist perfectly with the statements against which they are alleged.

Nov. 19. **Ramases.**

HOW A BOY MAY RAISE A SOLID TON WEIGHT WITHOUT MACHINERY.

[26529.]—IF "Nun. Dor." had read my letter, p. 195, carefully, he surely would have perceived that the boy must be on deck, for he has to pull each yarn separately "upwards," and make fast to a nail driven either into the combings of the hold or the deck. Each yarn on being stretched with a strain of 10lb. and fastened to a separate nail, lightens the weight or pressure upon the bottom of the hold, until it becomes suspended.

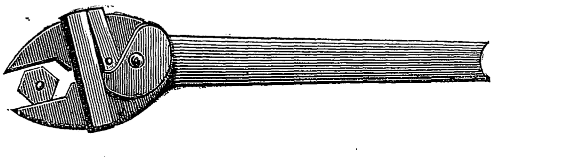
My demonstration consisted in pulling up a 7lb. weight, by using several lengths of cotton attached to it, either of which would have broken if pulled with a greater force than a quarter of a pound. By increasing the number of lengths of cotton, seven, or even seventy tons, may be raised in the same manner, and by a boy.

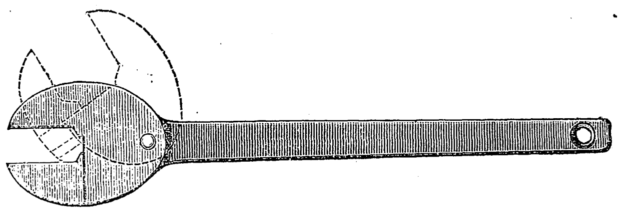
I will leave "Nun. Dor." to work out the little banter problems, of making 13in. to a foot, and carrying himself about in his own tub.

B. R.

INCANDESCENT LAMPS—TO MR. SHIPPEY.

[26530.]—I WAS very pleased to see Mr. Shippey's letter in the "E. M." for the 19th inst. (p. 266), and should be very glad if he will kindly enlighten me on the two or three points specified below. (1) Ought incandescent lamps to be raised until they scintillate, or appear to be surrounded with rays of light when observing them at some little distance from lamp? Any information as to the appearances indicating when a lamp is giving as much light as it will safely bear would, I think, be acceptable to many readers of "Ours," as a goodly number of amateur dabblers with the electric light have no means of measuring the current given by the dynamo employed. (2) In a 12v. l.r. lamp which I bought some little time ago, I notice that the carbon filament is very much shorter than in some 25v. lamps that I have; both lamps are called 10c.p. I, unfortunately, burned off the 12v. lamp soon after getting it, so had no opportunity of comparing the light given by it with the light given by the lamp with the longer filament. Do these l.r. lamps give as much light as the lamps with longer filaments of the some denomination? If so, please explain the reason why. **Iota.**





SPANNERS.

[25531.]—REFERRING to your correspondent's letter, "C. H. C.," on the subject of spanners, permit us to say that the spanner described is well known to us, but is, we think, far excelled by the Schwartzkopf spanner, sketches of which we inclose herewith.

This spanner is entirely self-adjusting, is made of wrought-iron throughout, in three sizes, taking in nuts from $\frac{7}{16}$in. up to $2\frac{5}{8}$in., and is, in our opinion, by far the most powerful spanner in existence.

Selig, Sonnenthal, & Co.

[26532.]—IF "C. H. C." (p. 263) will refer to p. 62, No. 653, he will find a description of the adjustable spanner he illustrates as "an excellent French one." In No. 653 this identical spanner is stated to have been forwarded by Messrs. Rawkins and Co., of Bury St. Edmunds, and it is mentioned as likely to become a favourite with bicyclists and others. **Nun. Dor.**

INVENTIONS AND PATENT LAW.

[26533.]—IN your number of 19th November, p. 255, you give an extract from an American (Mr. T. Pray, jun., of Hartford, Connecticut) which bears on Mr. T. Fletcher's invention, "A New Departure in Water Heating," described in "Ours" of No. 1108. Now, T. Pray, jun., is quite right to write and say that he had anticipated Mr. Fletcher in his idea, only the remark naturally occurs to one, "Why did T. Pray, jun., hide his light under a bushel?" But the sting of T. Pray, jun.'s, letter is that he claims to destroy T. Fletcher's right to a patent.

I have heard that such a thing as a discovery in America *may* prevent an *American* patent, though I do not believe it goes so far as to enable a man to make an experiment, never disclose it, and then prevent anyone else from getting an *American* patent. But what I am interested in is the English law and the right to an English patent, and I unhesitatingly affirm that what was done in America, secretly or openly, will not take away the right to an English patent if what was done even openly was not known by books or newspapers in England. This much in justice to Mr. Fletcher.

R. S. T.

THE DANIELL CELL FOR ELECTRIC LIGHTING—WONDERFUL LAMPS.

[26534.]—THE truth concerning these so-called Wonderful Lamps which I gave last week has caused Shippey Bros. considerable alarm, judging from their very hasty reply in this week's issue of "Ours." In their advertisement, which has now appeared for some time, they tacitly endorse Mr. Bottone's description, that it is a lamp giving a light of 5c.p., requiring 4/7 ampère, with an E.M.F. at the terminals of the lamp of 4 volts. I wrote to Mr. Bottone as soon as his communication appeared to know if this was really the case. He replied substantially confirming it. I could hardly credit it, though reluctant to doubt his bona fides. Shortly afterwards Shippey Bros'. advertisement appeared as the makers of this lamp, "as described by Mr. Bottone." Whereas, in fact, it is nothing of the kind. I procured two of them to test them for myself. In order to be quite certain, I sent one to an electrician not unknown in these columns, and his measurement of the r. *cold* agreed with mine. If the lamps had the wonderful properties claimed, electric lighting would advance by "leaps and bounds." When a firm or an individual advertises a certain article which is claimed to be so much superior to anything else, and it turns out to be decidedly not so, the transaction is, to say the least, not creditable.

The E.M.F. of 15 Daniell cells in series is 16 volts. If this battery would light eight 18 volts standard 10c.p., then "may I be there to see." They are probably another variety of the Wonderful. To show that I am not "prejudiced," I should advise "Nemo" to adopt them in preference to those I specified. It would be advisable to have them on trial.

If Shippey Bros. had read my letter with a little more attention, they would have discovered that I advised the overrunning of lamps only when used with a battery with zinc as the postive element. Zinc here occupies the same relative position as the coal in the furnace of a steam boiler, and being about 100 times as costly is more to be studied than a long life of the lamp. As a corollary of this, the cheaper the lamps become the more overrun it will be economical to use them. Messrs. Shippey's condemnation of this overrunning lamps is somewhat curious, considering that Mr. A. Shippey advocated such a course in the *Electrical Review* some months back, and actually confirmed it in a reply to an inquiry I addressed to him, asking if the extraordinary efficiency of the Wonderful lamp was to be attributed to this method of using them. He replied that I was quite right in assuming that to be his theory, which was shared by Mr. Preece and other eminent electricians. I also asked what was the life of the lamps subjected to this strain; he replied that with care they would last 500 or 600 hours.

As to the formula, "We simply challenge and defy," I will simply (not challenge or defy) say that when the resistance of an incandescent lamp is mentioned it is usually understood to be the R. *hot*. (In Shippey's 6 volt lamps the resistance hot is about 2·5 ohms.) A 5c.p. lamp of 4·5 ohms hot requiring an E.M.F. of 6 volts, would have an efficiency of 1·59 watts per candle. Try again, Shippey Bros.

The lamps I commented on were not coupled up to the 15 Daniell cells, and only Shippey Bros'. imagination has conjured up such a dreadful proceeding. If they had been, probably their duration would have been 20 minutes or less, and a light of perhaps 50c.p. The explosion I referred to was of the wonderfulness, not of the material lamps; these, I am happy to say, are as yet intact. I shall run them up to my standard, and let "Ours" know the result.

I will reply to "Electra" if possible next week.

F. L. Striffler.

TRICYCLING MATTERS.

[26535.]—IN reference to John Bell's communication last week, I would state my experience on two points—viz., the steering handles and the speed.

I have had, in all, six tricycles during the past seven years. My first mount was a "Challenge," by Singer, with what practically amounted to "bicycle steering," seeing that both hands were employed on the handles that communicated directly with two combined steering wheels. My next four mounts, four different kinds, had spade handles; but, to my joy, I have thankfully returned to a bicycle-steering machine, which is so much more pleasant to use, in my estimation (and my experience has been varied).

Now, as to speed-gearing, your correspondent finds his present gear unsuitable to both conditions of hilly and level ground. Let him adopt the Crypto gear, and he will find it all that he can possibly desire. My present machine is fitted with it, and I cannot speak too highly in its favour. I never spent £6 more satisfactorily to myself than in its purchase. I need hardly say that I have no connection with the Crypto firm, being merely a **Country Parson.**

[26536.]—I AM obliged to C. Leni for his invitation to call and take a ride with him; but were I to do so I fear he would wish me at Jericho. Being old and heavy, I "go in for" ease of transport, and do not care a button about speed, so far as I myself am concerned. In discussing tricycling, as well as other matters, it is sound policy to distinguish carefully between ascertained facts and mere personal opinions. Now, the question of a cross-handle bar or spade handle for steering I regard as belonging chiefly to the latter category. I have a great objection to the cross-handle; it seems to bar the rider into the machine in the first place, and though it may "give great support to

the body when brought forward on the machine," it induces, if it does not even compel, the rider to adopt that attitude which is to me an abomination. That C. Leni has had several machines, having both handles to steer, through his hands that he found difficult to sell, I can surely admit as evidence that double-steering is objectionable—even if the difficulty of selling these machines actually arose from the mere fact of the double-steering, of which he gives no evidence, that would only prove that the mode adopted for accomplishing that object was inefficient or interfered somehow with other functions.

The superiority of large wheels geared even, or small wheels geared up as driving-wheels, surely admits of becoming an ascertained fact by judicious experiment, so that if any superiority on either side actually exists, it cannot be a mere matter of opinion. *Primâ facie* it would seem that from generally-accepted axioms in mechanics, as well as from the behaviour of carriages propelled by horse-power, the larger driving-wheels ought to be preferable; but when I find men who are certainly skilful cyclists, and who know absolutely nothing of mechanics, and, consequently, have no preconceived notions to prejudice their judgment, deliberately assert that they find a practical advantage in the newer machines with the geared-up wheels, both as regards speed and ease of propulsion, I have no reason whatever to doubt the fact. What I want to ascertain is whether the advantage is really gained in consequence of, or in spite of, the smaller geared-up wheels, and if in consequence, I want an explanation of the fact, for I confess myself unable "to figure it out." The question in my mind is whether the declared advantage of having the smaller wheels may not in fact be due to some other cause operating in the newer type of machines. Certainly there may be less resistance to an adverse wind to some extent, and again in ascending an incline, the position of the rider is less displaced than when large wheels are employed; but a strong adverse wind is rather an exceptional than a general condition, and as far as my experience goes, a rough surface has more effect injuriously than displacement of the rider's position, and with a rough surface large wheels I have found preferable to small ones.

Before concluding, I will ask leave to make a comment on Mr. John Bell's remarks in your last issue, who puts it rather mildly when he says, "To me there is no pleasure in dismounting and pushing." Well, perhaps not; but that is scarcely in question. I, like himself, usually frequent hilly neighbourhoods, and though I have power-gearing attached to my machine, which gears down a 50in. wheel to 34 or 25in. at my option, so that I can really ride up almost any incline, I find it is *practically less fatiguing* to push up all hills that I cannot ride up without the aid of the power-gearing. It is true that with a Tandem the pushing is, perhaps, not so handy as with my single machine, which is peculiarly convenient for use in that way, as it runs very easily, does not run back, so that one can stop pushing anywhere on the hill without any inconvenience, and actually assists me in mounting a hill, having something to lean upon and taking my weight off my legs. Without going so far as to say that I "take pleasure" in pushing my machine, I certainly do say that when I want to get up a hill I prefer doing so by pushing the machine to having to get up by riding it, or by simply walking up.

Gamma Sigma.

ORGAN WINDCHESTS.

[26537.]—WOULD Mr. Audsley kindly say whether Roosevelt's patent windchest is suitable for a chamber organ, and if any firm has the right of making it in England? I should also like to ask what size the feeders should be for an organ of ten stops, supposing the bellows to be supplied by three feeders worked with a three-throw crankshaft, and what the diameter of the flywheel ought to be? In a case where this method of blowing was adopted, the work proved to be very laborious—more so than if the usual lever handle had been provided. As this may have arisen from some fault in the construction of the apparatus, perhaps Mr. Audsley can give the name of a firm of organ builders who could satisfactorily make this kind of blowing apparatus. I have found the "Notes on the Chamber Organ" most interesting, and I believe many readers besides myself are looking forward most anxiously to the time when the art of organ building will be treated in a practical manner. All the works relating to the organ which I have been able to obtain invariably omit to give the dimensions of the various parts of the instruments they describe, and this is exactly the information which would be most useful to amateurs.

W. H. H.

[26538.]—I SHOULD certainly advise "C. H. D." to have nothing to do with the windchests he refers to in his letter. What benefit may be derived from them, and the benefit would be extremely small, is outweighed by the extra trouble and increased complexity. In amateur-made work nothing is better than the ordinary soundboard with slides. Have nothing to do with pneumatics of any kind. They are very liable to leak, far more than the ordinary soundboard, and waste a quantity of wind.

Uranium.

DIATOMS—VEGETABLES OR NOT?

[26539.]—IT may interest microscopists to know how I saw one of those boat-shaped diatoms behave under the microscope. It was going ahead at a good pace when it came close to a "rock," and stopped for a bit. It then went ahead again, and got under the "rock," which heaved about it and nearly upset. The diatom next finding, I suppose, it could not get out the other side, backed out and went clean round. Diatoms are, I believe, now generally held to be vegetable organisms. I would like to know the proof thereof. Did that look like a vegetable act?

Londiniensis.

SPRING SAFETY VALVES.

[26540.]—THE following table from actual workshop practice may interest some of your readers; it shows the behaviour of different springs under various loads:—

Turns in Length	11	14	14	14	14	13	13	13	14	14	14	15
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Diam. of Valve............	2	$2\frac{3}{4}$	3	3	3	3	4	4	4	4	4	$6\frac{3}{8}$
Size of Spring per sq. in.	$\frac{5}{16}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{9}{16}$	$\frac{9}{16}$	1
Diam. of Spring	$2\frac{1}{16}$	$2\frac{5}{8}$	3	3	$3\frac{3}{8}$	$3\frac{3}{8}$	$3\frac{3}{4}$	$4\frac{1}{8}$	$4\frac{1}{8}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$6\frac{3}{8}$
Length of Spring	$5\frac{3}{8}$	$10\frac{1}{2}$	12	12	$13\frac{1}{2}$	$13\frac{1}{2}$	$14\frac{15}{16}$	$16\frac{1}{2}$	$16\frac{1}{2}$	15	15	$25\frac{1}{2}$
Compression	$\frac{1}{2}$	$\frac{7}{8}$	$\frac{7}{8}\frac{1}{16}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{3}{4}\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{3}{16}$	$\frac{7}{8}\frac{1}{16}$	$1\frac{7}{8}$
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Dead Weight	188	480	560	455	630	630	816	1067	1130	942	753	2700
Pressure per sq. inch ...	60	80	80	65	90	90	65	85	90	75	60	90

Liverpool. **P. F. Otto.**

NEW OPTICAL GLASS.

[26541.]—IT would appear from your report, on p. 211, of the meeting of Royal Microscopical Society, that at last some real advancement has been made in the art of making glass for optical purposes. Mr. Crisp states that all particulars as to the optical qualities of the glass were published, together with "indications as to the best kinds to be used in the construction of objectives for telescopes, &c." As the ENGLISH MECHANIC circulates largely among opticians, both amateur and professional, in all quarters of the globe, may I earnestly ask some of our friends, who have access to the catalogue to which Mr. Crisp refers, to copy out and send to this journal the particulars of the refractive and dispersive powers of these new glasses?

Some of us will be glad to be able to compare their theoretical properties with those of the glasses in ordinary use.

Orderic Vital.

DOUBLE-ENGINE RUNNING ON THE MIDLAND RAILWAY.

[26542.]—NO doubt the statements contained in the letter by Mr. Charles Rous-Marten, page 263, No. 26507, are based upon evidence or facts which he obtained when in this country; he must, however, either have been fortunate in the time when he made his observations, or circumstances must have very greatly changed.

The enormous amount of *unnecessary* double-engine running on the Midland Railway is a most serious matter for consideration, as it is the great cause why the locomotive working expenses are not further reduced. If the long trains were well filled with passengers, there would be no cause to complain; but this is not the case. Numbers of empty compartments and carriages may daily be seen, and it is this hauling of useless dead weight at express speed which necessitates the double engine running on the Midland Railway. Constant travellers on that line will also confirm the statement that the trains are not as punctual now as they were previously, and the reason is not far to seek; the running speed has been very greatly increased, until, even under favourable circumstances, time can only just be maintained, and unfortunately the number of extra, or conditional stops, has been increased to a serious extent.

If any of your readers will refer to a Midland time table, they will find on almost every page that trains, and some of the best and most important expresses, are to stop at certain stations to pick up or set down, when required. An extra stop means a delay to the train of from three to five minutes, and it follows that, if a train has to make several such stops, as between Bradford and Leeds, Liverpool and Marple, at Chesterfield, Luton, and other stations, it is absolutely impossible for punctuality to be maintained.

Mr. Marten says he has never seen a train from St. Pancras with a pilot engine if under 15 vehicles. I may, however, mention that I have ridden in a train when an engine of the 1667 class has had to take a pilot with only equal to twelve; this, of course, was unusual, and was only done by one of the 1667 class of "failures." It is a fact that these engines, through being badly designed—that is, having boilers both theoretically and practically too small, have lost more time, and necessitated more pilot working in the two years of their existence, than have all the 800 class since they were built in 1870.

If the Midland Company would reduce the number of conditional stops, and take off the empty carriages on the trains, punctuality would be regained, and a much-required improvement, which I have long advocated, could be introduced—namely the addition of third-class dining and sleeping carriages, the former of which would save considerable time at Normanton and other refreshment stations.

Clement E. Stretton, Consulting Engineer.
306, City-road, London, E.C., Nov. 20th.

FOUR-CYLINDER ENGINES.

[26543.]—REFERRING to the article on "Triple-Expansion Marine Engines" in the "E. M." of Nov. 12, it may interest some to know that a four-cylinder engine has already been tried in a screw steamer (of 900 tons burden), built about 1871 by an East Coast firm, and that it gave so little satisfaction that they were, a few years ago, removed and replaced by the ordinary compound engine. However, some improvement in the construction of such an engine may lead to better results in future.

J. T.

USEFUL AND SCIENTIFIC NOTES.

Solanine.—An account of the properties of solanine has recently appeared in the *Bulletin Général de Thérapeutique* from the pen of Dr. A. G. de Montguyon. Solanine poisons the terminal motor plates of organic life, narcotises the medulla, spinal cord, and nerve trunks, and so produces paralysis of the terminal extremities of the sensory and motor nerves. These physiological effects allow solanine to be classed as an analgesic agent. Solanine may be prescribed without risk in strong doses. It has none of the inconveniences of morphine or atropine, has no cumulative action, and is specially a substitute for morphine. It does not cause congestion of the brain, even in elderly people, and probably not in children. In all conditions of excitement, spasm, or pain, solanine may be employed with a prospect of success. The ordinary dose is thirty centigrammes three or four times a day. It may be given fasting or after meals, and the dose may be greatly increased. For hypodermic injections a solution of the chlorhydrate in distilled water may be used in the proportion of from one to five centigrammes per dose, administered from two to four times a day.

Chemical Apparatus and Chemicals.—Messrs. Mawson and Swan, of Newcastle-on-Tyne, have sent us one of their new catalogues of chemical apparatus, chemicals, &c. It is nicely got up, and is freely illustrated, while the explanations of the various apparatus are all that could be desired in a work of the kind.

MR. L. TIETJENS, of Stassfurt, Germany, has recently patented an ingenious method of damming back the flow of water in shafts by the application of the well-known fact that certain salts increase their volume very materially by the absorbing of water of crystallisation in hardening. To accomplish this, he takes either calcined soda, anhydrous alum, kieserite, or oxychloride of magnesium, mixes them into a paste, and then immediately injects them through a suitably arranged pipe into the fissures through which the water flows. It is said that as this paste hardens, it swells enough to fill all the interstices of the rock and to renderit water-tight.

THE Board of Directors of the Berlin Machine Factory, formerly Schwarzkopf, has announced its determination to give up the building of any more locomotives, but instead, to give more attention to the development of torpedo-boat engines and to patented specialities. This may be considered the next most important factory for locomotives after that of Borsig, recently closed, and there can be no doubt that other works will have to adopt the same policy, if in Germany the manufacture of locomotives is ever again to become a remunerative business.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60334.]—**Falling Bodies.**—As "Vulcan" proposes a problem to me, I suppose I must give some answer. I labour, however, under this difficulty, that the data are partly unintelligible, and, besides that, they are put in such away that it is uncertain how much is given by them. In addition to this, the problem consists of two questions; the answer to the former being self-evident, without any calculation, and, moreover, quite independent of the data! If a body be dropped from *a* (for this is what his words really mean), it will pass through the centre of force, *c*, and go to an equal distance on the other side of it and then return, whatever be the function of the distance according to which the force may vary. As to the second question of his problem, he asks me to measure a period of time in units of linear distance. Perhaps I may attempt this if he shows me first how to measure momentum by quarts. This is the gentleman who tells us that he differs from Newton's "Principia" in the solution of the present problem. I now believe that he is only making fun of the readers of the ENGLISH MECHANIC.—DUBLINIENSIS.

[60552.]—**Air-Gun Trigger.**—The trigger plate is fixed to the gun-barrel by a corresponding plate, which is soldered on side of barrel (a brass tube) for this purpose. The air passes into barrel through a hole at side of pin. The valve is conical, with a stem for spring working on, and an outer case, having holes for air passing in, is screwed on seat, keeping valve and spring in position. A piece of W. I. tube made to screw on air-chamber, and having a solid piston, will answer for pump.—P. L. R.

[60596.]—**Pump.**—The querist had better use an air-pump for forcing his vitriol to the height required. This is the plan adopted in many chemical works. Have a cast-iron vessel made of the size required to hold his vitriol, with an egg-shaped bottom. Then place an ordinary wrought-iron tube so that it shall go to the bottom of the vessel; then it is continued through the lid at the top, and thence to the height required. Now connect a tube from his air-pump to the lid of his vessel; fill the vessel, through an opening in the top, about two-thirds full of vitriol, fasten the cover of the opening tight; apply air pressure, and the vitriol will be forced out up the tube. A pressure of about 25lb. per sq. inch will be required. The querist need have no fear of the action of the vitriol on his iron vessels, as the writer has had the same iron vessel in use for seven or eight years, and his air-pump will not come into contact with the vitriol. If further information wanted, ask.—CHEMISTIANA.

[60623.]—**Dynamo.**—TO "S. AND E.," COVENTRY.—The amount of current an armature wire will bear depends, to a certain extent, on the arrangement of armature. Our own practice is not to exceed 3,500 ampères per square inch. You will need considerable practical experience as well as theoretical knowledge, before you will be able to design a dynamo to give a stated current and E.M.F. at a given speed. We should advise you to read the paper read to the Society of Telegraph Engineers and Electricians, by Mr. Gisbert Kapp, on "The Pre-determination of the Characteristics of Dynamos."—S. AND E., Coventry.

[60659.]—**Getting up Fire Brasses.**—The atmosphere of the place must be very bad if the work discolours before it can be burnished and lacquered; but here is a difficulty—"burnishing" is the highest form of polish, and you ask what lubricant to use to "prevent scratching." Nothing. If scratches appear, there must be something wrong with the burnisher or the workman. The brushes are wire, as a rule, the finishing being done with bobs made up of discs of cloth held firmly together between two plates. Rottenstone with oil or spirits will do the rest.—E. G. M.

[60664.]—**Pendulum.**—This question is well answered on p. 80, and in previous volumes.—NUN. DOR.

[60665.]—**Scent.**—Certainly a scent can be made from verbena or lemon-grass. The oil is extracted from the fresh flowering V. odorata, or Aloysia citriodora, in the usual way by distillation, and is mixed with rectified spirits of wine. A little oil of bergamot and oil of lavender or essence of ambergris are often added. But oil of verbena is generally imported from India, where it is obtained from Andropogon citratum. If the question should be asked whether it is worth while to attempt to make the scent here from native-grown plants, I should say decidedly no, because the perfumes of tropical plants are never fully developed in this country, even when grown in hot-houses, I believe; and besides it would not pay commercially.—SAML. RAY.

[60668.]—**Etching Brass.**—See indices. Nitric acid, sulphuric acid, and hydrochloric acid may all be used; but the main part of the etching will be done with nitric. See p. 559, last volume, for instance.—NUN. DOR.

[60671.]—**Boiler Incrustation.**—The reason the boiler became tight when the use of the soda was discontinued seems obvious enough: the leaks became stopped by incrustation.—NUN. DOR.

[60676.]—**Mother o' Pearl.**—This can be cut by means of discs of iron and emery, or in the same way as a lapidary cuts and polishes stones, &c.; but the amount of "polishing" on mother o' pearl is very small. Use the very finest putty powder and a soft bush. Great care is required in cutting it. There is something on the subject in Campin's "Turning in Wood, &c.," and no doubt also in Holtzapffel.—NUN. DOR.

[60677.]—**Vergara's Slides and Woodbury Tissue.**—Where these not described in No. 1,114, p. 475? Surely anything further could be obtained on application to the makers.—I. J. H.

[60681.]—**Water Clock.**—The conical drum is for regulating.—J. B.

[60685.]—**Electrical.**—The kind of carbons are fully described at p. 71. They are moulded carbons, of course; but you can cut them out of retort scurf if you like—and can.—C. B.

[60686.]—**Staining Iron Black.**—If it must be a stain, would the oil or Lancashire black seen on some tools, bits, &c., do? Any way, you will find suitable processes in back volumes.—J. B.

[60690.]—**Wood-Carving.**—All carving that is worth doing depends for its forms on the cunning hand and eye of the workman, not upon the shape of the tool. I mean, you can no more produce fine carving by trusting to the curve of your tools than good drawings by the use of French curves. Even if it be but a row of flutings to relieve a hollow moulding, it is just the slight irregularity of hand work which makes the difference between a pleasing and a lifeless piece of work. It is true you want some special tools: you cannot cut those flutes without a bent gouge of suitable size and curvature. But this tool must be servant, not master; and, as I happened to notice in the practice of a first-rate professional, you require the constant aid of a pencil even for fluting. You run your moulding and then mark, and then pencil your flute edges. For less simple cases you have, after roughing out, to pencil in detail, and a carver should be no more a slave to the drawing than to the tools. In short, carving requires taste and feeling. I like "G. H. H.'s" statement of his wants. Surely every worker in wood should be taught some skill of this sort. There are many cases in which carving is the quickest way of making a tidy finish. Speaking as an amateur, I find it quicker to do a simple leafy edging to a curved piece of wood such as a bracket than to finish it up square with spokeshaves and rasps. Unhappily, it is not so much the first step that is grievous, but later on, the difficulty of obtaining reasonably good designs and finding examples of really fine style to improve one's standard becomes great. The average trade designs are lifeless, and the execution, with all its dexterity, is lifeless too. The same sort of "handling" obtains in carved wood and in embossed brass as in stamped and machined counterfeits or stamped paperhangings. The only fine carving of which there is much to be found is Gothic, and it is not easy to use it in ordinary work. I have never found even fairly good designs in handbooks of wood-carving, and the Royal School at South Kensington feel the difficulty acutely.—W. A. S. B.

[60696.]—**Dynamo.**—Is not the dynamo mentioned a Gramme? and has not that been described almost *ad nauseam* in recent volumes?—C. T. M.

[60701.]—**Japanning.**—A turning barrel is the best thing for taking off sharp edges; but for japanning heat is requisite.—J. B.

[60700.]—**To Draughtsmen, &c.**—The way in which I managed with trig. was this. The chord of any arc of not more than 180° is double the sine of half the angle. So I divided 360° by the number of divisions into which the circle had to be divided multiplied by 2. Then from table of natural sines found sine of this angle, which multiplied by the diameter gives the chord. Now, "Nephesh," you must be a peerless expert at judging distances if you can set dividers within $\frac{1}{20}$in. of $\frac{1}{13}$ of any line, first go. And although you may be this, if pitted against a "scheme-a-jack," armed with a sector, "E. L. G." tells us of, I rather think you would find yourself doing the "fiddling." And if this be so, what about the workman incapable of the mental arithmetic and eye-measuring (and there are many such) that figure so largely in your methods. Many thanks, "E. L. G." Your replies have been of great service to me, as I find from them I have invented what was already well known (a disappointment I have experienced more than once), my instrument being simply a sector with semicircular strut and set-screw.—WORKMAN.

[60702.]—**Liquid Gold.**—The querist seems to know what Duterte's process is; but he might, for experiment, dissolve a grain of fine gold in aqua-regia, and concentrate until deep blood colour; then add half a litre of hot distilled water containing four grammes of cyanide of potassium. Stir, and filter.—E. G. M.

[60744.]—**Question in Dynamics.**—How the monkey can raise the weight without raising himself also (as stated by "M.I.C.E.) is a mystery. He does not move, so can do no work, and yet raises the work against gravity. If either the monkey or weight begins to move up, while the other is stationary, it will put more tension on that side of rope (in consequence of motion against gravity). This tension immediately moves the body on the other end of the rope, and continues to do so until it is equalised by the motion of that body. There being no friction, the tension will be instantly compensated, and both the monkey and weight will rise with equal velocities. "W. A. S." must admit that to put extra tension on the rope the monkey must raise himself if only a small fraction of an inch. If not, he agrees with "M.I.C.E.' in saying that the monkey can do work without raising himself, which is against all laws of mechanics.—R. W. W., Newcastle-on-Tyne.

[60744.]—**Question in Dynamics.**—This amusing puzzle has been solved at last by "Nephesh," so "W. A. S." must acknowledge himself to be in the wrong, and my original solution turns out to be right after all. I have rather put myself out of court by endorsing the argument of "W. A. S."; but *magnum est veritas*, &c. To take a homely illustration. From my window I see two invalids being pushed along in Bath chairs. Now, suppose the two chairs with their occupants to be placed some distance apart, and a rope passed from one to the other; if one of the occupants pulls the rope both chairs would be put in motion, and would approach each other. Now, suppose the road to consist of two steep hills, meeting at an apex like the letter A, with a wheel or pulley at the apex, over which the rope passes, a chair being on each slope; as before, when the rope is pulled both chairs will ascend the two slopes. Now suppose the two slopes to become so steep as to be vertical; when the rope is pulled, precisely the same action takes place as before, and the two chairs would approach each other at the apex. When the chairs were on the level, if there were no friction, they would go on approaching each other when once set in motion; but when on the two slopes, the action of gravity would also prevent any motion except that due to the pulling of the rope, and the same when the rope is vertical. There is no tendency to accelerated motion as "W. A. S." supposed. If the pulley worked without friction, both chairs would travel upwards at the same pace.—M.I.C.E., Bath.

[60774.]—**Heating Conservatory.**—Would the writer state the diameter outside, and hole inside, with the length he recommends of tube?—JAMES J. GRUNDY.

[60781.]—**Corundum for Aluminium.**—There is a mistake in last week's "E. M." The correct analysis of Kaolin is—

Alumina (Al_2O_3)	40·76
Silica	46·52
Lime..............................	3·17
Water	9·55
	100·00

—F. W. GERHARD, Wolverhampton.

[60796.]—**Arithmetical Question.**—In order to find the amount of ten equal annual payments to satisfy principal and interest of £1,000 mortgage, "Puzzled" should in the first place calculate the amount (*a*) to which £1,000 would increase at compound interest in ten years; secondly, the amount (*b*) to which an annuity of £1 would increase at like compound interest in the same time. Then *a* divided by *b* will give the annual payment required.—S. M. COX.

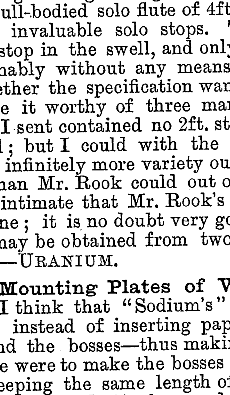
[60815.]—**The Sun's Radiation.**—A. Treyer Evans attempts to give an explanation of the construction of air and vacuo thermometers; but he does not appear to know that an *absolute* vacuum is an *absolute* impossibility. The exhausted (?) glass tube, then, does absolutely contain a modicum of air, however ridiculous "A. T. E." may consider it. I wish to be informed the value of the knowledge that the vacuo thermometer registers on three days, say, 80°, 90°, 100°. Although the air thermometer on each occasion may record 60°, does it indicate more or less moisture in the air, a lengthened exposure to sunshine, or what? I do not think fruit-growers will be much edified by the explanation of "A. T. E."—B. R.

[60820.]—**Chamber Organ.**—I am extremely obliged to E. Franklin Rook that he considers the specification I sent in reply to the above query

"good." I am sorry to say I cannot return the compliment with regard to the specification he sends of his own instrument. I am perfectly aware that to dispose the stops on to three manuals is, for a large organ, most judicious and extremely useful; but in the case of a small organ, matters differ somewhat. Cost must be taken into consideration. The third row of keys, for the keys and frame alone, would cost about £3 10s. This is the price of a small wood stop. Better have the pipes as the keys. Then there is the separate action—more cost still. If Mr. Rook will kindly look at the specification I sent on page 245 he will see at the foot of the list great and choir ventil. This to a certain extent provides the third manual. The great and choir occupy the lower row of keys, the swell the upper. To use these for accompanying and solo purposes, the mode would be as follows:—If a solo was desired on the great op. diap., the choir ventil would be off, and the accompaniment could be with the swell. If a solo was desired on the choir vox angelica, the choir ventil would be on and the great off, when the accompaniment would be the swell vox celeste. Then to use the swell stops individually as solo stops, requires in a room a very soft accompaniment. This would be provided by the vox angelica, with the choir box closed. Now, I don't deny that this can be done on the three manual, but if it can be accomplished on the two manual, why go to the extra expense of the third row of keys? By having only two rows of keys, the whole of the organ stops can be brought into use for a grand forte, whereas, in Mr. Rook's organ this cannot be, as there is no provision for coupling the choir to the great. I do not think this choir to great coupler really needful in a large church organ; but it is essential in a small organ to obtain all the power you can. In Mr. Rook's specification there are, in my humble opinion, three almost useless stops—viz., principal, gemshorn, and piccolo, except simply for augmenting the general organ tone. There is no full-bodied solo flute of 4ft. pitch, one of the most invaluable solo stops. There is no string-toned stop in the swell, and only one in the choir, presumably without any means of expression. Altogether the specification wants remodelling to make it worthy of three manuals. The specification I sent contained no 2ft. stops, nor are they needful; but I could with the two octave couplers get infinitely more variety out of it, and power, too, than Mr. Rook could out of his. I do not mean to intimate that Mr. Rook's organ is an indifferent one; it is no doubt very good, but the same effect may be obtained from two rows at a less expense.—URANIUM.

[60839.]—**Mounting Plates of Wimshurst Machine.**—I think that "Sodium's" plates will not crack if, instead of inserting paper between the plates and the bosses—thus making them bed unevenly—he were to make the bosses not quite so long, but keeping the same length of projecting pieces, so that he could slip boxwood washers on to the projecting pieces without interfering with the requisite length—that is to say, the solid bosses and washers to make up together the required length—and then he could insert the paper between the washers and solid bosses without making the bedding of the plates uneven. I should be obliged if "Sodium" would inform me whether he has tried having a turned spindle with centre holes, which would enable him to true up the bosses on it between the centres, with some small contrivance to key them to it to cause them to revolve with it, and, if so, with what results?—G. M. S.

[60856.]—**Battery.**—To Mr. Bottone.—Get piece of electric light carbon about $\frac{1}{2}$in. in



diameter and $3\frac{1}{2}$in. long; procure a wide-mouthed glass bottle about $3\frac{1}{2}$in. in height and $1\frac{1}{2}$in. wide. Cast a leaden lug around the top of this carbon, taking care, however, to have the carbon not central; the lug must be of such a size to fit nicely the neck of the bottle. At one side of the lug must be drilled a hole, about $\frac{1}{4}$in. diameter, to allow of the insertion of a zinc rod; a binding-screw may be screwed into the leaden lug to make easy connection with the coil. The zinc rod must also be furnished with a binding-screw for the same purpose. When the lead lug has been thus shaped and drilled, it should be warmed and well basted on the underside with hot melted pitch, a little of which should be also painted round the upper part of the carbon rod (i.e., the part nearest the lug). In order that the zinc rod should not make contact with the leaden lug, a small piece of indiarubber tubing should be drawn tightly over it, at the place where it rests against the lug. This battery should be charged with a chromic acid solution, made as follows: Chromic acid, $\frac{1}{2}$lb.; water, 1 pint; sulphuric acid, 3oz. Mix, and allow to cool before using; the battery should not be more than half filled with the fluid. The annexed sketch gives an idea of the make of the cell: A, the glass bottle; B, the carbon rod; C, the zinc; D, the leaden lug; E E, binding-screws.—S. BOTTONE.

[60864.]—**Gas Products.**—Replying to Robert Perry, no doubt the stoppage in ascension pipes arises from the formation of pitch caused by the high heats near the retort mouthpieces. There are several remedies other than structural alterations. A very simple one is to put about half a pail of water over the last three shovelfuls of coal when charging. An impending stoppage can always be detected by the bottom of the pipe being quite dry. If water is allowed to trickle down the outside of the pipes most liable to stop up, care being taken not to allow more water than the heat of the pipe will evaporate, it will be found to answer very well. The best means for accomplishing this, of course, depends upon local circumstances. It is useful too, to let the hydraulic run out every day, and keep the dip as shallow as possible, consistent with leaving enough in to form proper seal.—F. M. E.

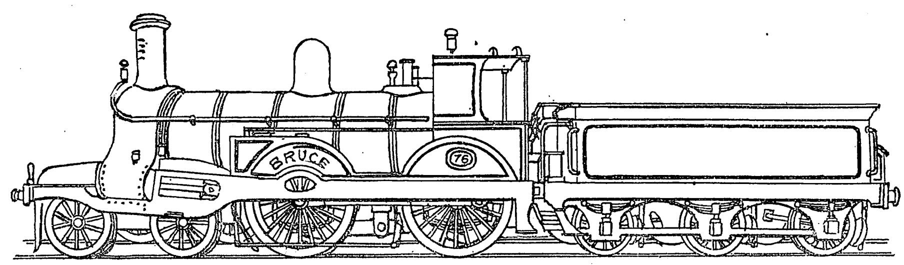
[60870.]—**Horsehair.**—A hair rope is easily made, if querist can obtain one of the twisters used by farmers for making hay ropes, and get someone to turn it for him. Fasten a bit of the hair on the end and feed the hair to it as the machine is revolved. The rope of hair must be twisted hard and allowed to curl up, and lie by for a while to set. If he does not know what a twister is like, I will send a sketch of one he can make for twopence.—DOCTOR MEDICINÆ.

[60877.]—**Finishing Cast Steel in the Lathe.**—We have large quantities of cast steel, and use neither water nor any other lubricant.—J. H.

[60877.]—**Finishing Cast Steel in the Lathe.**—Cast steel must be finished dry in the lathe with a slow speed, and afterwards filed up and finished with emery cloth.—WALTER MATHER.

[60877.]—**Finishing Cast Steel in Lathe.**—I should advise you to ascertain by experiment what you wish to know, as it would not take long, for no one can tell you, as the quality of steel varies greatly. What the turners told you is quite right, as they might have worked steel of different qualities—viz., one oil, one suds, and the other dry; but I always find it best to work it dry myself, as I have worked it this last 10 years. You should rough it to near the size, then with a very sharp tool and speed to suit, take a cut over, leaving $\frac{3}{1000}$in. above size; then, if tool is dull, rub with oilstone, take another cut, leaving barely $\frac{1}{1000}$in.; then with a very fine-cut file (known as dead smooth), finish to required size. But if it is for common work, any of the three ways will do. The way I speak of is for tool work, which requires the greatest accuracy.—LUMSIE.

[60900.]—**Highland Ry. Loco.**—In reply to "Amateur" I send herewith sketch of Bruce, the Highland Railway Locomotive at Edinburgh, which is one of six made for the company by the Clyde Locomotive Company. The following are some of the dimensions:—Boiler: length 9ft. $9\frac{1}{2}$in.; outside diameter 4ft. 2in.; tubes, 223, $1\frac{3}{4}$in. diameter by 10ft. 4in. long; fire-box, length inside at top, 5ft. 4in.; length inside at bottom, 5ft. 6in.; breadth, 3ft. 5in.; height, 4ft. $9\frac{1}{2}$in.; cylinders, 18in. by 24in.; diamer of bogie wheels 3ft. $9\frac{1}{2}$in.; diameter of driving and trailing, 6ft. $3\frac{1}{2}$in.; wheel base, bogie wheels centre to centre, 6ft. 0in.; driving to trailing, 8ft. 9in.; centre of bogie to centre of driving, 9ft. 9in. Boiler painted light green; frame maroon. Six-wheeled tender; 2,250 gallons water. Fitted with automatic vacuum brake.—B.



[60892.]—**Annuity and Estate.**—I notice in the printing of my answer to above, p. 268, there is a compositor's error. In giving the value of $1{\cdot}05^{-32}$, it is stated to be equal to $\frac{1}{1{\cdot}05^{-32}}$; it should, of course, be $\frac{1}{1{\cdot}05^{32}}$.—SURVIVOR.

[60899.]—**To Chemists.**—(1) Nitric acid acts on iron according to three equations, varying as its dilution:—Very dilute, $Fe + 2HNO_3 = Fe2NO_3 = H_2$. Dilute, $Fe_4 + 10HNO_3 = 4Fe2NO_3 + NH_4NO_3 + 3H_2O$. Strong, $Fe + 5HNO_3 = Fe3NO_3 + 2NO + 2H_2O + H$. Nitric acid of sp. gr. 1·38 at temp. 31°, or sp. gr. 1·42 and temp. 55°, has no action on iron—it renders it passive. (2) Ferrous sulphate and bichromate of potash. $6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 = 3Fe3SO_4 + K_2SO_4 + Cr_23SO_4 + 7H_2O$.—E. F. S.

[60906.]—**Lens.**—To T. PERKINS.—I am in want of a lens to do such work as described by you last week. But I wish also to take long-distance views with it. Will you say if this lens is suitable? What is the largest size plate it will cover perfectly? Does the front combination screw off? If so, then, how is stop used, and what is the advantage or disadvantage of working with back lens alone? What is its diameter outside over all?—T. BROWN.

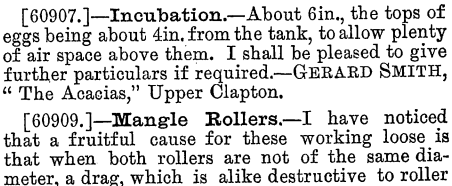
[60907.]—**Incubation.**—About 6in., the tops of eggs being about 4in. from the tank, to allow plenty of air space above them. I shall be pleased to give further particulars if required.—GERARD SMITH, "The Acacias," Upper Clapton.

[60909.]—**Mangle Rollers.**—I have noticed that a fruitful cause for these working loose is that when both rollers are not of the same diameter, a drag, which is alike destructive to roller and rags, is the result.—A., Liverpool.

[60909.]—**Mangle Rollers.**—If you will make about eight wedges of wood about 12in. long, of oak or ash, and of a sufficient thickness to fill up the gap round the shafts, and insert them, four at each end of roller close to the shaft, and drive them up tight, and then put four iron wedges in each end of the roller. You will not be troubled with them again coming loose if done properly. I have done scores of rollers in this way.—WALTER MATHER.

[60918.]—**Screw-Cutting.**—All you need to do when cutting odd pitches of screws is to put a piece of wood or iron between the back centre and the carriage of the lathe, and let the carriage be against this before commencing to cut the screw, and at each cut run the carriage against the wood or iron, and wait till the nut will gear, and then you will be all right.—WALTER MATHER.

[60918.]—**Screw-Cutting.**—Put down the pitch in fractional form, and the numerator indicates the least number of inches which the saddle must travel to fall into gear again—5, 7, 9 $= \frac{1}{5}\frac{1}{7}\frac{1}{9}$; in each case 1in. is the least number of inches or any multiple of 1 according to the length



of screw being cut, as 2, 3, 4, &c. Mark the lathe-bed with chalk, or measure from headstock, unclasp the nut, and move the saddle to either one of these distances. The diagram illustrates this in a graphic way.—J. H.

[60918.]—**Screw-cutting.**—In cutting either odd or even pitches in screw-cutting lathe it is best to work as follows. Your article must be held firm between the centres, your wheels arranged to cut the thread wanted; your saddle must be brought to a stop against the loose headstock, or a block of wood or iron placed purposely to stop in the right position; set tool in holder firm and in place to begin, turn over the rest handle to take up the backlash of the rest-screw (to the right for right-hand screws, to the left for cutting left-hand screws). Now pull round your live centre until your nut falls into gear with leading screw. Before starting your lathe mark with chalk the face-plate and the wheel which is on the leading screw, preferring the top or highest part of both, and each time take a cut; see that your saddle and the chalk marks are in their right places (before starting). If they do not come right (in odd pitches they seldom fall on), pull your live centre round, or run the lathe (with the nut out of gear) until the chalk marks are at the top (the place of starting); the saddle you must pull back against the block. Some men use a chalk mark for saddle; I prefer a block. I have seen men place their saddle anywhere, start the lathe, and try to put tool in place; but good work is never done in such haphazard ways. I do not know if your lathe is new, or in good condition. All lathes, when worn or used for a time, have backlash, which must be taken notice of to turn out good work. Further advice if desired.—WESTWOOD.

[60921.]—**Petroleum Spray.**—I have seen diagrams of a petroleum furnace where the petroleum was blown down a long slanting passage by the steam-blast through a series of two or three iron grids, the steam entering at the end and meeting the petroleum dripping down from above, the supply of both being regulated by a valve and turncock respectively. The blast was blown down on to the surface of hot cinders and fireclay lumps in the firebox. I believe hot cinders and steam, both from another source, unless there was enough steam pressure left in the boiler, if there was one, had to be supplied to start the furnace in the first instance.—E. CONRY.

[60922.]—**Albatross Skin.**—Will not the albatross skin make a good tippet for a lady's shoulders? Some wiseacre may tell "Rara Avis" what to do with the skin; but for the feathers, heed me. I have seen a naturalist treat a large bird, which he had just stuffed, by daubing it all over with a plentiful supply of starch; the commonest starch will do. Blend a good supply of it with cold water into a thinnish paste, and lay it thickly over the feathers. Let it dry for a couple of days, thoroughly dry, then, beginning at the head, knock off the starch (no use objecting to the dust from it) from every feather down to the very tips, and you will find that blood stains and other dirty spots have disappeared, and that the feathers have been plumed quite beautifully. "What man has done, another may do."—H.O'B.

[60924.]—**Portable Electric Light.**—As far as the E.M.F. is concerned your lamp will require about four of such cells as you mention. But they are not of much use for the purpose, as oxychloride forms on the zinc plate, thus increasing the resistance of the cell very rapidly, and reducing the current. You can remove the said deposit by washing it in dilute hydrochloric acid.—W. HOLDER, Newport, Mon.

[60924.]—**Portable Electric Light.**—The E.M.F. of the chloride of silver battery is about 1·19 volt, no matter what the size. If charged with caustic potash, the E.M.F. rises to 1·5. Supposing the latter modification is used, and that the 2c.p. lamp has a resistance of 3 ohms, then you would need at least three cells to do the work, and give you a little margin for internal resistance of battery itself. This battery will run about an hour, after which the potash solution must be renewed. The chloride of silver must also be replaced after the battery has been used two or three times.—S. BOTTONE.

[60924.]—**Portable Electric Light.**—Our "Standard" chloride of silver battery of three cells, as used for surgical purposes, will serve for 50 operations of about 30 seconds each duration, and will then remain strong enough for medical inductions. If six cells of the same type are used, by adding a little alkaline solution to the existing liquid the battery can be made powerful enough, if moderately used, to light a Fairy lamp of two candles for nearly one minute for about fifty times from one charge; but it is not advisable with this strong solution to let the battery remain idle for more than thirty days when same is required and used for intermittent lighting purposes.—SHIPPEY BROTHERS.

[60924.]—**Portable Electric Light.**—Certainly two, and probably three, if the cell be what is known as "Clark's Chloride of Silver," as this has an E.M.F. of only 1·03 volt. If Skrivanoff's, which is also a chloride of silver cell, but moistened with caustic potash solution instead of salammoniac ditto, probably two cells would be enough, as the E.M.F. is 1·45. The latter is the best for lighting, owing to the smaller number of cells, and consequently space required. The length of time either would last would depend on the amount of chloride of silver put in. With cells of your size a layer of this, about $\frac{1}{16}$in. thick, would last about an hour of continuous lighting. At the Paris Opera house they use a thinner layer than this, and recharge every evening, which they find more satisfactory than making one cell large enough to last two or three times, especially as the cells are subject to a good deal of shaking from their position in the headdresses, &c. The chloride of silver, however, is an expensive cell to use for the electric light.—E. CONRY.

[60927.]—**Recutting Chasers.**—Put a suitable hob in lathe and apply the softened chaser to it either by a handle on a T-rest or, if a self-acting lathe, fixed in rest and suitable wheels on. You can do inside tool best on tool rest by either cranking it or having a suitable handle, and must be applied at an angle of double the pitch so as to make it left-handed.—T. C., Bristol.

[60927.]—**Recutting Chasers.**—For recutting outside chasers you will have to get hobs the same pitch as your chasers want to be; then put the hob between the centres and tighten the steel in the tool-rest, then proceed as if screw-cutting. Drive a very slow speed with back gear. If you have not got hobs, it would be cheaper for you to buy them. Then, in the case of inside chasers, centre each end of steel, then proceed as if you were screw-cutting.—WALLACE NEWLAND.

[60928.]—**Reversing Gear to Motor.**—This is perfectly feasible. It is only necessary to reverse the direction of the current in the armature, *without* altering it in the F.M.'s. This can be done by rotating the brushes through an angle of 180°. A neat way of doing this, due to Mr. Reckenzaun, is illustrated in the ENGLISH MECHANIC Vol. XLI. page 570, No. 1066, August 28, 1885.—S. BOTTONE.

[60928.]—**Reversing Gear for Motor.**—It would make no difference at all which way you connect your battery to the motor with the object of reversing its direction of rotation. If the current is reversed in the armature alone it would have the desired effect; or, again, if the current was reversed in the field magnets alone (which means a reversal of its magnetism) it would act as required. If both are reversed, which happens when battery-current is changed, then, of course, the motor still continues rotating in the same direction as the relation between armature and field magnets remain unaltered. Now, as neither the above methods of obtaining the desired result is practicable in your motor, the brushes must be reversed, or you must have another pair of brushes attached to a sort of lever arrangement which will throw the one pair out and put the other pair in. I am presuming that you understand about the "lead" given to the brushes. See a sketch in No. 1066, p. 570.—W. HOLDER, Newport, Mon.

[60929.]—**Nickel Plating.**—Dissolve nickel sulphate in liquid ammonia. The sulphate can be obtained by dissolving the metal nickel (either in the pure or commercial state) in sulphuric acid; but the process is not worth the trouble, as the salt is a commercial article and can be bought very cheap. The deposition of aluminium up to the present has not been a success commercially. Scientific authorities have an idea that it will be more readily deposited as an alloy.—W. HOLDER, Newport, Mon.

[60929.]—**Nickel Plating.**—Nickel can be dissolved for electro-deposition by what is known as the "battery process," the resulting solution being the double sulphate of nickel and ammonia commonly used. Attach a plate of pure nickel to the positive pole (carbon) of a powerful battery, such as the Bunsen, and suspend the plate in a dilute solution of sulphuric or hydrochloric acid, in the proportion of 1 of acid to 10 of water. Place a few pieces of clean sheet copper in a porous pot, pour sufficient dilute acid into it to the level of the acid solution in the large vessel, and set the porous cell in it. Attach a sheet of copper to the negative pole (zinc) of the battery, and place it in the porous cell in contact with the pieces of copper already in it. In a few hours the acid will have combined with its equivalent of nickel. Weighing the nickel before and after immersion gives the amount of nickel the solution contains. After removing the porous cell, add liquid ammonia to the solution in the large vessel till it has no effect on the blue litmus paper. To each ounce of sulphate of nickel in the solution 1oz. of chloride of ammonium is to be added. It may be mentioned, however, that the trouble of this operation is saved by purchasing the double sulphate of nickel and ammonia in crystals, and dissolving in hot water. Sorry I cannot answer the query as regards aluminium.—BOBADIL.

[60930.]—**Triangular Tool.**—You cannot have a better or more useful one than is to be made by grinding and set-stoning the end of any suitable for the job old sawfile, leaving it at its normal temper. Also for a parting tool, grind a thin, old, smooth flat file until, say, an inch of the end is free of teeth marks; grind the cutting end a little slanting, according to the nature of the material to be parted.—A., Liverpool.

[60930.]—**Lathe Tool.**—A parting tool for metal is square on the front and from $\frac{1}{16}$in. to $\frac{3}{16}$in. wide, but rather less at back to allow clearance, and flat on top with, say, 5° clearance in front. Triangular tool for C.I. for small lathe of, say, $\frac{5}{8}$in. square steel drawn down to $\frac{3}{16}$in. to $\frac{1}{4}$in. wide in front, and either round or pointed. If for W. I. front angle about 60° to allow shaving to curl. Any book on tools will give illustrations of all.—T. C., Bristol.

[60932.]—**Inlaid Veneers.**—These are built up soldid, carefully fitted, glued, and then taken to a veneer saw-mill and cut into veneers. This is the reason why "O. J. L." found the errors, such as badly shaped curves repeated in each.—B.SC., Plymouth.

[60933.]—**Gut Driving Bands.**—Get a piece of $\frac{5}{16}$in. square steel. Chuck it in lathe. Run in a drill (of size to suit $\frac{1}{4}$in. tap) about $1\frac{1}{4}$in. deep. Bring loose poppet-centre to bear in the hole bored. Mark off 1in. length; turn down ends of the inch length, and cut off. Drill two $\frac{1}{4}$in. holes close together in the middle of the piece; ease off their outer edges with a small rounded cold chisel. Tap the long hole right through, Screw a short length of $\frac{1}{4}$in. steel rod, and cut off two screws to fit. Use a $\frac{1}{4}$in. band of leather, cord, or gut; something without a twist is best. If cord, a coat of shellac varnish improves it. This fastening is chiefly intended for rough, heavy work, and for those out of reach of gut.—HENDON.

[60934.]—**Magneto Machine.**—TO MR. BOTTONE OR MR. EAVES.—Most likely the little spring which should press upon the square shoulder of the spindle is at fault. To get a shock, the spring must just touch the rounded portions (during rotation), and be just clear of the squared portions.—S. BOTTONE.

[60936.]—**Oxygen.**—A bright-red heat is sufficient. The manganese should be put into an iron bottle or piece of gas-pipe. It requires no purification, the gas being sufficiently pure for all optical purposes. About 8 tons per annum was thus treated at the old Polytechnic Institution, and was there passed through a simple washing tank to cool it and condense any moisture that might come over with the gas. From manganese the gas comes off rather slowly, and not at all like the chlorate of potash process, which is more rapid—rather the purest, but more expensive.—E. T. P.

[60937.]—**Photographic.**—Does the querist mean to "copy lantern slides," or to produce them from his negatives? Seeing no meaning otherwise than the latter, I, therefore, give a short account of my experience, and at the same time recommend the following formula by Woodbury: Glycerine, 10 drops; potassium bichromate, 30 grains; glucose, $0\frac{3}{4}$ drachm; gum arabic, 1 drachm; water, 2oz. After solution, filter through a piece of sponge or cotton wool plugged into a funnel. A clean glass plate is flooded with the solution, dried rapidly on a hot-water plate, or what I used was a flat powder-tin filled with hot water; expose from two to four minutes to bright sunshine under the negative to be copied, take it out of printing frame in dark room, and leave it until the evening, when it may be developed by ordinary candle-light. During this interval it absorbs enough moisture to effect development, assuming that it has not been over-exposed. A faint image will be apparent, which is due to the altered bichromate, and the darker the shades of this picture the less moisture it aborbs on exposure to air, and consequently the less tacky. It is, in this state, dusted over with fine-powdered electrotyper's graphite by means of a camel's-hair brush, and, with careful manipulation, the picture may be built up according to the operator's own artistic skill, omitting those portions that are objectionable to the pictorial effect, whilst a wide field for retouching is here opened, by which accessory, and even *forte* points may be introduced, as sheep on a blank lawn, a boat on a pond, that originally stared at the admirer with a disinterested blankness, and so forth. When development has been effected, and all extraneous plumbago removed, coat the plate with a film of structureless transparent collodion, and, after having thoroughly set, wash in several changes of water, so as to remove the unaltered bichromate, drain, let dry, and then mount in the ordinary way. I may add that the solution for coating plates is of very little use after 24 hours, hence it should be prepared immediately before use. Coating the plates must, of course, be conducted in a darkened room, illuminated by a candle. Upon any account, be on your guard against dust, as the tacky film has a great affinity for any little particle it can lay hold upon.—A. TREYER EVANS, Newport, Mon.

[60938.] — **Photography.** — Probably "B." means to ask the difference between burnishers and rolling presses. The latter are the best for general work, but burnishers are much cheaper. In the latter case (burnishers) the mounted photos are forced over a bar of highly polished heated steel, and in the other (rolling presses) the photos mounted or unmounted are laid on a hot steel table and rolled backwards and forwards till they acquire a high gloss, if such is required, or rolled cold, if the subject is a landscape or unmounted.—B.Sc., Plymouth.

[60939.] — **Casting of Gun Metal on Wrought-Iron Shafts.**—A similar query to this was asked some time since, and I then expressed my opinion that it was not practicable. If sound castings are required, the simpler plan would be to cast them as bushes, bore them, and drive them on; but, as this is obviously impossible where a square shaft is concerned, and as it would be difficult to cast a 1¼in. hole 23in. long, straight and true enough for a driving fit, I subjoin some hints derived from the practice of casting iron barrels on square shafts: First, see that the shafts are perfectly free from spots of rust and scale; next make them hot, as you say, so hot that they cannot be handled, but nothing approaching to red heat. If practicable, cast them on end and run at the bottom, the metal rising up the bar; well vent the mould and run the metal dead, so that it shall set as quickly as possible. I should be glad to know the result of your experiment, since this kind of work is always, more or less, troublesome.—J. H.

[60940.]—**Oxalic Acid.**—Before J. Montague Jacques sets up any plant for manufacture of oxalic acid from sugar, he should ascertain the relative cost of the sawdust process. I am under the impression that the oxalic acid of commerce is nearly, if not all, made from sawdust by Dale's patent, 1856. According to Lunge ("Sulphuric Acid and Alkali," Vol. I. p. 319), an attempt was made in France to make oxalic acid from molasses and nitric acid, utilising the nitrous fumes evolved in an acid chamber; "but the yield of oxalic acid was not large enough to compete with the manufacture from sawdust."—C. J. Woodward, Birmingham and Midland Institute, Birmingham.

[60941.]—**Fire.**—As a rule, Scotch people keep their fires in all night and all ordinary house coals serve for the purpose. At, say, 10 p.m., the fire is "gathered," a lump of coal about 8in. square is put on against the grain, and the ashes accumulated during the day are heaped on all round, so as to "damp" the fire. Next morning, on getting up, the gathering coal is struck with the poker or a hammer, and the red fire bursts into a flame.—B.Sc., Plymouth.

[60941.]—**Fire.**—If a piece of sheet-iron just large enough to fit in the bottom of the grate, and having a flange of about 1in., turned up at the front, be inserted every night, and the fire made up with coal and well banked with slack, "E. P." will find the fire will last for quite fifteen hours. In the morning, a few jerks to the iron to liberate the ashes will cause the fire to burn up brightly.—S. Henry Smith.

[60941.]—**Fire.**—In a great many parts of South Wales, especially Pembrokeshire, the fire is very seldom left to go out in the night time. The way in which it is managed is this: a kind of shaly anthracite coal, which is locally called "culm," after having been crushed, is mixed with water and slime or clay in a proportion so as to make the mixture hold together. It is not very important as to the exact proportion in which they are mixed; but it is something like this: a cartload drawn by one horse of clay to about a ton of culm. Before going to bed the fire is covered over with it to about an inch thick, and a hole made in the middle with the poker. In the morning it is only necessary to break this up, and a nice little fire is ready to make breakfast; but if the kettle is left all night on the hob, a minute or two is sufficient to make it boil, if not already boiling. Instead of culm, an inferior quality of coal would do, but not so well as the culm.—J. T. Le Davies.

[60941.]—**Fire.**—Much depends upon the sort of fireplace and the weather: a fire packed to keep in all night, in breezy weather will kindle up too soon; whereas, of a dull, mild night, it may go out for want of draught Fifty years' housekeeping has taught me that what "E. F. G." asks about, can be done, and I insure success seven times in ten. Thus, let the evening fire burn rather dim, so that the heat of the fireplace and chimney shall have moderated towards bedtime. Then stuff the bottom of the grate, below the hot coals and ashes, with flat pieces of new coal, so as to cover the spaces between the bottom bars, and keep out air; gently beat down the surface of the fire, then throw on a big shovelful of real slack coal to cover the whole fire, next, two large lumps of coal on top; then run the poker down right through the centre to make a vent for smoke; shut all the doors of the kitchen to prevent draughts of air to the fire. Prepare a handful of chips, or a fire-lighter, placed near the grate ready for use in the morning, should the fire be only smouldering, not bright; the poker must then be used to open the coals, and let air through the fire. "Cannel" coal is a very blazy kind, not at all adapted for burning slowly; but very delightful to throw on top of a fire of a winter's evening, when you are telling ghost (or other) stories to the children.—H. O'B.

[60942.]—**Spirits of Wine.**—Yes, you can distil spirit from sugar or molasses. The fine is only £100 if the Excise catch you at it. Further particulars if required.—Doctor Medicinæ.

[60944.]—**Power to Grind Coffee.**—I know a man, a grocer by trade, who used to employ a boy to grind his coffee: now he does it by the aid of one of Gilbert's small coffee mills, driven by one of Shippey Brothers' little steam motors of half man-power, which I frequently see advertised in our Sale Column. The engine is placed over an American gas-stove, which is heated by a Fletcher burner. The coffee required for daily sale is weighed and placed in a hopper having a small glass tube to coffee mill, which feeds it gradually. When all the coffee is nearly ground, the outlet supply to hopper is closed, which forms contact and rings an electric bell as a signal to turn out the gas to prevent waste, the engine finishing the work while steam runs down; thus for about 2d. per day for gas consumed by this arrangement, the work which took the boy about three hours per day is done by this little engine, besides having the advantage of a good and cheap window advertisement, which shows customers that the coffee sold at this establishment is fresh ground. Perhaps this ingenious arrangement will suit "H."; should he only want to grind sufficient coffee for his own consumption, he will find it more economical to still use his own energy to grind his coffee by hand-power; but should he require to grind a few hundredweight per diem, by all means go in for a small engine, as it will be time, money, and energy saved for other purposes. I should hardly think the Seal engine powerful enough.—Nemo.

[60945.]—**Working Model.**—Why not buy a set of castings? You would then require piston rod of ⅛in. steel wire and slide-valve rod of $\frac{1}{16}$; crank shaft, say, $\frac{3}{16}$, with ¼in. bearings and ¼in. crank pin. For the rest, work to your own fancy.—T. C., Bristol.

[60947.]—**Chloride of Silver Cell.**—My idea of mixing lime with chloride of silver might not be considered scientific, but my reason for it was this:—In making hermetically sealed batteries for experiments, I was always troubled with gas which so accumulated that the battery burst in a few days. I tried the lime addition, and the results were better. Of course, it is of no use unless the battery is to be sealed. A single cell connected to a bell, rang it continuously for nine hours. On dissecting the cell, I found the chloride in a metallic state. I believe that with double the quantity of chloride it would have worked for double the time. Two cells in series worked the bell in the ordinary, intermittent manner for twelve months, and then died from the same cause—the chloride got converted into metal. In each experiment the cells had a little lime, and none of them burst. The number of cells which 1oz. of chloride of silver will be sufficient for really depends on how much is used in each cell, and on the diameter of the piece of silver foil on which it is laid. In the cells referred to (about the same size as "Holland" mentions) the paste of chloride and lime was laid on about ⅛in. thick. An ounce, at this rate, will go a long way.—Bobadil.

[60950.]—**Tricycle House.**—The damp is in the air. Varnish all the bright parts with clear white varnish; or else brighten them once and then keep them constantly slightly greased by wiping down with a rag and lard or tallow—preferably the first.—E. Conry.

[60950.]—**Tricycle House.**—My experience is that a tricycle keeps freer from rust in an open shed than in an inclosed house. Of course, when the atmosphere is moist and warmer than the metal the moisture will deposit. In an open shed where a free current of air blows over the machine, as soon as the temperature of the metal rises and that of the air falls the deposited moisture is taken up again. This may be observed on houses where the outside walls are frequently dry, while the inside ones are streaming with moisture.—Doctor Medicinæ.

[60950.]—**Tricycle House.**—Practically you cannot prevent dampness during the winter months in such an erection as you describe. The best thing to do is to rub the bright parts of the machine with a warm cloth, and then coat the nickel with vaseline. Of course the painted or enamelled parts require no such protection. Then cover the machine with a waterproof sheet if you have one—they can be bought cheap at army stores—and look, say, once a week to see that all is right. This advice is based on experience, as I have kept a tricycle for the last three winters in a wooden outhouse in my garden, and have maintained it in excellent order by following the above method. Rudge, of Coventry, advised me to use vaseline, and it has proved all that one could desire as a protective against damp, being cheap, easily put on, and non-evaporative. In fact, one coat is sufficient for the winter.—Lithium.

[60950.]—**Tricycle House.**—This trouble with damp is through no fault of the building. All the winter, but most particularly just in November and December, the most carefully constructed room will not secure bright machinery against rust. Whenever warm, damp weather succeeds cold quickly, the moisture is deposited on the cold iron; but if all bright parts be previously coated with oil, or painted with grease and whiting, all trouble with damp will be avoided.—F. R. Davis.

[60950.]—**Tricycle House.**—If "Tri." bores the holes it will do no harm; but to preserve the nickel-plating of his machine, if he will do as follows, he will have no trouble: Clean the plating well—I find the German pomade (a polishing paste) the best thing; then dip a rag in the ordinary petroleum, as burnt in lamps, and wipe all over—a little will do. When he wants it out, wipe off with clean rag. This is what I have done with mine for three years. Last winter it was stowed away four months; all the plating, with the exception of spokes, looks as well as new.—F. G. F.

[60951.]—**Electro-Deposition of Copper.**—I presume there is no deposit on to the anode caused by the mixture of tin and bismuth being electro-positive to copper. No doubt you would have seen this had it occurred, so probably the corroding is due to local action. Either the bismuth or the tin is of uneven quality, or have not got thoroughly blended in formation, so that local currents are set up between one part where there is an excess of one metal to another part of the same plate, where there is an excess of the other.—E. Conry.

[60952.]—**Lathe Matters.**—To drive a lathe or, indeed, anything, with an eccentric is quite impracticable. An eccentric can only be used to convert rotary into reciprocating motion; but not vice versâ.—F. R. Davis.

[60952.]—**Lathe Matters.**—If "L. H. R." lays down on paper the comparative sizes of an ordinary crank and of a corresponding eccentric, he will see that it would interfere with the convenient action of the leg in treadling, as well as to cause, when applied in this way, considerably more friction.—A., Liverpool.

[60952.]—**Lathe Matters.**—Your idea is not new; but, if adopted, mind your shins. Fancy an eccentric sticking out 6in. from shaft! If you want to do away with forging, have a straight shaft and cranks outside, also cranks on ends of treadle bar; but the usual way is by far the simplest. The eccentric would work all right.—T. C., Bristol.

[60952.]—**Lathe Matters.**—I have known this appliance used for transmitting small power, but discarded owing to its making more work by friction than the simple crank and chain with a momentum action of some sort, like those on a sewing-machine, or the chucks and gearing of a lathe.—E. Conry.

[60952.] — **Lathe Matters.** — An eccentric is equivalent to a crank having its crank-pin enlarged till it embraces the shaft. It can perfectly be used as you suggest, and has been so used. It is not, however, in theory quite so perfect, since if you use an eccentric, then the pulley in the treadle which takes the other end of the chain cannot well be much larger in diameter. Eccentric and pulley will, therefore, revolve at about equal speed, and you have only exchanged the friction of the ordinary hook on crank for the friction at the centre of the pulley plus the power required to bend the chain, so that probably you have gained nothing. With a crank and chain, since the crank-pin is about one-quarter the diameter of the pulley, that pulley will only make one turn to four of the crank, and as the rubbing surfaces at centre of treadle pulley move over one-quarter of the space, there should be a slight gain if the chain is in good order and bends easily. I dislike these chains: they lengthen and you have to put packing under the standards. I have nearly an inch of it under mine, and very likely the foot-board will bump the floor again soon; besides, they make a slight rattle just when you want to hear your tool cutting in a small hole.—F. A. M.

[60955.] — **Steam Hammer.** — The hammer will strike any blow, according to the hardness of the material struck—the less it gives the greater is the impact. All you can say is that the blow equals so many foot-lb. or foot-tons, as you please to express it, and this is absorbed in the small distance the material yields; pressure of steam 3,630lb. and of piston 560lb., or, say, in round numbers two tons falling 2ft. = 4ft.-tons. This you will notice is very different to $16 \times 2 = 32$ft.-tons of the falling condenser.—T. C., Bristol.

[60956.]—**Corn Thresher.** — The drum of a threshing machine can be balanced by placing it either on lathe centres, or the bearings resting on knife edges, and screwing on to the wood beaters pieces of flat iron, until the drum, when left alone, will remain stationary in any position, and to attain this end a great deal of patience is required. —F. R. DAVIS.

[60956.]—**Corn Thresher.**—Rest the spindle on two smooth bars, and balance drum so that it will remain in any position on the bars when placed truly horizontal. If there should then be any tremor when running, hold a piece of chalk against any true part of it, and then add a little weight on the side of the drum away from and opposite the chalk mark.—T. C., Bristol.

[60957.]—**Pitch.**—The number of teeth divided by the pitch gives the diameter of the pitch line. Thus: 60 teeth of 10 pitch = $\frac{60}{10}$ = 6in. diameter of pitch line. Conversely, the number of teeth divided by the pitch diameter gives the pitch number—thus: 60 teeth, 6in. pitch diameter = $\frac{60}{6}$ = 10 pitch. Box, on "Mill Gearing," published by Spon at 7s. 6d., is certainly the most practical book, but incomplete in some respects.—J. H.

[60958.]—**Crutch Slipping.**—A leather stocking to the crutch should be used, inserting a thick piece of indiarubber between the bottom and the leather.—S. HENRY SMITH.

[60958.]—**Crutch Slipping.**—A very complete answer to this query appears on p. 118 of Vol. XXV. (No. 629 of "E.M."). If "Magnet" cannot procure this No., and will advertise his address next week, I will copy out the reply referred to and will forward it to him. It would occupy too much space to reproduce it in these columns. —D. G.

[60959.]—**Chuck.**—No chuck having a scroll or spiral will do what you want. You require a die chuck, and the best die chuck I know of is the J. K. P. chuck made by the Britannia Company, and advertised several times in this paper. This costs 50s. with one pair of dies, and you would require about three pairs at 10s. the pair. Another plan would be to get the large-size "Oneida" from Churchill's. This is self-centring, and never lets go. Its cost is 45s. Both these chucks will hold 1in. Both hold by direct pressure of screws. —F. A. M.

[60960.]—**Bearings Heating.**—The position of the set collars on shafting has nothing to do with its heating, and they are, according to your description, in their proper place. The heating is probably caused by all the bearing not being quite in line. Carefully look to this, and write again if still troublesome.—F. R. DAVIS.

[60960.]—**Bearings Heating.**—See if your shafting runs true, and that drums are nearly balanced. I think that there may be some hammering due to the latter cause, which splashes all the oil out of the bearing, and hence heating. It matters little where the collars are.—T. C., Bristol.

[60960.]—**Bearings Heating.**—Perhaps it is the collars themselves rubbing on the sides of the brasses, but more probably something in the faces of the bearings. Have you had the brasses off and examined them? If not, why not sling or prop the shaft up, and take the central bearings out and examine them? You would probably get an idea from the state of the faces where the grind comes; perhaps it is only a little grit lodged somewhere.—E. CONRY.

[60961.]—**Chemistry.**—Dissolve oxide of cobalt in acetic acid, and add a very little nitrate of potassium; this will make an ink invisible when cold, and pink when heated. I know of no ink that could be rendered invisible by heat.—S. HENRY SMITH.

[60962.]—**Exhaust.**—It rots, and eventually crumbles away, the bricks and mortar. Carry the outlet end up to the open air, or through the brickwork into the open air away from the chimney.—E. CONRY.

[60962.]—**Exhaust.**—I have been using the exhaust steam pipe on the same principle as "Stoker" mentions for this last twelve months with great satisfaction; I find the chimney in as good condition as when I fixed tube. Take great care to fix the end of tube vertical in chimney, so that it does not affect the sides of chimney. The tube you connect it with to chimney must be at least ½in. larger in the bore than the delivery from port. By all means have the tube lowest in chimney, so that no water stands near exhaust port. Any further information on the subject I shall be pleased to give, if required.—EXPERIENCE.

[60964.] — **Rubber and Lead.**—The following is much used, and has a very good name as a cement, though I cannot myself vouch for its excellence: Dissolve 5 or 6 bits of gum mastic the size of a large pea in as much spirits of wine as to make a thick liquid solution. In another vessel dissolve as much isinglass (previously softened in water, though none of the water must be used) in spirits of wine as will make a 2oz. bottle of very strong glue, adding two small pieces of gum ammoniacum, which must be rubbed or ground until they are dissolved; then mix the whole with a sufficient heat, keep it closely stoppered, and, to use, set the phial in boiling water to soften it. This is said to unite anything, even to polished steel.—W. HOLDER, Newport, Mon.

[60966.]—**Accumulator.**—It suffers from the fault of all pocket accumulators: it slowly short-circuits itself inside, owing to the quantity of liquid held being so small that the plates are not always covered, aided by the fact that in the pocket cell the plates of necessity are in much closer connection with the sides, &c., than they are in the larger forms. To be really reliable all the pocket batteries require to be charged up only an hour or so before they are used. You would find it rather expensive working it as a De la Rue's cell, if you want to use it much; but if the use is not frequent, it would be much more handy in this form. Get two plates of unamalgamated zinc and silver respectively, the latter as thin as you like—silver-foil will do; cover this with a coating ⅛in. thick of chloride of silver, which you can best buy, and wrap it in very thin white flannel, backing the foil if necessary, on a piece of cardboard to stiffen it. Moisten well with saturated solution of salammoniac in water, and make up in the same way as an accumulator, adding a few drops of solution from time to time to keep the supply up. You would want three cells to get a good light. The action is very similar to that of a Daniell cell, silver being deposited on the silver plate, which gets continually thicker, being in the situation of a cathode.—E. CONRY.

[60967.]—**Ferrous Oxalate Developer.**—Put about one grain of tartaric acid to each ounce of used developer. Fill the bottles as nearly to the top as you can, compatible with getting the corks in without bursting. Place the bottles in a good light, and the developer will recover its energy. —S. BOTTONE.

[60967.]—**Ferrous Oxalate Developer.**—I have never used ferrous oxalate for developing enlargements; but I have used it very extensively for plates. My method of revivifying it is as follows:—I make a solution of tartaric acid, 1 drachm to 2oz. of water, I add to the used developer (say, half a pint) a few drops of the tartaric acid solution, and then expose it in a white bottle to sunlight for a few hours. It is then ready for use, and works as well as if it were freshly made. This renovating can be done over and over again. I have always obtained uniformly good results by the above method of reviving the developer, and I have heard some of my friends say that they could develop as many as 120 to 180 plates with one half pint of ferrous oxalate developer.—GLAUCUS.

[60968.]—**Bichromate Battery.**—1st. If five Bunsens are required to work your coil, it means that the coil requires an E.M.F. of nine volts to work it, since each Bunsen gives about 1·8 volt. Now no single-cell bichromate, no matter the size or number of plates, can ever give more than two volts; hence your two-gallon cell would not give a 4in. spark. 2nd. Chromic acid.—S. BOTTONE.

[60968.] — **Bichromate Battery.** — No; your one-cell, however large you make it, will only give just half the E.M.F. of two cells, however small; size in all carbon and zinc batteries only appertains to durancy. 2. Chromic acid is the best of the two, as you can use the spent liquid over again by mixing it with any spongy acid-proof substance dried into a paste, which can then be utilised as an element for a battery suitable for ringing your electric bells, should you desire it.—SHIPPEY BROTHERS.

[60968.] — **Bichromate Battery.** — One cell with zincs and carbons of any size whatever will not work a coil as well as two smaller ones joined in series, and containing carbons and zincs half the size. Doubling the number of cells doubles the E.M.F., and if 4in. sparks are wanted, the E.M.F. must be high. Large plates increase the quantity, not the force, of the current. The only advantage of a large bichromate cell is that, it remains constant longer than a smaller one, and this arises from the quantity of liquid it contains. I should advise the querist to halve his size of plates, and make two cells. Either bichromate or chromic acid will do: if for sustained action, the latter is best.—BOBADIL.

[60968.] — **Bichromate Battery.** — One cell, however large, would be inexpedient, for you would thus reduce the E.M.F. of your primary current from about 9 volts to less than 2, and you would not get enough current round the primary of your coil. If the primary had been specially wound for use with only one cell it might do; but as it is, you had better stick to the five cells in series. You can easily try the effect of one large cell by coupling your five cells up in parallel—all the zincs together and all the carbons together. You will thus have one large cell quite as effectually as if all the plates were in one vessel. If you want to save trouble and expense, why not use them as double-fluid bichromate or chromic acid cells? You would not then have to charge them so continually, but could leave them standing, and the cost would not be so great. The chromic-acid cell for preference. See back numbers.—E. CONRY.

[60969.]—**Fulcrum.**—If you do not require a long mathematical calculation, I may tell you at once that the proposed casting does not err on the side of weakness; but to be proportional should be either thicker or deeper where cored for the pin. Cast iron amply strong.—T. C., Bristol.

[60970.]—**Lathe Work.**—A suitable feed for roughing cuts on a bar of wrought iron of about 2in. diameter would be from $\frac{1}{20}$ to $\frac{1}{32}$ of an inch; that is to say, while the tool traverses $\frac{1}{8}$in. the bar would make about three revolutions.—J. H.

[60971.]—**Dynamo and Lamps.**—To MR. BOTTONE AND MR. EAVES.—The resistance of the two lamps in parallel is evidently below the critical point of working for this particular dynamo, so that the magnets do not get enough current through them. Put the two lamps in series, and you will probably get good results. But what resistance lamps are you using?—S. BOTTONE.

[60972.] —**Dewrance's Water Gauge.**— I always have these put to new boilers, and like them very much indeed. They will not require repacking for a couple of years, at least, according to the state of your water. If the plugs are not much worn you can repack them yourself with asbestos, and if they leak a little you can screw up the gland and tighten them.—T. C., Bristol.

[60972.] — **Dewrance's Asbestos Packed Water Gauges.**—These water-gauge fittings are the best ever introduced; they never set fast, and require no skilled labour to keep them tight. If leaky, take out the plug and remove all the asbestos, if required; grind in the plug, replace, and carefully repack, using a square brass rod to push the asbestos fibre in the recesses provided for the same. A little tallow will assist to keep them in good order.—P. F. OTTO, Liverpool.

[60973.]—**Double Engine.**—"Nominal" must give more particulars as to speed, and boiler pressure, and if any cut-off.—T. C., Bristol.

[60975.]—**Paraffin Oil or Coal Gas.**—Write to Mr. Paterson, of Alexander and Co., Kirkintilloch, for the details wanted. I can, however, from experience in my own family, say that for a private house the paraffin gas is superior to the coal gas—at least on a small scale. Existing gas works are easily altered to suit the new system.—B.Sc., Plymouth.

[60978.]—**Electric Lamp.**—To MR. BOTTONE. —I also have one of the 12-volt 10c.p. lamps from Messrs. Shippey. I find that I get excellent results by coupling six chromic-acid cells in series to each lamp. The Fuller battery is an excellent battery, which has an E.M.F. of 1·3 to 1·5 volt; but its resistance is rather high, so that the current is not nearly so large as in the plain chromic-acid cell. If you use pint bichromates, you will want about eight coupled up in series, zinc to next graphite, and so on; but chromic acid is better still.—S. BOTTONE.

[60981.] — **Cracked Wheel.**— Let the crack remain as it is, and rivet a strap underneath. You can tap studs in crack if required; but if not, let it remain open after riveting on the strap.—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

60380. L. and S.W. Locomotives, p. 73.
60387. Toolholder, 73.
60400. N.E. Locomotives, 73.
60423. Zither, 74.
60424. Acid Stains for Wood, 74.
60427. Sheet Wax for Micro. Objects, 74.

60655. Strength of Type Metal, p. 162.
60684. Shaft, 163.
60692. Relative Positions of Flat and Eyepiece, 163.
60694. Phosphorescence, 163.

ORDERS have been issued for extinguishing the electric light in the tower at Hell Gate, New York Harbour, from and after December 1st. This action was based on the recommendation of the lighthouse board, and because of the constant complaints from mariners that the dazzling character of the light made it a detriment instead of an aid to navigation.

QUERIES.

[60982.]—**Chronic Inflammation of Nostrils.** —For some time past I have been suffering from this distressing complaint, and shall be very grateful if any of "ours" can tell me of a drug or course of treatment which will effect a cure. The insides of the nostrils are red and inflamed, and remain constantly so. Every few weeks, the inflammation increases, beginning with a smarting around the nasal orifices at the back of the mouth. This increases until the smarting has extended all through the nasal passages. Sometimes it extends over the back of the throat, producing hoarseness, and occasionally affects the lungs. As it is accompanied by an influenza cold, I am rendered half frantic between them. In a day or two, the acute inflammation subsides into the (now) usual state of low inflammation. I have tried iodine and eucalyptus without any permanent benefit. I also have cold baths every morning. Any suggestion thankfully received.—MISERY.

[60983.]—**Chloride Battery.**—Will some of our competent electrical friends please give their experiences of this form of battery? I refer to the one that consists simply of a porous cell with zinc rod in chloride of zinc and a carbon rod in the outer jar with a mixture of bichromate of potash and muriatic acid. I have been told one cell is equal to three Leclanchés. Is this so? Also, it will go three months without attention. At the end of this period, what happens? Are the solutions exhausted, or the rods covered with crystals from their respective solutions? Is this battery suitable for working bells? What I mean is this: does any local action take place when the circuit is open? The fact is Leclanchés have been doing the work, but other bells being added in circuit, more cells are required, and there is not room in the place alloted for them, so a more powerful cell must be used besides. I have the materials at hand for making them up at once if the general opinions are favourable. I have looked in back volumes, and can only find the cell mentioned once (and that for a special purpose), although I am told it is largely used.—M.M.I.SC.S.

[60984.]—**Boat Propulsion.**—I shall be obliged to any correspondent who has had actual experiences of the working of the most recent and approved methods of propelling boats, say, up to 20ft. long. I have spent some weeks in searching for the information in vain. I have heard of one style, built, I believe, upon the river Dart, in which the engine and boiler can be taken out and boat used as an ordinary yachts dinghy. Has a gas or hot-air engine yet been made to work satisfactorily and economically? Has anyone tried a treadle motion with propellor, of course not with a view of attaining any great speed, but as in whiffing in waters like the R. Fal, or other arm of the sea where this style of fishing is practised, and it is only just necessary to keep the boat moving along, which is usually done by keeping gently paddling along, both hands being thus engaged? If a treadle motion, similar to tricycle, could be adapted, it would leave both hands at liberty to manage the fishing line, or even two lines could then be used. Any information on these subjects will be gladly received.—HARRISON.

[60985.]—**Tides.**—Can any reader inform me the difference between the times of high tide on the Pacific and the Atlantic sides of the isthmus of Panama?—E. F. S.

[60986.]—**Waggon Grease.**—I would be thankful if one of my fellow readers would give me a recipe for making a good waggon grease.—R. J. C.

[60987.]—**Organ Query.**—I purpose building a single-manual organ to be played in a room 12ft. square and 8ft. 6in. high. Will one or more of "ours" be so kind as to give me a specification of one suitable? It must not exceed 6ft. 3in. high, and 2ft. 3in. deep, and 4ft. 6in. long. Would this scheme be at all suitable? Open diapason, to tenor C, 44 pipes; stopped diapason, bass, 12 pipes; keraulophon, 44 pipes; flute (for principal), 56 pipes? If not a good one, will any subscriber alter it for me? Is there any objection to the reservoir being fixed to bottom of windchest, similar to harmonium? If so, please say what. What height should reservoir 2ft. 6in. long and 1ft. 6in. wide be when fully inflated, and would this with two feeders be large enough to supply the above number of stops?—C. AND P.

[60988.]—**Loans to Building Societies.**—Would Mr. Weatherfield, or some other legal correspondent, kindly give me an idea on the following problem? A. takes up a number of shares in a building society, and builds a house, the society finding the money. B. lends money to the society, and the said society deposits the deeds, &c., of this house of A.'s as security. Now if the society becomes insolvent, can A. claim his deeds by paying up the balance of his shares in the society, or can B. retain the deeds or sell the house to recoup himself for the whole amount lent to the society? The society in their agreement with B. offer to make over at any time legally the deeds deposited with him as security for the loan; but the question is, can they do so if they become insolvent, or would A. be bound to lose his money as a shareholder in an ordinary limited liability company. I may say the society in question is incorporated under the Act of 1874. —CYCLOPS.

[60989.]—**To Mr. Wimshurst and Others.**—Having made one of your influence machines as described in the "E.M." a week or two ago, I should like to ask you a few questions relative to the working, as, although made strictly according to your instructions, it is not the success that I hoped it would have been. It was with the utmost difficulty that I could get it to work at all, and then only when warmed and induced by moderate friction with a warm duster. The results were fairly good; but the machine soon required re-warming. One very peculiar thing was that the machine would not start till the combs had been removed. Can you explain this? Our bosses were accurately turned in a lathe by a professed wood-turner; yet when the plates were fixed they did not run true. For joining the glass to the wood I used "diamond cement," which stuck exceedingly fast; but, in cooling, contracted the glass and cracked it. This it did to four plates. Is there any way to remedy this and to insure the plates running true? I should like to know why one of the brass balls on the discharging rods is larger than the other. I have inquired of many people in the electrical world, and, among others, one of your agents; but can get no satisfactory answer. Also, how is the electricity formed? Some say by the friction of the brushes; but this is manifestly wrong, as the friction is practically nil. I should say by the friction of the air between the plates. Am I right?—N. P. LONDON.

[60990.]—**Steel-McInnes Brake.**—Can any of your readers kindly explain to me how it is that the Caledonian Ry. Co. can, according to returns, work 28,000 miles with this system of brake, and yet have no engines fitted with it?—INQUIRER.

[60991.]—**Brakes on the North-Eastern.**—How many brakes are used on the North-Eastern, and what stock have they with two sorts of brakes?—INQUIRER.

[60992.]—**New Midland Engines.**—What has become of the new 1667 engines? Where are they at work? Is it true that they are having new steel boilers put on them to carry 160lb. of steam?—LOCO.

[60993.]—**Permanent Way.**—Mr. E. Woods, in his address the other day, told us at the Inst. of C.E. that a Mr. Hartley used stone walls to fix his rails on, and that in one case the chairs were fixed to solid rock. Wanted, the names of places were these plans were tried, and who first used stone-block sleepers on railways, and when?—PERMANENT-WAY MAN.

[60994.]—**Waggon Couplings.**—Do all the new waggon couplings work with loose couplings, or is there any plan to have a tight coupling without a man going in between?—SHUNTER.

[60995.]—**Brighton Engines.**—Do engines which are coupled in front, like the Gladstone, ride as smooth as those coupled behind, like 204? Does "front coupling" cause oscillation, or not, and what are the advantages of it, if any?—ENGINEMAN.

[60996.]—**Points and Crossings.**—On a straight double-road I want to put in a cross-over-road. Now, what is the extreme length, the distance from point to crossing, the angle of crossing, and the radius of curves in chains? Is there any simple book on how to lay out such work?—PLATELAYER.

[60997.]—**Cranks.**—A carriage-wheel radius (r) has a weight (w) clamped to its rim. The wheel rotates on an axis (not rolls on the ground) and is assisted by weight (w) during rotation from its highest to lowest point, and correspondingly retarded in rising from lowest point to highest point. A spoke is abstracted from the wheel and fastened as a crank to the hub, and weight w affixed to the end of this crank. Is there any difference in the retarding effect on the uprise of the wheel between the weight w clamped on the rim and the weight w affixed at the end of the spoke or crank? Centrifugal force to be excluded, or allowed for? Some of "ours" will kindly answer.—T. W.

[60998.]—**Cottage Range.**—I want to fix to chimney opening 30in. wide a range with oven on one side, but no boiler, open fire, having a fire-brick back, so that it can be replaced when burnt out. Can any reader inform me how such a range could be constructed so that it will heat the oven? The back of all the open fireplaces I have seen are made up with oven wing, and another iron part called the "sham," which soon burns out and cannot be repaired.—BRICK.

[60999.]—**Condensing Engine.**—I have one of Fowler's portable double engines, 14in., driving a large circular saw, and the discharge makes so much noise that I should like to put it to condense its own steam and to reduce the pressure. Would you kindly oblige me with information how to start to work to make it condensing? —A POOR SAWYER.

[61000.]—**Pipe Moulding.**—Would some of our readers give me a sketch how 4in. hot-water pipes are moulded to have flanges and to be ½in. metal, with a sketch of pattern and core box, to be greensand cores, with saddle placed in core for to take stud to hold down core, and if the cores are blackened or plumbago is used, and what kind of sand would you recommend?—H. S. H.

[61001.]—**Landscape, &c., Painting in Oil-Colours.**—Being very desirous of attempting to do a little landscape, &c., painting in oils, but having, as yet, not done anything beyond drawing and sketching with lead-pencil, would any of "the knights of the palette" (for I am sure there must be some amongst the numerous readers of "Ours") kindly give a few instructions in regard to the rudiments of the fascinating art of landscape painting in oils, as well as in the use of colours, vehicles, &c.? In using the colours contained in the collapsible tubes, is it necessary to use anything besides linseed oil, megilp, goldsize, &c., as the nature of the pigments require before placing them on the canvas, that they may be permanent? Being very remotely situated in a country village amongst the hills of Wales, and not within reach of placing myself under professional tuition, I cannot get the necessary information only through the medium of "Ours." Would any kind artist friend contribute a few articles on the above, or recommend a few good and cheap treatises or textbooks?—WELSH HOG-HAIR.

[61002.]—**Dynamo and Storage Battery.**—Will Mr. Bottone, or any other reader, inform me where I can get the following information? I want to light a room 12ft. by 16ft. with two 16c.p. lamps, or to about same power of light, and I want to make a storage battery that will maintain them for about 30 hours, and also a dynamo that will charge the battery. Will anyone give me details of battery best suited, as I want to drive it from a treadle lathe? What speed will it want to run at, and what time will it take to charge battery to maintain the lamps the 30 hours?—LUMSIE.

[61003.]—**Boiler Flue.**—I have a main flue at the back of boiler, 3ft. wide by 5ft. 6in. deep, which is arched with brick. Between the crown of arch and flooring tiles there is a space of 2ft. 6in., which is filled up with lime and rubble. Would it endanger the draught if I were to take away the arch and put metal girders across flue to carry a series of pipes in the 2ft. 6in. space, and cover over the top of water pipes with flue cover? Also, what is about the average temperature of a boiler flue, and would there be any danger of metal girders deflecting with the heat?—ENGINEMAN.

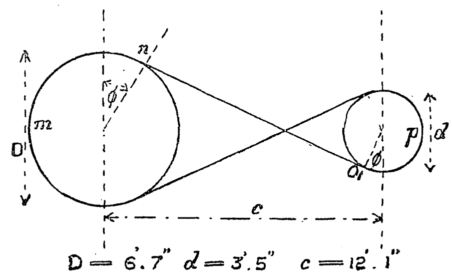
[61004.]—**Italian Language.**—TO MR. BOTTONE.—Will you kindly assist me to surmount the following difficulties—viz., how can I determine when the S at the beginning of a word is impure? How am I to obtain the present and past participles from the infinitive. These are rarely given in Italian grammars. What is the proper place for the adjective? I find it placed before and after the noun, and would like to know why it changes its position. When is it proper to leave out the personal pronoun before the verb, this being apparently a matter of taste? Is "coloro" or "englino" the proper word to use for the third-person plural pronoun? Some grammars give one and some the other. In translating the following sentence: "I go 'to the' friends of the lawyer" into Italian, why is "to the" expressed by "dagli," and not by "agli"? What grammar would you recommend, and what books to read by way of exercise? I may say that I know French thoroughly. I have travelled much in Italy, and can speak Italian sufficiently well to make my wants known; but I have a great desire to speak it grammatically. Any advice you can give will be gladly accepted by—A STUDENT.

[61005.]—**Combination.**—I have a great wish to add to my organette (31 reeds) a set of keys, so as to play with them as well as paper. Will some kind friend suggest a method, and, if not asking too much, send sketch for the same?—A. B. C.

[61006.]—**Influence Machine.**—TO MR. WIMSHURST.—I have made one of these machines with 16in. plates but no Leyden jars, the conductors being mounted on glass rods. Can readily obtain sparks between the terminals, but they are only about an inch long. Should they not be longer? I cannot notice any escape of electricity when working the machine in a dark room.—NIL.

[61007.]—**Polishing Whalebone.**—I should feel obliged if someone would tell me the material that is used for polishing whalebone, and if it can be done on a wheel. What speed should it travel, so that it can be done quickly?—BLACKSMITH.

[61008.]—**Length of Belting.**—Will any of your correspondents help me? In a work on belting I have, the following formula is given for obtaining length of a crossed belt (the enclosed diagram gives figures and measurements):—



Length—$L = 2\,(m\,n + o\,p + n\,o)$

$$= \left(\frac{\pi}{2} + \phi\right)D + 2\,c \cos\phi + \left(\frac{\pi}{2} + \phi\right)d.$$

$$= \left(\frac{\pi}{2} + \varphi\right)\Sigma + 2\,c\cos\phi\;(\Sigma = D + d) \qquad 2$$

$$\text{Sin}\,\phi = \frac{D + d}{2\,c} = \frac{\Sigma}{2c} \qquad 3$$

The length of the belt is obtained thus: Calculate the value of sin ϕ. From a table on natural sines and cosines "find the nearest values of cos. ϕ and φ, the latter being expressed in circular measure." Then eq. 2 gives the belt length. If ϕ is found or measured off the drawing in degress the circular measure of the angle is obtained by multiplying by 0·0175. I don't quite understand the meaning of the words between inverted commas, and I shall be glad of any assistance in the difficulty. If any of your correspondents would work the question out on the measurements given, and you can spare the space, I would be obliged.—OLDHAM CHAP.

[61009.]—**Induction Coil.**—TO MR. S. BOTTONE.—Will Mr. Bottone kindly say what length of primary and secondary I should require for a coil to give a 3in. spark in air? Also the proper size of each and length of coil? What number of quart-size bichromate cells would be required to work it full power?—REKLAW.

[61010.]—**Donkey-Pump.**—Will someone kindly say if the "Atlas" steam-pump made by Tangye Bros., or the "Special," made by Piggott, Birmingham, are suitable, and which is best, to feed two 25H.P. low-pressure boiler that work to 25lb. pressure, and to supply good pressure to hose for washing decks, or is a fly-wheel pump the best? How would either of above answer with steam cylinder 6in. and pump (double-acting) 3in.?—TUG-BOAT.

[61011.]—**Faulty Dynamo.**—Will some brother electrician help me in my difficulties? I have made a dynamo machine, and it will not work, as I cannot get a spark out of it; but as a motor it works well. Can you give me the reason? I don't know if I have enough wire on it for a dynamo; I have 4½lb. of d.c.c. wire. The F.M. is 7in. high, 3in. wide, and 6in. jaws. It has Siemen's armature, 2ft. 6in. I have tried the battery on it, and it is well insulated throughout. I have given it 1,700 revs. per min., and it will not give a single spark. Will you kindly explain it to me?—ANXIOUS.

[61012.]—**Annealed Zinc.**—What is the best way to anneal zinc after casting? Any information as to this will extremely oblige—METAL.

[61013.]—**Physics.**—In what proportion does the specific gravity of the principal elements decrease with an increase of temperature, or, in other words, what is the co-efficient of expansion in "mass"? Ganot gives the "linear" coefficient; but would this be as correct for the expansion in bulk as the specific gravity at different temperatures? Also, who is the publisher of "Woodward's Arithmetical Chemistry"? I have searched several catalogues without success.—EQUIVOLT.

[61014.]—**Chocolate Glaze.**—Will anyone kindly tell me how to make the chocolate glaze used by confectioners for glazing pastry?—PUZZLED.

[61015.]—**Magnets.**—I wish to make about 20 pairs of small field magnets whose pole pieces (when the wire is wrapped round) are only ½in. diameter. Will it make any difference to the "power of fields" if there is twice as much wire on one leg as the other?—MECHANIC.

[61016.]—**Organ.**—Would our invaluable and ever-willing friend "Uranium" oblige by giving width and length of C C and top G oboe reeds? Also same measures of clarionet reeds and the width of their four respective tongues, suitable for a chamber organ of 12 stops—four on great, four on swell, 2½ wind? I am thinking of making blocks and feet of hard wood, turned in the lathe, and tubes of paper or zinc. Also say which is best—vertical or diagonal notches in flue pipes, as the latter seems to me to have a tendency to drive or direct all the wind on one side of the mouth.—J. H. C.

[61017.]—**Incandescent.**—Under the heading "A New Incandescent Lamp," the following appears in one of our "weeklies": "An incandescent lamp which requires no vacuum in the globe has been invented in Germany. The wire used is a mixture of conducting and non-conducting elements, the latter preventing the former from melting." Could anyone give us correct information about this lamp—what the filament is made of, &c.?—LAMPS.

[61018.]—**Optical Lantern.**—I am making a lantern, and find that with the same condensers I can place the lenses, say, 6in., 9in., or 12in. from the condenser, provided suitable lenses are used. Why is this? If 6in. is the proper place to catch the right number of rays of light from the condenser, how is it that I can get, or appear to get, the same number at 12in.? Can I have as good lenses for the long focus as for short, or must I use single lenses for long focus?—LIME LIGHT.

[61019.]—**Brazing.**—Can any of our readers give me any hints on brazing steel saws? They are an inch broad. I should also like to know whether there is any apparatus for performing the same.—G. M. W. W.

[61020.]—**Electrical Paper.**—I want a solution in which to soak paper, so as to make it a conductor of electricity when dry. Also want to put a surface on paper which will conduct electricity. I have some magneto generators, which I want to convert into motors. What size wire shall I wind armatures with, so as to get best results with, say, 20 cells, gravity battery? and please give arrangements of cells. Armature sizes, 3in. long, 1⅜ diam, Siemens H.—LUX.

[61021.]—**Induction Coil.**—Core, 8½in. long, ⅞in. thick; primary coil, 7in. long. Query: (1) Whether 20 or 22 iron wire for core; (2) whether 16 or 18 double silk-covered wire for primary, the number of layers being two; (3) whether 36 or 38 double silk-covered wire for secondary, and the quantity, which will be wound in two sections, divided by a piece of millboard soaked in paraffin-wax, ⅛in. thick; (4) thickness of insulation (which will be of paraffined paper) between each layer of secondary, and between primary and secondary coils; (5) full length of spark to be expected?—L. W. WILLIS.

[61022.]—**Leather.**—Can any of your numerous correspondents inform me of a rapid means by which I can extract the colouring matter from leather? I have had a piece of the best English-tanned leather in water for the last three weeks, and, no matter how often I change the water, it still turns red after standing a few hours. Is it necessary that I should wait, perhaps months, till I can keep the water clear?—J. P.

[61023.]—**Reducer.**—Good formula wanted for above, to reduce parts only of a negative by aid of a camel-hair brush.—CROW'S-NEST MAN.

[61024.]—**Sensitising Drawing Paper.**—Formula wanted for sensitising drawing paper, such as Whatman's. Does such paper receive previous preparation in any way?—CROW'S-NEST MAN.

[61025.]—**Platinotype Printing.**—Does the quality of daylight matter in printing in above process, or can equally good results be obtained in all states of daylight and time of year?—CROW'S-NEST MAN.

[61026.]—**Smoking Fish, &c.**—Could any reader inform me how to keep the sawdust smouldering, as, unless I keep red-hot irons in it, it goes out?—ARCHER ASHBY.

[61027.]—**Single-Lens Eyepiece.**—Would "F.R.A.S.," or Mr. Sadler, kindly say form of single lens eyepiece he would advise? I see Mr. Webb, in "Celest. Objects," says it is better to have the lens convex side to the eye. I certainly find a single lens most useful for certain purposes, as I have slow motion.—H. A.

[61028.]—**Etching.**—I have a difficulty in getting the ordinary fluoric acid to bite. Is there any way of increasing the etching power of the acid on glass, or is there any special preparation of fluoric acid for this purpose? I have tried the principal chemists in London.—C. W. ELLACOTT.

[61029.]—**Gourd Drinking Cups.**—I have heard of, and want to make, cups of gourds. Will some of "ours" say how to proceed, how long to be kept to dry, if fitted with feet or turned off, and how chucked, &c.?—CAZENOVE.

[61030.]—**Cleaning and Tapping Brass Nuts.**—Will any reader inform me how to clean up outside and tap hexagon ½in. brass nuts, as I have a quantity to do, and wish to do several together, if possible? I have a lathe and shaping machine at my disposal.—CAPTAIN CHRISTY.

[61031.]—**Brass Boiler.**—What pressure could a brass boiler of ⅛in. in thickness and having brazed seams stand? Also give me a good description of Leitch's rotary engine.—NEILSON.

[61032.]—**To Mr. Bottone.**—What size and quantity of wire should I need to wind a dynamo double the size described in your book? How many 5c.p. would it run, and what power should I require to work it?—G. P. R.

[61033.]—**Panorama.**—Will some correspondent kindly give me a description (and sketch, if possible) of the rolling gear of a small panorama? The continuous canvas is 6ft. wide and about 60yds. in length.—HENRY W. WEBB.

[61034.]—**Boiler.**—To "T. C." OR OTHERS.—Will you explain the following? On the feed-pipe of a boiler there is a valve with the words, "regulate the lift of this valve so as to give a constant feed." A sketch if possible. 2. There is a row of economisers behind boiler. Now, how is the water run in these? Does it require two pumps, one to force the water into corners and the other to draw it from corners to force it into boiler? Or will one pump do? If so, where should it be placed? Please state fully, as I have to take charge of these shortly.—ONE WILLING TO LEARN.

[61035.]—**Re-cutting Fret Saw.**—I have a large fret saw with four of the teeth broken. I should feel thankful to some kind reader if he could instruct me how I could re-cut it for a new set of teeth. I think I could cut the gullets out with a small emery wheel in the lathe; but how am I to get the old teeth all cut out in a straight line?—YOUNG TURNER.

[61036.]—**Observatory Shutter.**—Will someone kindly help by suggesting a means of working the above? Size, 9ft. long, 1ft. 6in. wide at top, 3ft. 6in. wide at bottom, of wood, with 4in. by 1in. styles, and rails with ⅝in. matchboarding, covered with painted calico; roof, conical (with a cap at top which lifts), on a 12ft. drum, the shutter to open and lie flat on adjoining portion of roof. The shutters originally stood upright when open.—C. T.

[61037.]—**Indigo-dyed Serge.**—TO MR. ALLEN.—In a sample submitted to me, I found an aniline blue. Is such a dyestuff ever legitimately added? If so, to what maximum extent? What quantity of indigo relative to the weight of the cloth, presumably of good quality, may one expect to be present? By a "practical" man, it was asserted that woad had been used. By this I suppose was meant that the cloth had been dyed in a woad vat. Now, seeing that woad is only used to start fermentation, and is thereby split up into indigo and other products which are not dye-stuffs, I cannot conceive how he was able to decide the point — certainly not chemically, I should think.—B. B.

[61038.] —**Ampere's Theory.**—When reading up Ampères Theory of Magnetism, I was much struck by the fact that he assumed an electric current to circulate round each molecule of a magnetic body. He did not (as far as I can learn from the textbooks I have read) seek to point out the origin of these tiny currents. Now, as every effect must have a cause, I have often tried to build up a theory which would satisfactorily explain their origin. I have succeeded in making out one, which appears to me to be good, and I would fain lay it before the readers of the MECHANIC for criticism. However, before doing so, I should like to know if any of "ours" have already seen an explanation of these currents, and, if so, in what work?—J. J. H.

[61039.]—**Electric Light Battery.**—Is there a battery (non-fuming) which will give a good light to, say, ten 15-candle lamps constant for 60 hours? I was in Messrs. Burrows and Watts', Soho-square, a short time since, and saw there a number of incandescent lights worked from a lot of 1ft. (cubic) cells, which I was told would last 70 hours. Can anyone give description and account of its performance? I want the light for a private billiard room.—THOMAS PLUNKETT.

[61040.]—**Levelling Glass Cells.**—What is a good thing to run into the bottom of glass battery cells to make them level, so that the porous cells may stand firmly? I have tried plaster-of-Paris; but the solutions seem to dissolve it. I have also tried bedding a glass plate in the plaster. This does for a time, but eventually works loose.—MEM.SOC.ENG.

[61041.]—**Joints in Hot-Water Pipes.**—Will any of our engineers kindly give me a little advice? I have a low-pressure cast-iron hot-water boiler, with tubes. The fire passes between the tubes and round them, likewise on the socket joints. What is the best material to make the joints with, and how made? I have some spongy cast tubes. Can they be made water-tight for low pressure? They are ⅝in. thick.—UNDER FITTER.

[61042.]—**Seeds.**—Having commenced making a collection of seeds, I should be very pleased to know how to preserve the full shining appearance of large seeds, such as chestnuts or acorns. I have some acacia seeds many years old, about the size of sweet peas, but elongated. They still retain vitality, and are as bright and full as when new. They are half red and half black. Is it their natural colour? Should be also much obliged to any one of "ours" who would give me the names of books on the subject.—W.

[61043.]—**Power of Gas-Engine.**—What will be the power of gas-engine on the compression principle, cylinder, 3in. dia. and 3in. stroke, rev. 450, with 60lb. fly-wheel?—C. J.

[61044.]—**Band Saws.**—I have a band saw running daily at an ordinary speed. Would someone tell me the average life of one of these, as I find they will not exceed two months? They have to cut all hard woods, such as English oak and ash and elm, from 2in. to 8in. thick. I find they give first in bottom of the teeth. The employers think it a short period.—WOOD SHOP.

[61045.]—**Spring Motor.**—I want to run a spindle, carrying 1lb. weight and running freely, 2,000 revs. a min. for six hours. Please say what power of spring (clockmaker's gauge) and arrangement of wheels is required.—M. NEWMAN.

[61046.]—**Logarithms.**—Why did Napier take 2·71828 for the base of his system of logarithms? Also, will some one inform me how, in the following formula, (2) is obtained from (1)?

$$z = \frac{2}{n^3 - 3n} \cdot \frac{1+z}{1-z} = \frac{n^3 - 3n + 2}{n^3 - 3n - 2} = \frac{(n-1)^2 (n+2)}{(n+1)^2 (n-2)}$$

$$\therefore 2 \log. (n-1) - 2 \log. (n+1) + \log. (n+2) - \log. (n-2) \ \ldots\ldots\ldots (1)$$

$$= 2\,\mathrm{M} \left\{ \frac{2}{n^3-3n} + \tfrac{1}{3}\left(\frac{2}{n^3-3n}\right)^3 + \tfrac{1}{5}\left(\frac{2}{n^3-3n}\right)^5 + \&c. \right\} \quad (2)$$

I fancy an answer to one of these two questions will answer the other also. As the same construction is constantly recurring in mathematical formula, I should be extremely obliged for a lucid reply.—EQUIVOLT.

[61047.]—**Multiplex Copying-Ink.**—In a former number this ink was said to be prepared from one part of violet methylated aniline to seven of distilled water and one of alcohol. Is the methylated aniline a fluid, and where can it be obtained? I have tried the powder, but do not know how to proportion it to the water. Can any of your readers favour me with a clear and well-tested recipe, and also give me the best recipe for the preparation of the jelly? And say whether Anderson's prepared paper in lieu of the jelly is satisfactory—whether it will keep for a long time, and how it is prepared?—SIGMA.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 24, and unacknowledged elsewhere:—

JOHN MACLEAN.—C. Penruddock.—A. Francois.—Fowler, Lancaster, and Co.—S. R. Bottone.—B. J. Hopkins.—A Fellow of the Royal Astronomical Society.—E. Conry.—H. Sadler.—C. Gunn.—E. F. S.—Stoker.—J. T. Garbutt.—J. W. R.—A. B. C.—Novice.—F. R. C. S., Eng.—Cedar.—Brian Boru.—W. H. Thurlow.—A. F. Shakespear.—E. R. Dale.—Omnium Gatherum.

J. N. H. (If any one can be said to have "invented" the locomotive, it is Richard Trevithick; but Cugnot, in France (18th century), and Oliver Evans, in America, are respectively claimed by those who regard facts through tinted spectacles. The printed letter you forward has been written in ignorance of the facts, for it is certain that Trevithick turned the exhaust steam up the chimney as early as 1804. Hedley, Hackworth, and G. Stephenson all helped to improve the locomotive; but there is no doubt that Stephenson is correctly described as the "father of railways." To speak of Stephenson or Hackworth as the "inventor" of the locomotive would be absurd. See pp. 404, 428, 475, 504, 549, Vol. XXXIII., or the "History of the Invention of the Locomotive," published by T. West, North-road, Darlington.)—MACHINIST. (How can it be when it is not yet completed? Probably it will be published in book-form.)—TERRANOVA. (Oxalic acid will certainly remove any iron ink; but it is necessary to bleach after its application with weak solution of chloride of lime.)—J. H. S. (Stand it on thick rubber sheeting, and line any adjacent wall with canvas papered over.)—H. G. (Coal-tar naphtha is the natural diluent of pitch. It is sold under the name of mineral naphtha.)—FRETOMANIA. (The Britannia Company, Colchester, have one which answers the description. Procure their catalogue, and also that issued by Churchill and Co., Cross-street, Finsbury.)—INQUIRER. (You could change it to a bichromate, of course; but see the indices. Bunsens always fume; but surely you can keep it outside the house.)—DR. HALL. (See indices for many articles and notes on the subject. For instance, No. 1092, p. 533; No. 1005, p. 380; No. 943, p. 158. See an article in last number about the Foraminifera.)—J. G. (If it is so hard, it has probably perished. Try what effect gentle warming has. Stop the leak with a piece of calico and solution of indiarubber or guttapercha tissue wrapped round.)—OLD LONDON. (Nicholl's "Theoretical and Practical Boiler Maker," published by the author at Blackpool; but there is no treatise specially devoted to boilers of the kind you refer to. Indeed, makers themselves are only experimenting.)—H. S. (Probably Mr. J. E. Aylmer, Leadenhall-buildings, E.C., can help you. He was the representative of M. Trouvé at the "Inventions.")—MAX. (Unless an acoustic telephone will do, you must apply to one of the companies. See advertisements.)—IGNORAMUS. (For coating iron with lead see p. 481, last volume. Coating with zinc is called galvanising, the iron being dipped into the molten zinc. The electrical process was abandoned years ago.)—ALOOK. (Saws, mitre block, shooting-board and plane, hammer, bradawl, nails, vice, and clamps.)—INKPOT. (1. No danger of "lightening." 2. The "Mechanical telephone" was described in No. 1061, p. 447.)—J. T. (Must be more explicit. Some moulds are made of wax, others of gelatine, others again of sulphur. Say what it is you want to do.)—C. F. (Squeeze them out, or rub in paraffin oil. 2. The law is not settled; but the local authorities can prevent their erection. 3. Scandinavian red fir is generally used. The duration depends on local conditions. 4. Yes. 5. No remedy, except lacing them together at frequent intervals by some non-conductor, wrapping the insulators with vulcanised rubber, or inclosing the wires in vulcanised tubing.)—AMŒBA. (Huxley and Martin's "Course of Practical Instruction in Elementary Biology," Macmillan, price 6s.)—LOGARITHM. (Probably you mean Haskoll's "Engineering Fieldwork." If so, that is published by Crosby Lockwood and Co., Stationers' Hall-court, E.C. There is a "Field Book," by the same author.)—G. B. G. (Spretson's "Treatise on Casting and Founding," published by Spon, 125, Strand, W.C., may suit.)—SCHEMER. (For how to make a smith's fan see No. 872 specially, and Nos. 861, 862, 886, 915.)—IGNORAIN. (Read the description again, and see if you have not omitted to notice some point of detail.)—COUNTRYMAN. (Try some of the recipes given

in back volumes. A simple and fairly effective method is to rub the wrong side of the cloth with pure beeswax until it is completely covered with a thin coat; then pass a hot iron over it, and brush the cloth whilst warm. Paraffin wax melted up with a little linseed or other drying oil, and cast into blocks, does as well as beeswax. To make waterproof calico damp the fabric, and coat with linseed-oil.)—A. E. PITT. (You are not obliged to patent it or register it; you can use any trade mark not already appropriated, but if you want to protect it you must register it.)—DUSTY MILLION. (Really, such questions should be sent to a sporting paper. Lord Falmouth's colours are—first, black, white sleeves, red cap; second, white, black sleeves, red cap; and third, rose upon ermine, black cap, gold tassel. 2. G. Barrett rode Farewell when she won the One Thousand.)—PUZZLED. (There is only one satisfactory way. Cover the articles with the black varnish, and put them in a "stove" to dry and bake. See p. 36, Vol. XXXIV., and the indices. 2. As to case-hardening, see answer to "Amateur, W. L.," last week, p. 271, and the indices.)—GAS-FITTER. (Use all Leclanchés. Procure a catalogue from Gent and Co., Leicester, or Mr. Blackwell's list, Chapel-street, Liverpool. Look through back numbers.)—M. R. (You will find an illustration of the details of an electrical "sign" in No. 886, p. 41, or a description in No. 790, p. 239. Little reflectors are suspended so as to swing in holes in a plate which is put into vibration by means of a magnet and a battery, on the same principle as an electric bell is made to work.)—A YOUNG ENGINEER. (If you cannot refer to back numbers you will find a full description in Mr. Jamieson's recently issued "Textbook of Steam and Steam Engines," and also in many of the manuals. It is known as a Prony brake, or absorption dynamometer.)—J. BURLEY. (They are sharpened by rubbing with emery and oil on a strong flat glass plate. If there is a machine, no doubt the wheels would run horizontally. See Hints No. 4.)—STEENIE. (The Australian sovereigns are nominally of the same standard in fineness, and the same weight and value as those issued from the Royal Mint. Practically they are identical in value; but if there is a difference it would no doubt be in favour of the Australian coin, which has silver instead of copper in its composition.)—CHEEKOS. (Take plenty of exercise, and avoid fattening diet.)—W. L. (See indices of back volumes, and recent numbers.)—IGNORANT. (Tire cements are made in various ways; but as good as any is made by mixing three parts of Stockholm pitch, 3 parts of resin, 6 parts of crude caoutchouc, and 12 parts of oil of turpentine by the aid of heat. Guttapercha, pitch, and turpentine make another good cement. As a rule, it is cheaper to buy such a cement than to make it in small quantities.)—CAZENOVE. (Yes, if the tap leaves the passage fully open. There is a slight difference after a time, as the burner becomes hot, and therefore expands the gas slightly, so that less passes than when the burner is not alight.)—T. BRIGGS. (Must explain fully. It is illegal to deface coins and tokens of the realm. What is meant by "enamelling"?)—ELECTRIC LIGHTER. (We have frequently stated that a Daniell battery is not suited to electric lighting purposes. If the electric light is wanted continuously, it may be economical to use a Daniell. You will have seen what has been said recently.)—METER. (If correctly drawn it reads 131,000 cubic ft.; but we never saw an index like it. The figures in the centre dial are the wrong way. Look again. All the dials surely are not alike. The small dial is for experimental purposes, to detect leakages, &c. One revolution means 2 cubic feet consumption.)—ETIENNE. (Try Messrs. Dawkins, 17, Charterhouse-street, E.C.)—G. T. T. (Kindly refer to the numerous replies about dynamos, which have appeared in the last six volumes.)—M. A. B. (See indices, and recent back numbers.)—H. BERT. (The gas-engine has been frequently described in back volumes. For a general description, see p. 92, No. 1071, p. 155, No. 1021, and the index to Vol. XXXIX.)—H. H. (Get Britten's "Watch and Clockmaker's Handbook" from the author at the Horological Institute, Northampton-square, E.C. 2. Try a mixture of red lead, flour, and sugar.)—AMATEUR, Halifax. (Do you mean bronze varnish, or "browning," such as gun barrels? Methods of doing both in back volumes. One method of bronzing the actual surface is to expose the articles to the vapours of a heated mixture of strong hydrochloric and nitric acids for a few minutes, and then heat the articles up to 650° Fahr., or so. When cooled, rub over with vaseline. Acetic acid is also used in conjunction with the above-named acids.)—HARRY. (Wood-engraving is practically replaced by the photo.-zinco. processes. Still, there is "always room at the top"; but at least 75 per cent. of those who earned a living six years ago by wood-engraving have had to adapt themselves to some other work. Messrs. Lockwood and Co., Stationers' Hall-court, E.C., publish a handbook of the art.)—JACK. (No, why should it?)—WALTER E. WEBB. (We do not know; but the Finsbury Technical College is not so very far from Hackney, and you would get the best teaching there. The college is not much more than a mile and a half from the Triangle.)—THOMAS SMITH. (We do not reply by post. 1. An oil would circulate. 2. We do not think there is; but what is your object? Water is the best thing. 3. Do not know what you mean by "40 degrees of steam," but steam at 40lb. pressure on the sq. in. has a temperature of 287° Fahr., and that would be approximately the temperature of the water in a boiler under such pressure.)—F. R. C. S. (In such circumstances a hot-air engine would be best, unless you can obtain petroleum cheaply, and like to try one of the new petroleum engines. A hot-air engine is rather large for its power, but it is practically no trouble, and wants only an occasional supply of fuel. A windmill would be useful.)—C. C. (Procure the pamphlet published by Gent and Co., Faraday Works, Leicester.)—W. T. CADMORE. (For incubators, see No. 1007, p. 425, No. 1009, p. 471; No. 935, p. 562; No. 908, p. 553; and the indices of back volumes.)—A., Liverpool, RAYMOND BROWNE, F. A. M. (In type.)

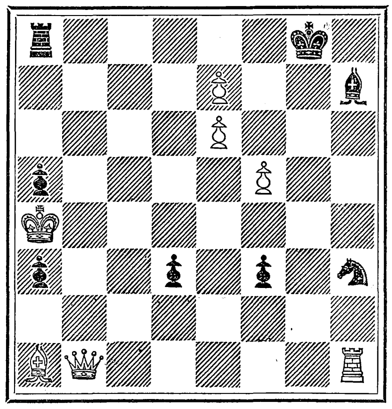
CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXIX.—BY C. KONDERLIK.

(From *The Gaulois.*)

Black.



White. [7 + 8

White to play and mate in three moves.

SOLUTION TO 1,017.

White.	*Black.*
1. Kt-Q 3.	1. B takes B (*a*).
2. Q-B 8.	2. Moves.
3. Mates	
	(*a*) 1. R-Kt 5.
2. Q-Q Kt 7 (ch), &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,016, by G. T. Stringfellow and Link; to 1,017, by A Beginner and J. Krasser, but second move in main play wrong, Q-R 7, as if 2. $\frac{\quad}{\text{B-Q 5}}$ 3. $\frac{\text{Q-Q 7}}{\text{K-B 5}}$. To 1,018, by Black Pawn.

G. T. STRINGFELLOW.—Thank you for your letter and for the friendly interest you take in Tourneys.

G. A. A. WALKER.—We are obliged by your suggestion, of which, when the time comes, we shall avail ourselves. Name entered for A and B.

SNOWDROP AND J. KRASSER.—Names entered for A and B; Hensing and Country Boy for B.

A BEGINNER.—If in your second attempt at 1,018 you mean 1. Q-K R 3, R takes Q. Your first attempt we have shown to you is wrong.

BLACK PAWN.—Revised version of two-er received with thanks.

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Wanted, **Photo Apparatus**, wet or dry, cameras, sundries, &c., in exchange for Microscopic or Magic Lantern Slides.—Apply, PIGGOTT, Chemist, Huddersfield.

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Tricycle, Coventry lever, double steering, two track, adjustable pedals, cushioned seat, good condition, newly painted. Offers.—FORD, 75, St. Paul's-road, Camden, N.W.

What offers for complete **Parts of Six Tricycles,** rear steering, partly made, rims drilled, hubs drilled and tapped, 6 wheels made, all lugs brazed on, cranks finished; when completed eminently suitable for hiring out; good winter occupation ready for next season. Wanted, one horse-power Gas Engine, suitable for dynamo. Other offers requested.—BLACKFORD, Mathinist, Windsor.

Steam Engine, powerful one-horse, Washing and Wringing Machine combined, Hand Sewing Machine, small Boiler on wheels, Shop Stove. Exchange.—MILLER, 1, Melbourne-square Brixton-road, S.W.

Lathe, back motion, expanding chuck, 10in. centres slide-rest, no bed; for Vertical Engine and Boiler, 3 H.P.—WM. SKINNER, 26, High-street, Elgin, Scotland, N.B.

"**English Mechanic,**" 5 Vols., Nos. XXXVII. to XLI., inclusive, for sale or exchange. Should like Mr. J. T. Sprague's "Electricity," latest edition.—J. GRAY, 10, Pancras-road, N.

A 10-stop Pipe **Finger Organ** for an American Organ. Space required.—Address, EXCHANGE, No. 83, Stanhope-street, Newcastle.

"**English Mechanic,**" to date, 44th volume, complete and clean. Offers in scientific articles.—Address as above.

Wanted, small **Rolling Press,** suitable for zinco-transfers. Offers.—BEAVEN, Warminster.

Wanted, small **Litho. Press,** suitable for amateur. Exchange Lenses, &c.—BEAVEN, Warminster.

Model **Vertical Engine,** cylinder 2¼in. by 1½in. Would take a Slide-rest, or anything useful for a 2½ centre lathe.—W. MARTIN, 25, Willow-grove, Plaistow, Essex.

Electro-Platers.—Brass Moulds for casting Britannia-metal Cruet, handle, feet, supports, weight 30lb. Samples sent. Exchange for Gramme Armature (Dynamo Castings, Xero). Value 70s.—HEMMING, 165, George-street West, Hockley, Birmingham.

Electric Motor and an Edison Electric Pen for exchange. Offers invited. Value 15s. and 42s. respectively.—BRAUN, 1, Kilburn-square, N.W.

Wanted, **Launch Boiler,** Engine, Propeller, &c., for 16 by 5ft. boat. Can offer lot new Hammers, Axes, Planes, Ironmongery, Cutlery, &c.—HARRISON, Devoran, Cornwall.

Youths' **Tricycles,** Meteor pattern, 3 machines, part finished; 1 cwt. loose fitting. Exchange good Lever Watch, offers.—Letters to W. SMITH, Bilston-road, Wolverhampton.

Model **Boiler,** 10¾ long, 6½ wide, all copper, tubular, Locomotive shape, with internal firebox, safety valve, taps, &c. Offers in exchange.—H. BUDD, Stoke-road, Gosport.

Leading Screw and **Change Wheels,** suitable for 5in. Lathe, and set suitable for 7in., in exchange for anything useful.—R. SMITH, Fazackerley-street, Chorley.

Blocks and Rope, three sheave, 1¼ rope, very good condition. Exchange good Opera-glass or offers.—R. SMITH, Fazackerley-street, Chorley.

Dynamos, two small, and one Motor. Drill Chuck, with plug, nearly new. Want 2-jaw chuck or offers.—REV. HERVEY, Hartley, Alton, Hants.

"**Marks on China,**" by Chaffers, published at 42s. Out of print; new; Set of eleven Pool Balls, in basket; for scientific apparatus.—SOUTHWELL, Chemist, Boston.

Half-plate **Camera and Lens,** by Lancaster, 2 double dark slides, tripod, case, drop shutter, &c. Value about £5. Will take £3, or exchange for good 52in. or 54in. Bicycle.—Full particulars to JAS. CHISHOLM, 390, St. Vincent-street, Glasgow.

Concert **Flute** (cocoa), eight German-silver keys, for Telescope, Camera, or offers.—T. K. MELLOR, Cloth Hall-street, Huddersfield.

What offers for any of the following?—**Photos.** of Actresses, Celebrities, &c., Pike Rod, Meerschaum, Lantern Slides, views Irish scenery.—EDWARD HUGHES, Graigue, Kilkenny.

50in. **Bicycle,** new, Bown's Æolus ball bearings to front wheel, cone to back, cowhorn handle bars, 60 spokes, splendid machine. Part exchange. Approval.—F. GRIFFITHS, Wednesfield Heath.

Portable **Bichromate Battery,** three cells with ratchet arrangement to lift plates, best make, in polished box, very powerful, good condition; cost £1 12s. 6d. Exchange for Electric Motor about same value, or other apparatus.—A. H. ULLYETT, Calham House, Folkestone.

Horizontal **Engine Patterns,** 2½ by 5, complete set with drawings. Made by an experienced man. What offers?—MACKAY, 48, Stanley-terrace, Lincoln.

Wanted, 6in. back-geared **Lathe,** complete, for 52in. Bicycle, nearly new, to value £9 10s. Not ridden 50 miles. Cost £12 10s.—GEO. E. R., 31, Farley-road, Norwood Junction.

Seven volumes of "**The Engineer,**" range from 1860 to 1867, well bound and clean. What offers?—W. MOSS, 18, Croton-place, Armley-road, New Wortley, Leeds.

Lantern, 3¼in. condenser, single; also some splendid Slides, astronomy, &c. Exchange.—IHOW, Lenzie, N.B.

Neat **Coil,** ⅛ spark, with battery; 8 "Crosby" Batteries, 5 c.p. Lamp, Wire, Chromic Acid. Offers, value 13s. 6d.—School House, Warborough, Wallingford.

Pigeon Hole Cupboard wanted.—R. BAKER, Sudbury-road, Thornton Heath.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 3, 1886.

NOTES ON THE CHURCH ORGAN.
I.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

FINDING that my "Notes on the Chamber Organ" have met with warm approval from the readers of the ENGLISH MECHANIC interested in organ matters, I feel emboldened to submit, for their consideration, a few remarks on the subject of the Church Organ. On first thoughts, the subject may appear to be one calling for little comment; for it is generally believed that all that can be done has been done to render the Church Organ a perfectly satisfactory instrument. While I am free to admit that the Church Organ, generally speaking, is not, at the present time, in the same neglected condition as we find the chamber organ to be in, yet I consider that there is a very general misconception with reference to the proper appointment of organs for churches; and that a little more thoughtful attention given to the matter would lead to considerable alteration and a substantial improvement in instruments intended for the accompaniment of sacred song. It is a noteworthy fact that, notwithstanding the great numbers of Church Organs which have been built during the last quarter of a century, it is quite a matter for congratulation to find one which can be pronounced entirely satisfactory. Several causes have led to this state of affairs; some attributable to the blunders of architects; some to the want of knowledge and skill on the part of the organ builders; and some to the total ignorance, on all matters relating to the appointment and construction of organs, of those persons who, through accident or other circumstances, have been deputed to decide on the specifications to be adopted and the manner in which they are to be carried out. Perhaps, after all is said, the most potent agent which has been at work in causing the failure of the generality of Church Organs is the misdirected ambition on the part of consequential "organ committees" and enthusiastic organists.

I have been speaking of the past; but all the causes of failure, above alluded to, obtain at the present time. Before proceeding further, it is advisable that I should enlarge somewhat on these causes of failure.

Firstly: Architects, in their carelessness, if not complete ignorance, regarding the requirements and construction of organs, very frequently fail in providing proper accommodation and suitable localities for their reception. It is only just to remark, however, that architects are often blamed without valid reason; for when they have succeeded in providing ample accommodation for organs of sufficient size for their churches, they are condemned by those wiseacres who have been induced to order instruments out of all proportion to the places they occupy. Cramping, crowding, and a host of other evils attend such unreasonable proceedings; and the architects get blamed for faults they have not committed. It is highly desirable that architects should study the organ sufficiently to be able to plan proper accommodation for the instruments to be placed in their churches. Even a rudimentary knowledge of the nature and construction of the organ would prevent many mistakes being made. Why architects should give the organ so little attention is a matter of surprise to many, as it certainly is a most important piece of church furniture. It is quite as necessary that the organ as that the pulpit or font should be properly placed. Apart from this, it may be made a most beautiful and effective feature in a church interior. All who neglect the organ err both on utilitarian and artistic grounds.

"The organ can go anywhere; any sort of a place will do for the organ!" are ideas which have been only too rife amongst church builders, and only too often acted upon when the slightest difficulty with regard to space has arisen, or when peculiarities of site have rendered some care and ingenuity necessary. I firmly believe some architects have looked upon organs as necessary evils—things with which they have nothing to do, except to take care that they are made as little of as possible and kept well out of sight; unfortunately, this means out of hearing also. As a general rule, an organ to be well heard must be well seen—every obstruction to sight will likewise be an obstruction to sound. It may appear strange that such a state of things should exist; but the facts must be obvious to every one who gives the subject of Church Organs the least attention. This may be said to be the age of cheap church building, and economy is the excuse for all manner of mistakes—small, low, and badly-planned organ chambers amongst the rest. The irrepressible desire to have every available yard of a church seated, to curtail every adjunct for the sake of sittings and pew-rents has, perhaps, been the most active agent at work of late years in cramping organs, and leaving organ-chambers little better than holes in the wall.

Secondly: Organ builders run in grooves. It is a matter of greater difficulty than the generality of persons have any conception of to get organ builders to depart from the lines they have been accustomed to; they, in all probability, gave their adherence to the traditional practice of the art when they swept out their masters' workshops, and ever since they have been far above being taught any *new* ideas. A short time ago, during an interesting conversation with one of the three greatest living organ builders, I asked, "How is that you organ builders leave anything to be taught you by outsiders"? He replied "We all work, day after day and year after year, in the grooves handed down to us by past generations of builders, and we thoughtlessly and conceitedly follow those grooves until we can see nothing good outside them." This admission was made by an organ builder who, of all men known to me, has displayed the least disposition and necessity to follow blindly in the footprints of others. It can only be this tendency to go on day after day in the well-beaten paths that accounts for the little progress and individuality displayed by builders of talent and reputation in the construction and appointment of their Church Organs.

This adherence to traditional grooves cannot help producing a certain degree of narrow-mindedness, and fostering a conviction that there is nothing more to be done or learnt; and it is probable, in a number of cases, that organ builders nurse their own conceit to such an extent as to look upon any attempt to convince them of errors of judgment as a gross impertinence. When an artist, in any branch of art, is satisfied that he has learnt everything, and that he has reached the highest point of excellence, he has begun his downward course. A true artist is always dissatisfied with his best endeavours, and is ever striving to achieve greater things.

In the foregoing remarks I have been alluding to the higher order of organ builders—to men who are above mere money-grubbing ideas and trade trickery, and who are working in all good faith, up to their lights.

I would rather not speak of the lower class of builders who look upon organs as merely so much merchandise, connected with which profit is the one important consideration; and who will build a Church Organ on any lines whatever so long as they make a satisfactory sum of money out of the job. These men fatten on the credulity and ignorance of the public, and secure contracts by alluring specifications, which present impressive lists of stops (generally insufficient and badly chosen) to catch the eye of ignorant organ building committees, or please the tastes of inexperienced organists. Amongst those who know very little about organ matters, there is a pretty general impression that an organ with numerous stops must be a better and more effective instrument than one with a lesser number, be they what they may. This is altogether a wrong, and, accordingly, a pernicious belief, and one which has done incalculable mischief, and, I regret to say, it continues to play into the hands of unscrupulous organ builders, to the detriment of all sound and genuine art. I do not think it is to be wondered at that builders, not overburdened with work, take advantage of this popular belief, especially while the bad practice of competitive tendering is encouraged, and inexperienced persons adjudicate and award. Human nature is human nature; and the human nature of a large class of organ builders is essentially weak.

Thirdly: The general ignorance of the public has always been an important factor in the decadence of Church Organ building. I have already said some words on this matter; but, as I feel the evil is a great and dangerous element, militating against the introduction of a more artistic era of organ building in this country, I may be pardoned for still dwelling on it.

The usual course of proceeding, when a new organ is required for a place of worship, is to appoint a small committee, with or without the organist's co-operation, with powers to invite specifications and estimates from organ builders, and ultimately to decide on the specification and tender to be carried into effect. Now, this proceeding would be satisfactory, and lead to desirable results if the members of the committee were experts, or even fairly conversant with the art of organ construction; but, in nine cases out of ten, not one of the gentlemen selected knows how the sounds of an organ are produced, nor could they, to save their lives, tell a Trumpet from a Flute pipe. This may appear a doubtful statement to some of my readers; but I can assure them it is not even an exaggerated one. With such a committee at the head of affairs, the *tradesman* has an overwhelming advantage over the *artist*; for, while the latter, in his honesty of purpose, may submit a well-considered specification, comprising a moderate number of weighty and well-balanced stops, calculated to produce the dignified and richly-coloured tones so desirable in an instrument for church use, demanding at the same time a price in just accord with the nature of the work; the former sends in a specification, which, probably, may present a list of stops half as long again as the other one, and a quotation of price considerably under that of his competitor. The committee sits upon the specifications, and, with a natural leaning, in its utter ignorance of the matter at issue, towards the longest list of stops and the cheapest price, decides without any hesitation. The member as they shake hands at parting, mutually congratulate each other on having achieved a very clever and business-like result. Alas for art! What would such wiseacres say if they were then and there assured, beyond question, that the organ they rejected, because it had fewer stops and cost more money, would be a much more effective and useful instrument, and cheaper far, in the long run, than the one they had decided on?

In all the preceding remarks I have spoken in a general way. This I desire to be clearly

understood, for there are noble exceptions in each of the classes spoken of. While writing this article a specification of a new Church Organ was sent me by a well-known organ builder; it clearly shows that by one artist, at least, the true principles of Church Organ building are being recognised. It is probable that in the course of my subsequent Notes, I may be tempted to give this specification, with my own comments on it.

Now let me turn to the special subject of the present essay. An organ, to be thoroughly useful and appropriate, from a musical point of view, should be schemed to suit, in all essentials, the place in which it is to be erected, and the work it has to do. A Church Organ, therefore, must be more or less powerful in exact proportion to the size of the building; power being understood to be volume of tone, not simply loudness and noise. The characteristic of a Church Organ should be grandeur, combined with refinement of tone; so that the instrument may be perfectly adapted for the accompaniment of choral or congregational singing, and the performance of voluntaries and other incidental pieces of a solemn and dignified character. A Church Organ is essentially an accompanimental instrument; its capabilities for the display of florid skill on the part of the organist being of secondary consideration. In Church Organs of the first magnitude, of course, there is ample scope for all classes of accompanimental and solo playing. I feel I cannot do better, in support of these views, than close the present article with a few apposite words, from the pen of an able writer, in the *Musical Standard* (June 23rd, 1877).

"In the first place, the organ should be of a size and power proportionate to the building and the congregation it will contain. We see in some churches, organs erected out of all proportion to the requirements of the service; as an instance, let that of St. Mary at Hill, London, be adduced—a very fine instrument is to be found there; but it is far too large and noisy for the comparatively small church. This instrument, although possessing great merit, is not a Church Organ in its true sense. The same fault applies to the recently-erected organ at St. Andrew's, Well-street, London; the instrument is far too large and noisy for the size of the church, placed, as it is, near the congregation. One more example, by way of contrast: take St. Alphage, London Wall; here is a small church, and an organ designed for the church—a Church Organ *par excellence*. It is unnecessary to go farther into detail upon this point: a Church Organ is an organ designed to accompany the voices, and to be at the same time capable of rendering with effect the voluntaries before and after service. When the musical demands of an ordinary Sunday service are considered, and the large proportion of accompaniment to voice-singing in which it consists, it is certain that noise is not the attribute best suited to the Church Organ, but rather the more mellow tones of the foundation stops —the diapasons, and those registers which best accompany the voice. Now, the stops of this class are much more costly than the chorus and mutation stops, and a properly-constructed organ of this type, with, say, twenty musical and well-balanced registers, would cost as much as an organ of forty stops upon the quantity principle of endless small pipes. This may be explained more clearly by stating that the last twelve notes of the 8ft. register on the keyboard cost about as much as the remaining forty-eight pipes; and hence, in the cumbrous 'churchwarden's organ,' it will be noticed how often the foundation stops are cut off at tenor C, 4ft., and grooved into a common bass, or left altogether incomplete, without any bass at all; while a number of ranks of small pipes are introduced without any proper counterbalance of the foundation tone, either upon the pedal organ or keyboards. We now see why one specification of an organ costing the same money may apparently represent a much more extensive instrument. Again, a Church Organ requires that in its design the tone of the pedal organ should be commensurate with the rest of the organ; the pedal organ ought to carry down the last octave of the keyboard an octave lower without any very apparent break in the tone. Comparatively few of our present church instruments have any pedal organ at all. A single 16ft. open wooden stop of a deep booming sound has to do duty alike for the full chorus organ and the soft choir organ vocal accompaniment. It is very rare to find a properly balanced pedal organ, even upon the most recently constructed Church Organs. The fact is, the cost of a proper pedal organ nearly equals that of the organ it has to balance upon the keyboard. Our present Church Organs are, as a rule, ill-constructed instruments; and, more or less, are erected in a commercial spirit, and form a transaction like the placing of the bricks, stones, and mortar of the building. No one takes any special interest, partly from a want of the necessary knowledge, and partly because 'it is no one's business.' What is wanted is a portion of that pure artistic spirit which animated the 'Father Schmidts' and other builders and organists of former days: men whose aim was too high for mere money-getting, and who gloried in the progress of the sublimest of all the constructive arts."

The strictures of this writer are perfectly just, and his remarks on the general deficiency of pedal organs in this country are worthy of serious attention. On this branch of my subject more will be said in the proper place.

(*To be continued.*)

FRIC'S MACHINERY FOR GRINDING CURVED SURFACES.

FIG. 1

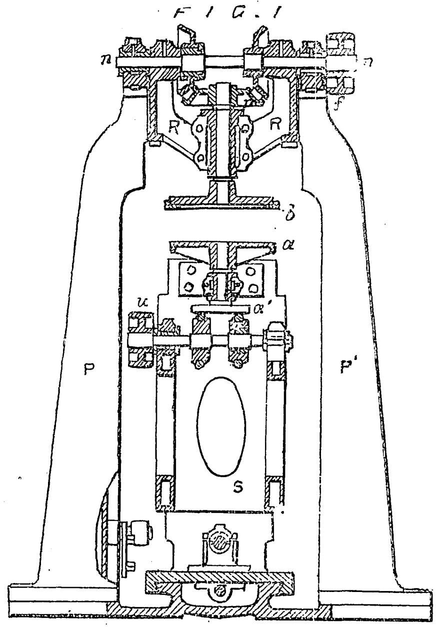
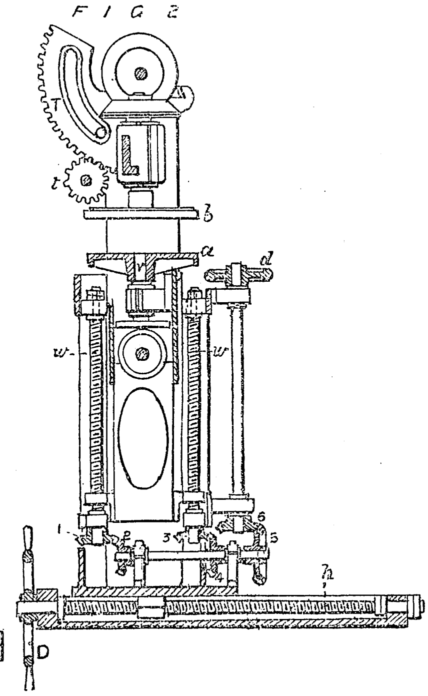


FIG. 2



IMPROVED machinery or apparatus for grinding and polishing curved surfaces, especially applicable for forming the surfaces of lenses and glass specula, have been recently patented in this country by Messrs. Josef and Jan Fric, Vinohrady, Prague. The machines, of which several forms are shown in the drawings attached to the specifications, can be used for cutting, grinding, and polishing spherical, elliptical, parabolic, hyperbolic, and other curved surfaces; but the illustrations given herewith will convey a sufficient impression of their general character.

In carrying out their invention the patentees mount the object to be operated upon in a suitable chuck, which is rotated in the usual manner. The cutter or cutters, operating upon the object, is, or are, also caused to rotate at the same time, but not necessarily at the same speed as the chuck and the object under operation. The cutters are preferably made in the form of a disc, the cutting edges being at, or near, the outer circumference of the disc. The cutters revolve on movable axes, and such axes are so arranged as to cut the axial line of the mandrel at a certain distance, which distance is controlled by the necessary curve to be formed upon the object. The cutters are also mounted so that, while operating, they may be swung upon their centres, and thereby caused to operate upon every part of the object. One, two, or more cutters may be mounted and

FIG. 3

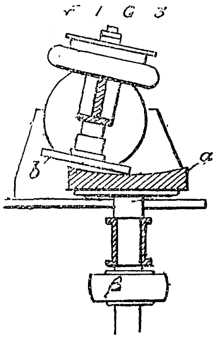
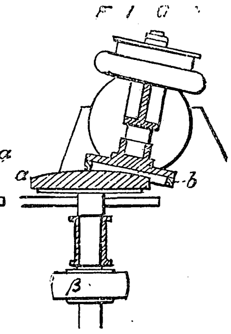


FIG. 4



caused to operate upon the same object at the same time, in cases where several surfaces are required on the object. When both the object operated upon and the cutting tool rotate in circular paths, the surface produced will be spherical. When the cutting tool describes elliptical paths, perpendicular to the axis of the cutting tool, an elliptical surface will be formed; and, by varying the paths of the several rotating chucks and cutters, parabolic, hyperbolic, and other concave and convex surfaces may be produced. The invention is applicable to the production of exact forms in metal or glass, and especially to the cutting, grinding, and polishing of lenses and reflectors for optical purposes.

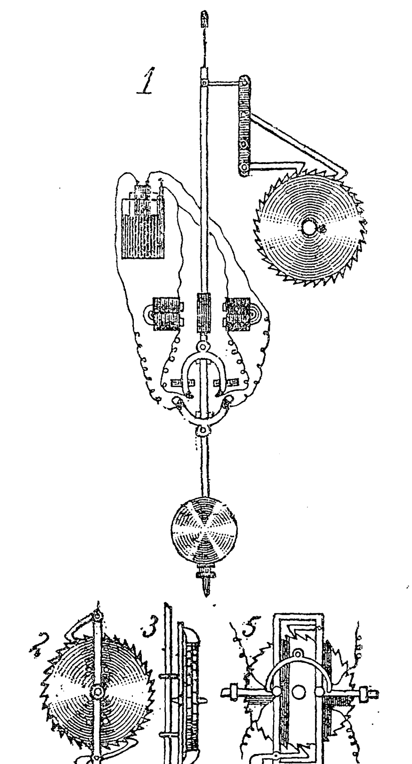
In most cases the machines are so constructed that the object to be operated upon is placed on a horizontal revolving table. It is fixed by means of pitch, or other suitable material, as usual. The cutter or polishing disc revolves on a separate axle, which may be inclined towards or in relation to the first. Both axes are intended to remain constantly in the same geometrical plane, and they must consequently meet in one point. The surface will be convex,

if the meeting point is below as shown in Fig. 4, and it will be concave if that point is above the surface, as shown in Fig. 3. The meeting point of both the axes is also the centre of the surface. The vertical axis meets the surface at its summit, which is common to all the orbits of the cutting point or the grinding circle. The summit must not lie exactly on the circumference of a circle which the cutting point describes. It may be a little inside the circle, but not outside. In the first case a grinding annular surface must act, and in the latter a central spot would remain on the surface. In finishing the ground surface, the annular surface is broad, and is composed of soft substances (of leather, lead, or pitch), while in the grinding process, the grinding rim is composed of emery, of metal, or of some other analogous substance. In many cases a common iron or wooden disc is sufficient, and it is used with a quantity of sharp quartz-sand. Messrs. Fric prefer the method of driving the axis of the cutter by means of conical or bevel friction gear, as shown in the accompanying figures. A horizontal driving-shaft *n n*, with one fixed conical wheel and one loose conical friction wheel (Figs. 1 and 2) turns, by means of the conical friction wheel *p*, the cutter *b*, at any inclination. The driving-shaft is mounted upon solid standards P and P^1. The axis of the cutter *b* is carried by the frame R R which swings on the horizontal axis *n n*, and is guided between the standards P and P^1. This frame is provided with toothed segments T, gearing with the pinions *t*. These pinions are keyed to a shaft which is carried by the standards P and P^1. In turning this shaft every inclination can be given to the grinder or cutter *b*, and it can be fixed in any position by well known means.

In addition to the variation of the inclination of the axis, horizontal and vertical movements are also required. The vertical motion is provided for by means of the table *a*. The table *a* with its support S slides between guides, and the vertical motion is produced by turning the vertical screws *w* and w^1 by means of the hand wheel *d* and the gearing 1, 2, 3, 4, 5, and 6. The whole slides horizontally on the bed-plate, and this sliding motion is produced by turning the hand wheel D and the horizontal screw *h*. In the arrangement shown in Figs. 1 and 2, the spindle of the disc *a* carries at its lower end a second disc a^1, which is supported by two small indiarubber rings fitted to pulleys, one of which is fast and the other loose; *u* is the driving pulley. This may be made to assume different positions by means of horizontal and vertical sliding motions actuated by the hand wheels *d* and D. But all these positions are necessarily confined to one and the same vertical plane. To meet this requirement the driving belt passes round two tension pulleys, which are pivoted to a bolt, sliding in a vertical slot, by which means they can be fixed to any height, as shown in Fig. 1. In some cases it is preferred to use a vertical driving belt cylinder, driving the pulley β by means of a belt, this pulley being fixed on the shaft *v* of the table *a*. It will be understood that concave surfaces are ground or cut by the outside, and the convex surfaces by the inside rim of the disc, as shown in Figs. 3 and 4, and the cutter can therefore be arranged as shown in Fig. 3, where a metal ring of angular section is fixed to the grinding disc. Its outside cylindrical face, with its lower edge, may also be used for cutting the facet of the lens or reflector. This offers the advantage that the rim or facet is centred accurately without removing the object. In case of other curved surfaces besides that of the spherical being required, each cutting point may be caused to describe an ellipse instead of a circle. All the orbits of the cutting points pass the point where the axis of the spindle of the table *a* meets the surface. The perpendicular in the centre of the ellipse on its plane must meet the axis of the spindle of the table *a* in the centre line of the rotating surface. The machine remains the same in other respects, with the exception that one or the other axis must be moved so as to obtain ellipses instead of circles, which can be obtained by known mechanical devices. The polishing of the reflector or lens is greatly facilitated by preparing the polishing disc at one operation. A negative and a positive object are readily obtained, both of which are of a nearly analogous form.

GARCIA'S ELECTRIC CLOCK.

THE clock herewith illustrated is constructed with two toothed wheels on the same shaft, one wheel having one or more teeth than the other, and both being operated by the same pawls, so that one is moved faster than the other; and by means of hands the relative positions of the wheels and the time are indicated. On the pendulum rod, Fig. 1, is an armature interposed between two electro-magnets connected by wires with one pole of a battery and with contact pieces on the ends of the shanks of a U-shaped anchor pivoted to swing on a suitable fixed support. These contact pieces are interposed between and arranged to be struck by contact plates near the free ends of an inverted anchor, also pivoted on a support, the plates being connected by wires with the other pole of the battery. In the shanks of the upper anchor are adjustable screws, which are alternately struck by the swinging pendulum rod. With this construction, when the pendulum starts to swing



to the left, it strikes the left-hand screw, and throws the corresponding contact piece on the upper anchor against the contact plate on the lower one, thereby closing the circuit through the left-hand magnet, which attracts the armature and gives the pendulum an impulse to the left, accelerating its motion slightly, until the contact piece slides off the plate and on to the non-conducting tip of the lower anchor. The circuit is thus broken and the pendulum allowed to swing by its own gravity to the right, when a similar impulse is imparted to it. The motion of the pendulum is thus maintained constant. Attached to the upper part of the pendulum is a rod secured to a lever provided with two pawls connected one above and one below its pivot. The motion of the pendulum causes the pawls to engage alternately with the teeth of both wheels, which are thereby revolved. These pawls may be arranged in different ways, as shown in Figs. 2, 4, 5, 6, and 7, Fig. 3 being an edge view of Fig. 2. The pawls act alternately, and each one always acts upon both wheels, so that when one wheel is revolved the other is revolved with it; and as one has less teeth than the other, it is evident that when the larger wheel has completed one revolution, the smaller has made one revolution and a few teeth more. The numbers of the teeth are such that the relative movements of the wheels will take place in times corresponding to the subdivisions of time into hours, minutes, and seconds. This invention has been patented by Mr. D. T. Garcia; particulars can be obtained from Mr. G. Castanos, of Guadalajara, Mexico.—*Scientific American.*

ELECTRIC WINDOW AND DOOR BURGLAR ALARM SPRINGS.

THE illustrations represent new and improved forms of burglar alarm connections for doors and windows. The door-spring (Figs. 1 and 2) consists of a hard rubber base-plate, through the

FIG. 1.

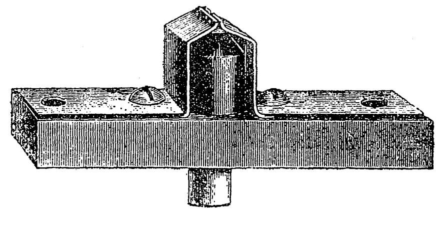
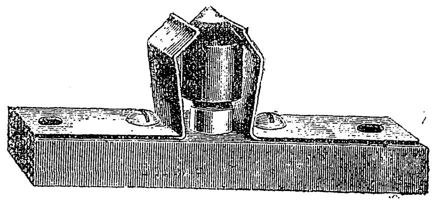
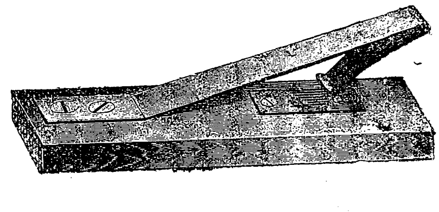


FIG. 2.



centre of which passes a stout brass rod having a rubber collar, which, with the end of the brass rod, tapers to a point at an angle of 45°. Two flat springs of German silver press on this bevel and force the brass rod out as far as the collar will allow, at the same time closing the circuit through the tip of the brass rod. When the rod is pushed back by the door, the springs are forced apart and insulated from each other by the rubber collar. By this arrangement spiral springs are unnecessary,

FIG. 3.



contact is insured by the rubbing of the surfaces, and connection is made with the wires by placing them between the spring and door-frame at each end of the plate. The window-spring requires no mortise beyond a countersinking of one-eighth of an inch, and, on account of its peculiar shape, makes a rubbing contact with a screw or plate placed under the free end. The inventor and manufacturer is Mr. Frank A. Perrett, of Brooklyn. —*Electrical Review* (N.Y.)

HOME-MADE WINES AND DRINKS.

THE flower and berries of the elder (*Sambucus*) have been made use of for wine-making from very early periods. The best known of the elder species is the common black elder (*Sambucus nigra*), which is a native of this country, and very generally diffused. It is a small tree, or, rather, bush, with an irregularly but oppositely branched stem, and it grows with the greatest rapidity. The cream-coloured flowers have a sweet, but rather heavy, smell; the fruit is a globular, purplish-black berry, with a red stalk. The variety mostly cultivated for wine making is the one above mentioned; but the berries of the green and yellow are also applicable to the purpose. The elder requires a good soil, a moist situation, and free exposure to light and air.

Elderflower Wine is made from the flowers in this manner:—(1) Gather the flowers on a dry day; remove all stalks, and to every quart of flowers allow one gallon of water, and 3lb. of loaf-

sugar; boil the sugar and water for a quarter of an hour, then pour it on the flowers, and let it work for three days; then strain the wine carefully through a hair sieve, and put it into a cask. To every five gallons of wine add ½oz. of isinglass, dissolved in cider, and three eggs (whites only) beaten up; close up the cask, and stand six months before bottling off. (2) Boil 18lb. of powdered loaf-sugar in six gallons of spring water; beat up the whites of two eggs, and add; skim very thoroughly, and put in a quarter of a peck of elder flowers, picked from their stems; take off the fire, and stir until cold, then add four tablespoonfuls of yeast and six spoonfuls of lemon juice, strained and free from pips; mix well with the liquor by stirring twice daily for four days. Stone 6lb. of Malaga raisins, and put them into a well cleaned-out cask; pour the wine upon them. Stop up the cask closely, and keep it in a rather warm place. If made in July or August, bottle off in February or March. This wine, when well-made, very much resembles Frontignac.

Elder-flower Vinegar.—To every half-peck of the flowers, free from stalks, put a gallon of strong ale vinegar; set in the sun in a stone jar for a fortnight, then filter through a flannel bag; bottle off into quite small bottles.

Elderberry Wine.—(1) Gather the berries when quite ripe, on a dry day; pick them off the stems, and bruise them with your hands. Strain the juice; let the liquor rest in glazed earthenware pans for twelve hours to settle. Allow to every pint of juice a pint and a half of water, and to every gallon of the mixed water and juice 3lb. of good moist sugar. Put it over the fire in a large saucepan, and when it is ready to boil, clarify it with the whites of four eggs. Let it boil for an hour, and when nearly cold, put in some yeast to work it; pour it into the cask, reserving some of the liquor to fill up the cask with, as it sinks with working. If you have about ten gallons or so, it should be fit to bottle off in two months' time after it has been closed down. Keep at least a year in bottle. (2) Gather the berries when quite ripe, and in dry weather. Pick them clean; put them into a copper with half a gallon of water, and keep up a slow fire until the berries sink; then strain the juice through a hair sieve, and to every gallon of it allow three gallons of soft water, and to every gallon of the mixed liquor 3lb. of good moist sugar. Put back into the copper, and boil for an hour, skimming thoroughly; draw off into a tube, and when it is about 70°, put a toast spread with yeast into it, and let it work for forty-eight hours, or longer, if necessary; pour it or draw it off, if you have a tap in your tub, as should be the case, into the cask which is to hold it, and if you have eighteen gallons of liquor, add 1oz. of cloves, 2oz. of allspice, 2oz. of Jamaica ginger, and 1oz. of sweet almonds, all bruised. Bung very slightly until fermentation is quite over; then close down tightly, and tap in three months.

(3) Old recipe:—Put the ripe picked-over berries into an earthen pot; put this into a copper with sufficient water to come up about two-thirds of the height of the pot, which is about as far as the berries should reach inside; be careful that no water touches them. Make a gentle fire, and keep the pot in the water till it is quite hot; then take it out. Pour the berries into a coarse cloth, strain the juice, and put it into a large saucepan; to every quart of juice allow 1lb. of good moist sugar; let it boil, and skim well. It should boil until rather thick, then pour it into a jar. Put 60lb. of raisins into a cask, and fill it up with water; let it stand for a fortnight; stir it well every day; then pour off the liquor into a clean cask that just holds it. It should stand until it has done hissing; then bung it down close, and stand until fine. To every gallon of this liquor allow half a pint of the elder syrup; mix well, and when it has fined down, rack off into another cask; bottle off after three months.

(4) Chop a quantity of Malaga raisins quite fine; allow a quart of water to every pound of raisins, and put raisins and water into an open tub; cover over with a double cloth, and let it stand for nine days, stirring up each day. Then draw off the liquor as long as it will run, and press the raisins to get out the remainder of the juice; mix all together in a barrel. To every gallon of liquor allow a pint of the juice of elderberries, prepared simply by mashing the berries with the hands, and straining off the juice. Stop down close, and stand for six weeks, then draw off the fine liquor, and to every gallon add ½lb. of moist sugar. Stand again until quite fine, and then bottle off. Keep in a cool cellar for use.

(5) Take 30lb. of Malaga raisins, add eight gallons of water to them, and allow to steep for twelve days; draw off the liquor, and put it into a copper with two gallons of elderberry juice; boil for ten minutes, removing all scum as it rises; then add 7lb. of moist sugar, ½oz. of allspice, ½oz. of cloves, and 2oz. of Jamaica ginger, all well bruised; boil again for an hour, skimming thoroughly; draw it off, and float some toast covered with yeast in it; leave it to work for two or three days, then pour it into a clean cask, and when all fermentation is over, bung down tightly. If made the end of August or in September, this wine would be ready to tap about Christmas, and should be bottled in January or March.

(6) Allow three quarts of elderberries, which are quite ripe and carefully picked over, to every gallon of water; boil, skimming well, until the berries break, then strain the liquor, and to every gallon allow 3lb. of moist sugar, and to every four gallons add 2oz. of bruised ginger, 2oz. of cloves, and 2oz. allspice; boil for an hour; work with yeast when nearly cold; cask it the third day, and when all working is over, bung down.

(7) To every gallon of berries allow a gallon of water; steep in a tub for four days, bruising well each day. Squeeze the pulp, and strain off the juice. To every gallon add 3lb. of brown sugar, and spices in the same proportion as in the above recipe; tie the spice in a muslin bag; boil all the ingredients for an hour; work with yeast when nearly cold; then pour into a well-cleaned cask, and bung down when the fermenting operation has quite ceased. Bottle off in two or three months. Into every bottle put a lump of white sugar and a little brandy.

(8) To one gallon of berries add three quarts of water; bruise in a tub, and stand for three days. To every quart of liquor allow 1lb. of moist sugar, 1oz. of ginger, and 1oz. of cloves, both bruised (the spice should be put into muslin bags); put all together into a perfectly clean vessel, and boil for one hour; then pour into an earthenware pan; when cool enough to dip in the finger, put in a tablespoonful of brewers' yeast; let it work three days, then skim and put into a small cask just large enough to hold the amount. Keep out the air for three weeks, but do not bung down close until that period has elapsed. Tap in two months to test it; if fine, bottle off.

I have given a variety of recipes for making this wine, as it is a very favourite beverage, more especially in country places. A glass of well-made elderberry wine taken hot at bedtime in the cold weather is by no means to be despised, and a drink I have frequently been called on to taste in farmhouses about Christmas time. In Cornwall it is quite a custom for farmers' wives to offer any visitor who happens to drop in a slice of what is there termed yellow (meaning saffron) cake and a glass of home-made wine, usually elderberry, and very well made it generally is.

Elder Beer Made with Ginger.—Take a bushel of clean-picked ripe elderberries; put them into a barrel of strong wort; boil up the liquor in a copper for a few minutes, then strain it off, and when cold, return it to the barrel, and work it in that, not in an open tub; add 1lb. of whole ginger, and stand for ten months in the barrel, well bunged down, before using it.

Mead is an old-fashioned beverage, but a very pleasant one, if care is taken in making it. It is generally made over-strong—too much honey being used to the proportion of water. The following is a good recipe:—(1) On 30lb. of honey (clarified) pour thirteen gallons of soft water, boiling hot. Clarify with the whites of eggs, well beaten; boil again, remove all scum as it rises, add 1oz. of best hops, and boil for ten minutes, then pour the liquor into a tub to cool, spreading a slice of toast on both sides with yeast, and putting it into the tub when the liquor is nearly cold. The tub should stand in a warm room. When fermentation has thoroughly begun, pour the mixture into a cask, and, as it works off, fill up the cask, keeping back some of the liquor for this purpose. Bung down closely when fermentation has ceased, leaving a peg-hole, which can be closed up in a few days. Let it remain a year in the cask before bottling off.

(2) To 15lb. of honey add six gallons of water; clarify the honey with white of eggs; boil for ten minutes, and keep thoroughly skimmed; add a handful of mixed herbs, thyme, rosemary tops, and bay leaves; boil for half an hour more; strain the mixture into a tub upon five pints of ground malt; stir well together, and when lukewarm, strain through a cloth into another tub; work it with yeast, and, when fermentation is set up, pour it into a cask. Suspend in the cask a muslin bag containing sliced ginger ½oz., ¼oz. each of cloves, nutmeg, and mace, well bruised; bung up tightly when it has ceased working, letting the bag of spices remain. It should stand in the wood for a year, and then be bottled off.

Sack Mead.—To every gallon of water allow 4lb. of honey; boil for three-quarters of an hour, skimming well; to each gallon of liquor add ½oz. of hops; boil again for a quarter of an hour; pour it into a tub, and let stand for twenty-four hours, working with yeast; then pour into the cask, and to thirteen gallons of liquor allow a quart of sack. Close lightly until all fermentation has ceased, then bung up close. If a large cask, allow a year in work before bottling off.

American Mead is made with cider. Take 20lb. of honey and twelve gallons of good cider, and blend them together in a tub; ferment with yeast, then pour into a cask, and add half a gallon of rum, half a gallon of French brandy, 4oz. of red tartar, dissolved, and ½oz. of cloves. Bung down close when it has ceased working, and bottle off at the end of three months; it will be fit for use thre months afterwards.

A wine called *Saragossa* is made with honey. To every gallon of water used add a handful of fennel root and two sprigs of rue; boil carefully for half an hour, and then strain through a hair sieve; add to each gallon of this liquor 3lb. of well-clarified honey; boil for two hours after the addition of the honey, skimming frequently; when the liquor is quite cold, pour it into a clean cask, keeping it for twelve months before bottling off, and six or eight months in bottle before use.

A very useful and economical wine for culinary purposes can be made with honey and cider in the following manner:—Take some new cider from the press, and mix it with as much clarified honey as will support an egg; boil it in an enamelled saucepan for half an hour, skimming it well all the time; when entirely cool, pour it into a cask, but do not quite fill it; bung down close when all fermentation is over, and keep in the cask six or eight months before bottling off, after which it will be fit to drink in two months. This is a rich, strong wine, keeps well, and answers admirably for cooking purposes instead of white wine.

Balm Wine.—(1) Into eight gallons of water put 20lb. of moist sugar; boil for two hours, skimming thoroughly; then pour into a tub to cool; place 2½lb. of balm tops, bruised, into a barrel with a little new yeast; when the liquor is cold, pour it on the balm; stir it well together, and let it stand twenty-four hours, stirring it frequently; then close it up tightly at first, and more securely after fermentation has quite ceased; when it has stood two months, bottle off, putting a lump of sugar into each bottle; cork down well, and keep in bottle at least a year.

(2) Put a peck of balm leaves into an open tub; pour on them four gallons of boiling water; cover up the tub, and let them infuse for twelve or fourteen hours; strain the liquor at the end of that time through a hair sieve, and to every gallon add 2lb. of good moist sugar, stirring well for twenty minutes; take the whites of four eggs, whisk them over the fire in a saucepan; remove it from the fire as the scum rises, and skim the latter off; then add it to the liquor; boil the whole for three-quarters of an hour, letting it work three or four days before you tun it; bung down, and, when fine, bottle it off; in six or eight months it will be fit to drink.

The fruit of the bilberry or bleaberry (*Vaccinium myrtillus*), in places where it grows plentifully, is often made into wine. It grows chiefly on moors and in waste places, and is a small shrub about a foot or so in height. In Great Britain it is found mostly in the northern counties and in the hilly districts of the southern counties. Its flowers appear in May, and its fruit ripens in autumn. Two other species of *Vaccinium*, the red (the cranberry) and the black (the whortleberry), are also common in many parts of this country, and are used, as are bilberries, for tarts, preserves, and jellies.

Bilberry Wine.—The fruit should be picked on a very dry day, when it is quite ripe. The leaves and stalks must be carefully removed from the berries, and the fruit then weighed. To four gallons of fruit allow either six gallons of cold water, or else three gallons of water and three of cider, and 10lb. of good moist sugar; let all these ingredients ferment in an open tub until working is over; then add half a gallon of brandy, a handful of lavender and rosemary leaves mixed, 2oz. of powdered ginger, and 2oz. of powdered tartar; let the liquor rest after this addition for forty-eight hours, then strain very carefully through a hair sieve into a perfectly clean cask, laying the bung lightly on the bung-hole until the working is quite over, and no hissing sound is heard; then close down quite tightly, and bottle off at the end of three months; keep six or eight months in bottle before use.

Cranberries can be made into wine in the same way. In America the cranberry is largely cultivated, and forms a considerable article of commerce, a quantity of the fruit being exported. In the northern parts of Russia it is also very abundant.

Ratafia, for flavouring, is by no means difficult to make when the peach is in season. The following is a simple recipe:—Blanch 2oz. of peach or apricot kernels; bruise them well; put them into a bottle, and fill it nearly up with good brandy; dissolve in a cup of cold water ½lb. of white sugar-candy, and add it to the brandy after it has stood for a month on the kernels; strain off the kernels before you add the sugar; then filter through paper, and bottle off in small bottles for use. Another rather more expensive method of making it is to take fifty bruised peach kernels, ¼lb. of bitter almonds, 1lb. of white sugar-candy, and mix thoroughly with one and a half pints of rectified spirits of wine; then add three quarts of water and one and a half gallon of malt spirits.—*Confectioners' Journal.*

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE second meeting of the session was held on the 10th ult., at King's College, Strand, W.C., the president, Dr. Dallinger, F.R.S., in the chair.

Mr. Crisp said that probably the Fellows would remember that some time ago they received a microscope from the executors of the late Miss Tucker. It had been since discovered that the comparatively inferior instrument then received was not the one bequeathed to the Society, but the much larger and more valuable microscope which, together with a box of apparatus and a cabinet of objects, was on the table, and was likely to be very useful to the Society.

The President thought that such a donation should be the subject of a formal acknowledgment, and therefore put to the meeting a motion for giving the thanks of the Society to the executors for forwarding the instrument.

Mr. T. C. White exhibited an album of photomicrographs of a great variety of objects, including also some photographs of the apparatus employed, which was very simple. It was so contrived as to be used either as a projection-microscope or a camera.

Mr. Crisp, referring to the interest which still attached to the work done by Leeuwenhoek with his microscopes, exhibited two facsimiles of those instruments. A collection of them was formerly in the possession of the Royal Society, but has disappeared—probably thrown away by someone unfamiliar with their form. The drawings gave only a very poor idea of what the original instruments were like, and it had been with much interest that some of the Fellows had had an opportunity of inspecting one, which was brought to England during the recess by Prof. A. W. Hubrecht, an eminent Dutch zoologist, who to other accomplishments added that of a most extraordinary mastery over the English language, both as regards grammar and pronunciation. Copies of the microscope had been made by Mr. Mayall, which were so close a resemblance to the original that only by minute examination was it possible to say which was which.

Mr. Crisp also exhibited Golfarelli's micrometric microscope for the special use of watchmakers in examining the teeth of very fine escapement wheels, and commented on the wide field that was opening if special microscopes were to be made for the different purposes to which a microscope could be put. He also exhibited Cailletet's apparatus for examining the effects produced upon minute aquatic organisms by enormous pressures up to 650 atmospheres, necessitating great strength in the apparatus. He also called attention to two "telescopic" objectives (belonging to Prof. Abbe) so arranged that the image of the object was not altered in size by varying the length of the draw-tube, a matter of importance in the case of micrometric measurements.

Mr. J. Mayall, jun., called the special attention of the meeting to the exhibit of Messrs. Powell and Lealand, who, not wishing to be behindhand in the matter of objectives, had procured some of the new kinds of optical glass from Jena, and had worked out an apochromatic 1-12th homogeneous-immersion objective on their own formula. They had produced an objective which certainly compared favourably with those of Zeiss, which had been exhibited in this country. The Fellows could see for themselves how extremely well this objective stood the test applied to it, using both axial and oblique illumination. It should be remarked that the eyepiece used by Mr. Powell had a magnifying power of 40 diameters *per se*, and even under this severe test the new objective did not break down. This eyepiece, it should be remembered, was a much higher power than the highest in the Zeiss series, which gave 27 only. He believed Mr. Powell's eyepieces were made on a formula analogous to that of Zeiss, though not quite the same. The formula of Mr. Powell's new objective was evidently less complex than that of Zeiss's; there were fewer lenses in the combination, and hence the difficulties of the construction were reduced. Mr. Powell also provided a correction-adjustment, without which it was impossible, in his opinion, to obtain the best definition with every kind of object and under every variety of illumination. The meeting would, he was sure, be gratified to know that directly the new optical glass was available opticians in this country had put their shoulders to the wheel, and had at once produced the first-class objective which was now exhibited.

The President said he had had the opportunity that evening of examining this new lens of Mr. Powell's, and he could only say that he was quite astonished at the definition which it gave. Even under the highest-power eyepiece it gave almost, if not quite, as perfect an image as those produced with the lower eyepieces. Since the date of their last meeting he had been afforded the opportunity of examining very carefully a set of the new lenses made by Zeiss, together with a new and complete set of eyepieces, and, whilst he was perfectly convinced of the immense gain which objectives of that construction would be to the microscopist, he was also perfectly sure that serious errors would be introduced unless they were made by the best makers. It would be interesting to know that Mr. Mayall had also made a critical examination of these lenses quite independently, and had written down the results, and that when these were afterwards compared with the observations he had himself recorded, the two sets of results were found to be almost exactly coincident. It was also a matter for great satisfaction that Mr. Powell had added to the value of his objective still further by increasing the power of his eyepieces with such excellent results. Except in one single instance, he had never seen the test objects shown better.

Mr. Cheshire thought Mr. Powell was greatly to be congratulated upon the success which he had attained, as the definition of the objects exhibited by him under such a high power was magnificent. It was, however, extremely difficult to compare the one with the other at a distance, and he suggested that a committee might be appointed to make comparisons under favourable conditions.

Mr. Crisp said, that if Fellows wanted to see the two objectives on the same evening, they would be able to do so at the conversazione on the 24th inst.; but he was afraid the suggestion of Mr. Cheshire could not be acted upon. Something of the kind had been done on a former occasion, and it was found to produce more harm than good.

Mr. Watson exhibited a new form of Histological microscope, which had been designed with the idea of producing an instrument as strong as possible at a moderate cost. It had a lever fine-adjustment; but the principal feature of novelty about it was two raised ridges on the stage to carry the slide, which was thus prevented from scratching the surface of the brasswork, and in consequence of the reduced size of the points of contact could be moved about with much less than the usual amount of friction.

The President said this little improvement was so simple and effective that it would no doubt commend itself to all who saw it.

Mr. C. Beck explained the additions which had been made to the portable National microscope, one of which be exhibited.

Mr. F. O. Ridley read a paper "On the Classification and Spiculation of the Monaxonid Sponges of the *Challenger* Expedition," illustrating his description of the various typical forms by drawings on the blackboard.

Mr. A. Dendy also read a paper "On the Anatomy and Histology of the Monaxonid Sponges of the *Challenger* Expedition," the subject being illustrated by drawings and specimens.

The President said the details concerning this group of sponges which had been given in the two papers before them were certainly very full and valuable, and he very much regretted that owing to the lateness of the hour it was impossible to afford time for their discussion. The authors, however, were to be much congratulated on the lucidity of their explanations that evening.

Dr. E. M. Crookshank read a paper on "Flagellated Protozoa in the Blood of Diseased and apparently Healthy Animals," illustrated by drawings, photographs, and specimens. He described a disease known in India as surra, occurring among horses, mules, and camels. A parasite was discovered in the blood of these by Dr. Evans, and was referred to Dr. T. Lewis for an opinion as to its nature, who concluded that it was not identical but closely allied to the flagellated organisms which he had observed in Indian rats. Five years later an outbreak of the same disease occurred in British Burmah, and the report of an investigation was published by Veterinary Surgeon Steel. Steel observed the same parasite, but regarded it as closely allied to the spirillum of relapsing fever in man, and named it *Spirochæta Evansi*. This opinion was not accepted by Dr. Evans, who placed blood-stained preparations and material for section cutting in Dr. Crookshank's hands for further opinion. Dr. Crookshank at once dispelled the idea of the parasite being a spirillum, and gave a full account of his observations. These had led him to discover an *anterior* flagellum, a longitudinally attached undulating membrane, and a posterior acutely pointed rigid filament, from which characters he recognised that the parasite was a flagellated monad, probably absolutely identical with the parasite discovered by Mitrophanow in the blood of the carp, and named by him *Hæmatomonas carassii*. Dr. Crookshank consequently observed that the Surra parasite should rather be called *Hæmatomonas Evansi* than *Spirochæta*, as suggested by Steel. Lewis's observation with regard to the flagellated organisms in Indian rats, led Dr. Crookshank to investigate the species obtainable in England, which resulted in his discovering flagellated parasites in 25 per cent. of apparently healthy rats from the London sewers. These organisms proved to be morphologically identical with the surra parasite and the parasite described by Mitrophanow in the blood of the carp, and were also recognised by a photomicrograph made by Lewis to be identical with the organism observed by him in Indian rats, though Lewis's description and figures presented material differences.

The President regretted that time did not permit of a proper discussion of the subject, which was evidently of great interest and practical importance, and Prof. Bell referred to some of Bütschli's papers.

Dr. Crookshank said it was rather a disadvantage to discuss the subject of a paper, only parts of which had been read; but when the paper was before them in extenso, they would see that he had not overlooked what Bütschli had said. At that late hour of the evening (10.10 p.m.) it was not possible to pursue the matter further.

SCIENTIFIC NEWS.

THE comet discovered by Barnard on Oct. 5 is visible to the naked eye, as it rises between 4 and 5 a.m. Dr. Oppenheim's ephemeris for the ensuing week at Berlin midnight reads—

	R.A.			N. Dec.	
Dec. 5.	16h.	0m.	54s.	17°	51·8′
7.	16	23	24	17	33·0
9.	16	45	27	17	0·1

Brightness still increasing.

Herr August Wagner, chief assistant (vice-director) of the Pulkowa Observatory, under Prof. Otto Struve, died on Nov. 14, at the age of fifty-eight.

General J. T. Boileau, F.R.A.S., F.R.S., who died recently at the age of 81, had charge of Simla Observatory many years ago, was elected a Fellow of the Royal Astronomical Society in 1840, and of the Royal Society some time before. Of late years he devoted much of his time to the establishment of institutions for the daughters of officers and soldiers of the army, and we regret to hear that members of his own family are left in rather straitened circumstances. An influential committee has been formed to raise a fund for the purchase of annuities, Lord Napier, of Magdala, being the chairman, and Major-General P. Ravenhill the hon. sec.

A fund is being raised, too, to purchase an annuity for the daughter of the late C. W. Peach, the famous naturalist and scientific observer, who died last March. Hugh Miller, Sir H. de la Beche, Sir Philip Egerton, Darwin, Huxley, Carpenter, Ray Lankester, not to mention others, have all been indebted to the labours of Peach for valuable information, and his important collection of fossils from Sutherland is now in the British Museum. Amongst the members of the committee are Sir W. Turner, Sir J. D. Hooker, the Director-General of the Geological Survey, Prof. Tait, Prof. E. Ray Lankester, John Murray, and W. Pengelly.

The Royal Society have just received from Egypt a consignment of specimens of the different strata of soil in the Delta. The borings have been carried out to a depth of nearly 200ft. and the solid bottom has not yet been reached. The Royal Engineers in Egypt have been intrusted with the work. The specimens, which are chiefly of sand and clay strata, are deemed of great importance, and the Society has granted money for the continuance of the work, which will be carried out by the detachment of Engineers as hitherto.

For one of the Rosebery lectures before the Edinburgh University Mr. G. J. Romanes chose "Aristotle as a Naturalist." In thought and language, in mode of conceiving and grappling with problems, and in the general reasoning which he employed, Aristotle resembled much more closely than any other philosopher of antiquity the scientific investigator of the present day. Mr. Romanes said that close upon 500 species of animals had come under his observation, including 70 species of mammals, 150 of birds, 20 of reptiles, and 116 of fish, and Aristotle would have differed from the natural scientist of modern times in one important particular. He everywhere regarded the purposes of nature as operating under limitations imposed by what he called absolute necessity. Monsters, for example, he said, were not the intentional work of nature herself, but the victory of matter over nature. He divided

nature into two classifications—organic and inorganic. Man he placed at the head of the animal kingdom, and he drew the true psychological distinction between him and the lower animals—namely, that animals only know particular truths, and never generalise from abstract ideas. His conception of life was more in accordance with that of modern science than any conception formed of it either in ancient times or in the middle ages. Aristotle was the first philosopher who distinctly affirmed the importance of heredity as a principle, not only in natural history, but also in psychology. He would have been something more than human if either his observations or his reasoning could everywhere have been justly compared with those of scientific genius more favourably circumstanced; but it was the glory of Aristotle that both his observations and his reasonings could stand such a comparison so astonishingly well as they did. When we remember the enormous range of his work in biology, that he was born into a world of mysticism, nurtured in the school of Plato, and therefore himself compelled to forge the intellectual instruments of research, there could be no question that Aristotle stood forth, not only as the greatest figure of antiquity, but as the greatest intellect that had ever appeared on the face of the earth.

At a recent meeting of the Bath Microscopical Society, Mr. Philip Braham, F.C.S., read a paper on "Films," in which he said that all optical instruments and even the act of seeing depended on films; were it not for the constantly renewed film of moisture over the surface of the eye vision would be impossible. The use of films in lenses was demonstrated by rendering a pair of translucent plates perfectly transparent by a film of liquid, of the same refractive power as the plates, placed between them. The use of Canada Balsam in cementing lenses together and rendering the combination achromatic was explained. In exhibiting some experiments with soap-films under the microscope, Mr. Braham explained that the thickness of the films when the colours appear is between the 36,000th and the 62,000th of an inch—the extreme wave-length of light; but where grey patches are seen the air on each side of the film is in optical contact, so that no light is reflected from the film, the thickness being under the two-millionth of an inch, and as this film is composed of several molecules which must be coherent, and cannot consist of less than three, but probably more, we could safely infer the size of the molecules to be very much less than the six-millionth part of an inch, so that by actual experiment and calculation we could estimate the size of the molecules. The films that inclose the liquid matter in the vitreous humour of the eye and prevent convection and other currents in that body, were shown to be so thin that no interference took place.

In a paper read before the Society of Arts last week on the "Purification of Water by Agitation with Iron and by Sand Filtration," by W. Anderson, M.Inst.C.E., the rather extraordinary assertion was made that "It is well-known that iron is inimical to vegetable and animal life. The presence of salts of iron in the soil produces sterility." In a number of analyses of various soils, which lie before us as we write, those marked sterile contain little, if any, iron, while those which are said to be fertile have considerable percentages of iron.

The directors' report of the Blackpool Electric Tramway for the year ending October 31st, shows that the undertaking is a commercial success, the profit allowing of a dividend of 5 per cent., and a considerable contribution to the depreciation and reserve fund.

The Metropolitan Board of Works have given notification of their intention to apply for a Bill enabling them to provide a new means of communication across the Thames at Blackwall, consisting of a tunnel under the river. The proposed subway will consist of a single tunnel or two parallel tunnels, and will be for the use of carriages, carts, and other vehicles, as well as foot passengers.

At the meeting of the National Academy of Sciences, Boston, Mass., Prof. E. C. Pickering, of Harvard Observatory, read a paper on the "Draper Memorial Photographs." This work of stellar photography was begun with the aid of the National Academy, which appropriated a portion of the Bates Fund to the work, but it becoming too extensive, the widow of Prof. Henry Draper has continued it as a memorial of her husband. The work is of three classes: 1. The general stellar spectra; each star with a photographic exposure of five minutes, a work which includes from 6,000 to 7,000 spectra; 2, a series of exposures of one hour each; and 3, investigations with the aid of Prof. Draper's 11in. reflecting telescope, which has been lent to Prof. Pickering for this work. The mounting of this large mirror, with its attendant prism, was described, and the progress of the work indicated. The paper was illustrated with lantern projections. The work with the new instrument is only just begun, photographs having been taken for two or three evenings. There is now no lack of light, but the greatest difficulty is to secure sufficient dispersion of the spectra. There are two classes of stars with distinct spectra. The first class has numerous bright lines on faint continuous spectra; in the second class, which includes more of the variable stars, the lines are much fainter. Prof. Young stated that progress during the year had been so marked as to lead to the hope that the study of the approach and recession of stars could soon be studied with satisfactory results.

At a recent meeting of the Academy of Sciences, Paris, M. Stroumbo drew attention to an interesting mode of recomposing white light by the aid of the colours of the spectrum. The prism is mounted upon an axle parallel to its edges, so that it may receive rapid rotatory movement. The seven prismatic rays are thrown on a pure white screen, the prism is then revolved, and when rotation becomes rapid the colours disappear, and a band of white light results.

M. Debray has reported to the Academy on behalf of the chemical section in reference to the alleged isolation of fluorine by M. Moissan. That chemist condenses pure anhydrous hydrofluoric acid in a U-shaped platinum tube, closed by two stoppers of fluor-spar, through which platinum wires pass. The lower part of the tube is plunged into chloride of methyl caused to evaporate rapidly by the passage of a current of air, whereby a temperature of — 50° C. may be secured. When a current from 20 Bunsen elements is passed through the hydrofluoric acid, there is a regular disengagement of hydrogen at the negative pole, while a gas of strange properties is evolved at the positive pole. This new body decomposes water in the cold, with disengagement of ozone; phosphorus burns in it, with production of fluoride of phosphorus; and crystallised silicon takes fire in it, with formation of fluoride of silicon. It is open to conjecture that the gas may be either free fluorine, or perfluoride of hydrogen, or a mixture of hydrofluoric acid and ozone. But M. Moissan discusses these hypotheses, and concludes with much plausibility that the new gas is really the long-sought-for element — free fluorine. If he is right, his researches are among the most interesting investigations in modern chemistry.

Drs. Tizzoni and Cattani, of Bologna, have been making a study of cholera during the present year, and they confirm and extend Koch's conclusions. They consider that flies play an important part in the propagation and dissemination of the disease; but their investigations confirm the assertion that the bacilli cannot live in an acid medium such as the healthy gastric secretion.

THE *Moniteur Industrielle* states that a mixture of oil and graphite will effectually prevent screws becoming fixed, and will protect them for years against rust. The mixture facilitates tightening up, is an excellent lubricant, and reduces the friction of the screw in its nut. Why not use clean fat with the graphite or blacklead? Washed hog's lard is the best thing.

PHILADELPHIA will soon have the highest tower "in creation." The town-hall of that city, which is nearing completion, will have a tower 537ft. high, consequently 17ft. higher than that of Cologne Cathedral. Until the erection of Eiffel's Tower at Paris, Philadelphia will possess the highest building. The tower is to be surmounted by a bronze statue (36ft. high) of William Penn. The new town-hall, the foundation stone of which was laid in 1872, will cost the city the enormous sum of twenty milllion dollars.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of he* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE LATITUDE OF THE LICK OBSERVATORY—THE STELLAR PHOTOGRAPHS OF MM. HENRY FRERES —ONE OF THOSE "COMMUNICATIONS" THAT CORRUPT GOOD MANNERS—DEATH OF THE "ASTRONOMICAL REGISTER"—U CYGNI—THE CITY AND GUILDS OF LONDON CENTRAL INSTITUTE—IS JUPITER SELF-LUMINOUS? — LANDSCAPE-PAINTING IN OIL COLOURS—SINGLE LENS EYEPIECE.

[26544.]—I LEARN that, during the month of August last, a fresh determination was made of the latitude of the Lick Observatory on Mount Hamilton, U. S., with the Repsold meridian circle installed there; the mean of the results of all the observations coming out as 37° 20′ 24·9″ N., which is therefore provisionally adopted as the latitude of the centre of the mercury basin beneath the circle. I fancy that this is slightly less than that derived from previous observations. Be this, though, as it may, it is difficult to avoid envying Professor Holden as the possessor of the matchless Lick achromatic, 4,250ft. above the sea level, with the mists and atmospheric worries of all sorts with which we are afflicted far beneath his feet; with our at present practically invisible Mercury and Venus nearly 32° and some 30½° respectively above his horizon; with Saturn at an altitude of upwards of 74° when on the meridian, and with Neptune under the same conditions at one of over 70°. If ever anything fresh is to be learned as to the physical structure of the last-named planet, surely it is to Mount Hamilton that we must look for the information.

Through the kindness of an old friend, I have had an opportunity of studying at my leisure a few of the perfectly marvellous stellar photographs of the MM. Henry Frères, of Paris; and among them one from a facsimile of which the very remarkable caricature on p. 65 was presumably taken. Granting the difficulty of reproduction, I must say that your engraver has failed conspicuously in giving an idea of this wonderful autotype of the glorious region in Perseus delineated in the original. This particular photograph gives the stars black upon white, like your woodcut; but in the case of other charts of regions in Gemini and Cygnus, they appear as they do in the sky—white upon a black ground. The circularity of the discs is very remarkable, and shows to what perfection the MM. Henry have brought their process. Everyone familiar with the working of the clock applied to an ordinary equatoreal knows that, although, all things considered, it goes with wonderful steadiness, yet that it will not keep a star rigidly on the intersection of two lines in the eyepiece for any length of time without repeated attention. Now, the exposure of the original plates of some of these astonishing photographs must have been a matter almost of *hours*, and under ordinary circumstances the images of the stars would inevitably have been distorted into ellipses and all sorts of figures. As a matter of fact, they are, as I have said, most beautifully circular, and as permanent records of the aspect of those regions of the sky which they represent, are, so far, as unsurpassed as they seem unsurpassable. For purposes of comparison, however, hereafter, photographs alone must be employed, as the magnitudes are actinic, and not visual ones. It is very notable that by sufficient exposure multitudes of stars imprint their images on the sensitive plate, of which no trace is under any circumstances perceptible by the human eye employing the same telescope.

Being in London one day, not long ago, I got sight of a little book by Mr. G. Pinnington, in which he shows (to his own satisfaction) that Kepler's third law is all wrong; that Newton "cooked" his calculations to bring observed facts

into accordance with this law as it stands; and in fine, that our present data of the elements of the solar system are all adrift, and that the earth, instead of being, as astronomers weakly suppose, 92,359,300 miles from the sun, is really removed from him by an interval of 115,658,780 miles! Now, if any of my brother readers wonder why I notice this at all, I will say at once, because the title-page of the pamphlet commences thus: "A paper communicated to the Royal Astronomical Society, January 13th, 1885," which certainly would induce anyone ignorant of the facts of the case to imagine that the Society had in some way *accepted* Mr. Pinnington's paper. Let me hasten to assure anyone labouring under such a delusion that the Fellows of the Society have never heard one syllable about Mr. P. or his production either. I protest against the assumption that a man has a right to pen any rubbish he pleases, put a penny stamp on to it, address it to a learned society, and then to announce publicly that it was "communicated to" that society on a specified day.

It is with sincere regret that I learn from an announcement on the cover of the November part of the *Astronomical Register* that that useful little publication is to come to an end this month. Originally started by the late Mr. Sanford Gorton, F.R.A.S., in 1863, it circulated for some years largely among amateurs of astronomy, its reports of the discussions at the meetings of the Royal Astronomical Society rendering it a valuable supplement to our *Monthly Notices;* while numerous communications from astronomers of eminence, both professional and private, formed a leading feature in its pages. For some eight years the *Register* enjoyed a practical monopoly of these reports of the debates at the R. A. S.; but (I think) about the year 1871 the ENGLISH MECHANIC entered the field with a monthly one of its own. If I recollect rightly, it was some time in the autumn of 1872 that the editorship of the *Register* passed from the hands of Mr. Gorton into those of the Rev. J. C. Jackson, a very able archæologist, if not a man widely known in the astronomical world. Under his supervision it continued to be the recognised organ of intercommunication among English amateurs up to the spring of 1877, when a most formidable rival to it arose in the shape of the *Observatory,* containing everything of value that the older serial did, with the addition of much that was new. Most ably edited, and possessing in some respects practically exclusive means of information, the ultimate triumph of the Greenwich magazine over any and all opposition was only a question of time; and I can only admire Mr. Jackson's true English pluck in having sustained the fight so long as he has done, and in having laboured to add so materially to what must always be a useful work of reference. Speaking for myself, I can only say that I could spare several works from the shelves of my fairly extensive astronomical library better than I could the twenty-four complete volumes of the *Astronomical Register*.

In reply to the query contained in paragraph two of letter 26492 (p. 260), I regret that I can find no record of any measures of U Cygni as a double star at all. It does not appear in Struve, Crossley, Gledhill, and Wilson's "Double Stars," in Smyth's "Cycle," in Burnham's list, nor, in fact, in any of the works in my possession. If it ever has been measured, Mr. Herbert Sadler, with his unsurpassed knowledge of stellar literature, is the only man likely to be able to reply to Mr. Baird Gemmill's question.

According to the latest balance-sheet of the City and Guilds of London Institute, to which I have been able to obtain access, the palatial building of the "Central Institute" at Brompton had cost up to December 31st, 1884, just £76,539 15s. 11d. What has been expended there since in "fittings and apparatus" I am ignorant; but, judging from a paragraph in the Fifth Annual Report of the Council, it must be something very considerable indeed. At the inception of this precious scheme, all who had the technical education of the British artificer really at heart pointed out and protested, both in the public press and on the very Council of the Institute itself, against the erection of so gorgeous a pile at South Kensington in a wholly unsuitable locality. Unfortunately, though, the Corporation of London, together with several of the wealthier City Guilds, scared at Mr. Bottomley Firth's Committee, and anxious to make for themselves friends of the Mammon of Unrighteousness, subscribed among them the sum of no less than £218,753 15s., and the astute wire-pullers who had the disposal of the money were hand-and-glove with the Ring at the "Cole-hole," in whose interest, wholly and solely, the site of the Central Institute was selected. To the objectors to the locality, who pointed out the really excellent work that was being done at the Finsbury Technical College and the South London School of Technical Art (both situated in the very midst of those who resort to them for instruction), it was replied that the Central Institute was to be on a totally different footing, and was intended for a quasi-collegiate education akin to that imparted at one of the Continental Technical High Schools. Now, though, I learn from a leading daily journal that the executive are "organising classes at their Central Institution, Exhibition-road, for the practical instruction of teachers in handicrafts," and that "arrangements have been made for a course of technical instruction, to consist of lectures on the construction and manipulation of wood-working tools and of practice in the workshop. The fee charged to teachers is quite nominal, seven shillings for the entire course, and each teacher-student is required to provide himself with a set of tools which he will be expected to keep in good order."! So, then, it was to turn out efficient carpenters and joiners after seven shilling courses, that something like a hundred thousand pounds has been expended in a palace miles removed from the workman's home—was it? Was there ever such a trumpery imposture as this? I hope to be able to get hold of some authentic returns of the number of students and of the work done after this system has been in operation for a year. If I do, I will assuredly give it all the publicity these columns will afford me—whether the Council like it or not.

If Mr. Duke (letter 26522, p. 283) has access to Vol. XLI. of the R.A.S. *Monthly Notices,* he will find on p. 47 of it an observation by Captain Noble of the transit of the shadow of Jupiter's IInd satellite, as a *brown* spot: a phenomenon scarcely explicable save on the hypothesis that that portion of the planet's disc totally eclipsed by the shadow must have been glowing with a dull red light. When the paper I refer to was read at the society, Mr. Campbell stated orally that he was observing Jupiter on the same night, and witnessed identically the same appearance. (See the last edition of Webb's "Celestial Objects for Common Telescopes," p. 425.)

"Welsh Hoghair" (query 61001, p. 292) will find a quantity of very useful rudimentary instruction in a little shilling book entitled "The Art of Landscape Painting in Oil Colours," published by Winsor and Newton, London. He may also derive many valuable hints from the Hon. John Collier's "Oil Painting," published by Cassell's. This is a two-and-sixpenny work. But he would, of course, learn more in even two or three lessons from a competent artist than he could from a whole shelf-full of books.

In reply to query 61027 (p. 293) I should not advise the use of any single-lens eyepiece at all, as it is a thing that I never have recourse to myself; an ordinary Huyghenian furnishing me with the very highest power I can ever employ. The greatest nuisance experienced in the use of a single lens is the extremely circumscribed field of view, as only a very small part of the centre of the lens is of any practical use. Having said all which, I would add that were I compelled to employ a single lens, I should have it in the form of a crossed double-convex one (as the curves would then, of course, be less violent than in the case of a plano-convex lens), with the most convex surface next to the eye.

A Fellow of the Royal Astronomical Society.

COMET *f* 1886.

[26545.]—FROM the scantiness of published observations of this comet, discovered by Barnard on Oct. 4, it would seem as though it were receiving but very little attention from amateur observers. This is probably due to the fact that one has to rise rather early, or sit up very late, as the case may be, before it is in a good position for observing; it may also be accounted for by assuming that some of the possessors of small apertures are unaware that it is visible to the naked eye, so that however small one's telescope may be, a good view of the tail and the changes it will probably undergo as the comet approaches the sun may now be obtained. The best time for seeing the comet is between 4 and 5 a.m., but it is easily to be seen (at present near Arcturus) as late as 6 o'clock; but it is needless to remind the would-be observer that he should aim to see it against as dark a background as possible. He should, therefore, look for it at the first-mentioned hours. Observing the comet this morning (Nov. 22) between 16h and 17h., with a 3in. refractor, and a power of 50, it presented the curious spectacle of having two tails, one very long one, of the same breadth throughout its length, so far as the optical means at my disposal allowed me to trace it, and a very short, narrow one on the preceding side, at an angle of about 40° with the principal tail. This small tail tapered off to a very fine point, and faded away very gradually. So far as I could see, no nebulous matter filled the space between the two. Perhaps my aperture was not large enough to show it.

Forest Gate, E. **B. J. Hopkins.**

U AND V CYGNI.

[26546.]—IN reply to Mr. Gemmill's inquiry (letter 26492), I may state that the prediction given in the *Companion to the Observatory* assigning Oct. 15 as the date of maximum of V Cygni is correctly printed. But the star has not been often observed, and its period is not yet sat sfactorily determined. Nor had I at the time of preparing the *Companion* for the press the observations made by Mr. Baxendell in 1885, and printed in the *Observatory* for April, 1886, p. 159. Mr. Baxendell found V Cygni at maximum, 1885, Dec. 30. Allowing 13 months for the period, this would make the next maximum, 1887, January 30, instead of 1886, October 15, as given in the *Companion.* I believe that the true period will be found to be somewhat longer than this, and that the star will not attain its maximum until the middle of February. Mr. Gemmill would render a service if he would keep the star under observation during the first weeks of the new year.

The spectrum of V Cygni is rather a fine example of Secchi's fourth type. The red star U Cygni shows the same type of spectrum, but decidedly inferior in beauty and distinctness to that of V Cygni. I do not know the character of the spectrum of the blue *comes.* **E. W. Maunder.**

Royal Observatory, Greenwich, S.E., Nov. 26.

THE INHERENT LUMINOSITY OF JUPITER, &c.

[26547.]—I DO not think it would be difficult to show that all numerical estimates of comparative brightness made with a wedge are inherently bad; but without entering upon that question now, I wish to point out there are two considerations absolutely fatal to any supposed visible luminosity of Jupiter. The hypothesis is that Jupiter's own light is bright enough to add considerably to the light he reflects from the sun, and that this is a consequence of his surface being at a red or white heat. I will not take Mr. Biggs's (page 255) conclusions that he is so many times brighter than he has any right to be; but merely assume that he presumes upon his position enough for his light to be perceptible as an addition to his borrowed brilliancy. Then he must give light to his satellites, and ought to make them visible in our telescopes when eclipsed; but the largest telescopes fail completely, as far as I know, to show the faintest trace of a satellite when eclipsed. Clearly, then, the inherent light of Jupiter is insufficient to make the surface of a satellite visible.

But the second consideration I have to urge is more telling. The satellites are visible in transit, and ought always to appear darker than the planet. The satellites reflect sunlight only, and sunlight, plus Jovian light, should be superior, according to the theory, to sunlight only. That III. and IV. are sometimes dark in transit does not affect the argument. They are sometimes invisible on the disc; but I. and II., as far as I know, are always visible as *brighter* beads, even upon the centre of the disc. Therefore, if Jupiter radiates light, satellites I. and II. radiate as much or more; therefore, they are red or white hot also, and therefore ought also to be visible from their own light when eclipsed. I think this is enough to completely refute the supposition that Jupiter has any visible light of his own.

We are sometimes treated to the supposition that Saturn also has light of his own; but this is negatived by the fact that the inner bright ring is brighter than any part of the ball, and, being extremely thin, cannot on the same theories be a hot and bright body.

It seems to me we are too much given to rely on our limited experience on earth in both framing and judging theories. How do we know that more reflective materials than any we are acquainted with do not exist? Our theories are, at best, deficient. Even the firmest and clearest of all—the theory of light—rests on an assumption that is sufficiently staggering—the existence of a substance that is more rigid than steel, yet permeates all bodies without difficulty.

We do well to hold these theories lightly, and to recognise our incomplete grasp of the phenomena of the universe. But sometimes objections are taken that merely prove the subject misunderstood. For instance, it has been argued the ether must prove a resisting medium, and slowly impede motion of planets and comets therein. Some have even detected retardation. But it is postulated the ether has no weight, and is entirely free from gravitation. How then can it have any effect in impeding motion in gravitating bodies? It is evidently non-existent to any such power. There can be no friction with the imponderable.

Again, we are assured no work can be done without waste. Here earthly analogy leads us astray. It is argued, the sun and the universe generally is losing energy. The sun may be; but the universe cannot. Energy no more than matter can become non-existent. The sun and every other body does exert a power continually, and without the slightest loss—the power of gravitation or attraction. If the sun loses light and heat, he must communicate it to something else. I presume if a hot body of finite dimensions had ever existed alone, and the rest of infinite space had been a perfect vacuum, the hot body must have remained hot to all eternity, since nothing existed to receive a single vibration. The solar energy only becomes light and heat now on reaching some other body possessed of gravity, for the interstellar space is absolutely cold and dark.

The sun neither heats nor lights the ether; if he did or could, none of his rays would ever light or warm us. They would all be used up on their way. We want to know much more before we can settle authoritatively anything about the waste of solar energy, and how long or how short a time it will last. E. Holmes.

ANOTHER BRIGHT METEOR.

[26548.]—LAST Monday night, on my way to our pillar-post, about 9.15, I saw a very brilliant meteor. It lit up the whole of the northern heavens with sudden and intense white light. From the position I was in, I could not be certain from what point in the sky it first started; but I saw its fall, which resembled the flow of fused metal along the line of the Milky Way in the North-West. Perhaps this was "the stray remnant" of "the unfortunate comet Biela" to which your correspondent "B. A." refers in your issue of Friday last. J. H. D.

Mount Bures Rectory, Essex, Nov. 29th.

BODIES REDUCING FEHLING'S COPPER SOLUTION—EXAMINATION FOR DIABETIC SUGAR — PAVY'S AMMONIACAL CUPRIC SOLUTION — ESTIMATION OF BORACIC ACID AND BORAX IN ADMIXTURE—DETERMINATION OF FOREIGN FATS IN BUTTER—TO CHEMISTS—OXYGEN—OXALIC ACID.

[26549.]—THE following bodies are among those which cause a precipitation of cuprous oxide when heated to boiling with an alkaline solution of cupric tartrate; in other words, are bodies which reduce Fehling's solution under the usual conditions:—Dextrose, lævulose, maltose, mannitose, milk-sugar, galactose, arabinose, gallisin, aldehyde, chloral, chloroform, valeraldehyde, resorcinal, pyrogallates, gallotannates, trichloracetates, and arsenites. Fehling's solution is not reduced by mannite, dulcite, sucrose, inosite, cellulose, dextrin, arabin, alcohol, glycerin, phenol, benzoic aldehyde, salicylic, aldehyde, formates, acetates, lactates, succinates, oxalates, tartrates, citrates, gallates, saccharates, mucates, gluconates, lactonates, benzoates, or sulphites.

In order to apply Fehling's test to urine in a reliable manner, certain precautions are essential. Albumin, if present, should be first removed by heating the slightly acid or acidified urine to boiling, and filtering from any precipitate. The liquid should then be rendered distinctly alkaline by caustic soda or potash, filtered from any precipitate of phosphates, &c., and the copper solution then employed in the following manner:—Heat to boiling in a test-tube 10cc. of Fehling's solution, prepared in the usual way, previously introducing a few small fragments of clay tobacco-pipe to prevent jumping. When boiling, add 0·5 to 1·0cc. of the urine previously treated as indicated above. If sugar be abundant, as in a decidedly diabetic urine, a yellowish or brick-red opacity and deposit will be produced. If a negative reaction be obtained, test for traces of sugar by adding 7 or 8cc. of the urine to the hot liquid, heating again to ebullition, and then setting the tube aside for some time. If no turbidity is produced as the liquid cools, the urine is quite free from sugar, or, at any rate, contains less than 0·025 per cent. If the quantity of sugar present is small—that is, under 0·5 per cent.—the precipitation of the yellow and red cuprous oxide does not take place immediately, but occurs as the liquid cools, the appearance being somewhat peculiar. The liquid first loses its transparency, and passes from a clear bluish-green to an opaque, light greenish colour. The green milky appearance is quite characteristic of dextrose.

By applying the above test quantitatively, the determination of glucose in urine may be readily effected; but it must be borne in mind that traces of glucose are found normally, or, at least, very commonly, in urine, and hence too great a stress should not be laid on the presence of an insignificant proportion.

Pavy's ammoniacal cupric solution may be used for the determination of glucose in diabetic urine, though it cannot be employed for the detection of small quantities of the sugar. Müller and Hagen determine the sugar volumetrically by Knapp's mercurial solution, which has the advantage of being applicable to samples of urine containing as little as 0·1 per cent. of glucose, while Fehling's solution cannot be applied quantitatively in the ordinary manner if less than 0·5 per cent. of dextrose be present, owing to the incomplete separation of the cuprous oxide in presence of certain obscure foreign matters contained in urine. Knapp's method is applicable in all cases, and the standard solution undergoes no change by keeping. Bodies other than glucose, capable of reducing both Fehling's and Knapp's solutions, are sometimes present in urine, but their exact amount and nature are not known.

It is a matter of indifference, so far as the application of the reagent is concerned, whether Fehling's solution be an alkaline sodic tartrate of copper, an alkaline potassic tartrate, or a mixture of the two. The amounts of caustic alkali and alkaline tartrate need not be rigidly those prescribed.

The action of reducing sugars on Fehling's solution is not precisely known, but among the products are:—(1) Acetic and formic acids; (2) certain non-volatile acids, especially tartronic, an acid forming uncrystallisable salts, and an acid decomposed with formation of humus-like products on heating its alkaline solution; (3) a gum-like substance.

It is true that in Pavy's ammoniacal cupric solution the copper does less duty than in Fehling's. As the reaction is complex and not fully understood, it is not possible to give an explanation of the fact. The presence of a varying proportion of salts, such as alkaline tartrates and carbonates, gravely affects the accuracy of the indications obtained by Pavy's solution.

I may perhaps be excused if I follow the usual custom of giving my authority, and state that I have copied the foregoing information on the employment of alkaline cupric solutions almost *verbatim* from Allen's "Commercial Organic Analysis," Vol. I. pages 225, 229, 285, 286, and 451.

In reply to query 60919, page 269, addressed "To Mr. A. H. Allen," the proportions of borax and boracic acid in a mixture of the two can be determined as follows:—Ignite a known weight, and note the loss, which is water. Dissolve the weighed residue in water, and titrate the solution with standard mineral acid, using methyl-orange as an indicator. Calculate the Na_2O found by the titration to $Na_4B_4O_7$, and the difference will be the B_2O_3 in excess.

The butter fat yields an average 88 per cent. of insoluble acids and butter substitutes 95·5, the difference, 7·5, is the rise caused by an entire change from butter to butterine. Hence a rise of ·075 per cent. in the insoluble acids corresponds to 1 per cent. of butterine. Therefore, if the excess of insoluble acids over 88 per cent. be divided by ·075, the result will be the probable percentage of butterine. But $\frac{1}{\cdot 075} = 13\cdot 3$. Hence, if F be the foreign fat and I the insoluble acids, $F = (I - 88) \times 13\cdot 3$. The factor is purposely made low so as not to cause over-estimation of the butterine.

Query 60899, addressed to "Chemists," has been answered completely and accurately by "E. F. S." (page 289), and so far as the reaction between ferrous sulphate and bichromate is concerned, by "F. C. S., Liverpool" (page 269). But "I wonder, oh! I wonder," what could have induced "Wis" (page 269) to fancy his equations had anything to do with the question asked. In addition, "Wis" should make the reaction formulated in his second equation the subject of a scientific paper, if on *trying* the experiment he finds the "event comes off."

"Oxygen," query 60936, though formerly prepared from manganese dioxide, as described by "E. T. P.," in his interesting reply (page 289), is now best obtained from potassium chlorate, which is much cheaper than was formerly the case. If the Polytechnic, the place to spend a happy day, were ever to be resuscitated, I fancy they would not return to the use of manganese; but would probably obtain the oxygen from barium dioxide, or indirectly from the air, according to Brin's process. In the theatres, many of which I should think must use quite as much oxygen as the Polytechnic ever did, I believe chlorate is universally employed. If not, will someone put us right on this point?

"Oxalic acid" (query 60940) is now always obtained by the sawdust process, and the manufacture is carried on by one or two firms only, with whom a manufacturer of oxalic acid from sugar and nitric acid would have no chance of competing. With an appropriate mixture of caustic potash and soda, sawdust yields half its weight of crystallised oxalic acid; but with caustic potash alone wheat bran is said to yield 150 per cent. of its weight of oxalic acid. The fullest description of the process hitherto published is that in Roscoe and Schorlemmer's "Treatise on Chemistry," Vol. III. Part II. Alfred H. Allen.

Sheffield, Nov. 27.

HOW A BOY MAY RAISE A SOLID TON WEIGHT WITHOUT MACHINERY.

[26550.]—IF "B. R." will read the letter on p. 262 again, he will see that the question is not "whereabouts" is the boy; but really where can so phenomenal a "boy" be found. If it is possible to raise a ton weight by putting a strain of 10lb. successively on each of 224 strands or yarns, it would be as well to demonstrate it. Perhaps "B. R." can tell us how he knows that the strain is only 10lb., and how many "yarns" it is necessary to strain before the ton begins to lift. No doubt the boy will have to be on the deck—very much so; and when there can tell his "yarn" to the marines; for he will not succeed in lifting the ton unless he puts a strain of 10lb. *simultaneously* on each of the 224 strands. Nun. Dor.

EXPRESSION IN ORGAN-PLAYING.

[26551.]—I OBSERVE that Mr. Audsley, in his very able and suggestive article on the Chamber Organ, speaks of the swell as if that, as a matter of course, were the essential means of expression on the organ, and, indeed, begs the question by calling his swell pedals "expression levers."

But is it quite so clear a case? While no one can be more sensitive than I am of the immense additions to the resources of the organ furnished by the invention by which the old "Echo" became the modern "Swell"—it is a pity it was not content to retain its old and appropriate name—I apprehend there is at the present time some danger of the swell being elevated into an undue position at the expense of what is, after all, the organ proper.

It is common to hear the organ spoken of as an expressionless instrument; but I cannot believe that Bach or Mendelssohn thought it so: they would hardly have written the many emotional passages to be met with in their organ works for performance on an instrument which could not give them utterance. If anyone were to play (say) a fugue unintelligently, without realising the entrances of the subject and answer for instance, it is certain he would never make his audience realise them. On the other hand, a sympathetic player, by the subtle delicacies of touch, the more or less *legato* and *staccato*, anticipation, acceleration, retardation, &c., will make himself felt, though he may scarcely be able to tell how beyond what he himself feels. *Si vis me flere, fleto.* I do not say for a moment that the swell is not a valuable assistance in aiding expression, but that it is not of the essence of it, and that without the sympathetic touch it is useless or worse.

It is not to be forgotten that the swell attains its effect by what is really the more or less muffling, and consequently deterioration, of the tone. The case is analogous to that of a band under the stage, or a singer behind the scenes. With the shutters fully open it is still at the best an organ confined in a chamber; that a stop of moderate power heard through a closed swell box is by no means the same thing as a really soft stop, will be recognised by anyone who is acquainted with the exquisite "Echo" organ at Doncaster; while in the effect of *crescendo* and *diminuendo*, excellent as that effect is within moderate limits, if these are overstepped, so far from the expression being aided, there is suggested rather the obtrusive lifelessness of an automaton.

I do not understand Mr. Audsley to advocate inclosing the great organ except in chamber instruments; but I confess I am unable to follow him even there. In my own case (where the organ was designed with the single purpose of rendering organ music proper, as adequately as might be on a small scale), I have a great organ commencing with a 16ft. covered and two 8ft. metal open stops throughout, and on a heavier wind than Mr. Audsley advises, entirely uninclosed; and, so far from finding this excessive, I could ill afford to lose its freshness and vigour, and the contrast thereby afforded to the swell.

But, like all facilities, the swell has its nemesis, and to deal with this is the practical point. That the swell stops should be voiced to a somewhat pungent tone is natural enough, for otherwise they would be apt to sound faint. It is also, perhaps, not unnatural that the organist should avail himself of a contrivance which enables him to pull his choir together, or augment or reduce his quantity of tone at a moment's notice, without taking his hands off the keys, and therefore uses his great and swell continually coupled—though to the listener this is about as tedious as if in the orchestra the reeds played throughout with the strings. The organ builder, knowing his great organ will seldom be heard without the swell, naturally voices its stops so that they shall assert themselves against the latter; hence the prevalent forcing and overblowing, so utterly destructive of the dignity and volume which should characterise the great organ.

After all that may be said as to the mellowing of pipes, by age, if there were really much in this, why do not builders "lay down" pipes after the manner of wine-merchants; plenty of customers would be ready to give a good price for a "fine old" diapason of such and such a year—and after all that is to be laid to the score of bad metal, bad scales, want of skill, and want of taste, I have a shrewd suspicion that the deterioration in voicing which Mr. Audsley laments is largely due to the swell-box and the inevitable coupler. I have met with organists in Germany who have told me they never made use of couplers, either manual or pedal—"they were not necessary." Without going so far as this, I cannot help thinking to make the great organ always complete in itself, and let it be

more generally heard on its own merits, would be a step in the right direction.

Again, it is mainly to the facility afforded by the swell that we owe the so-called "orchestral organ." Let it be now understood that the organ is an instrument *sui generis* and *sui juris* with a repertory of its own (and a worthy one), and that there are certain things it can do beyond comparison better than any other instrument, and it follows that to abandon its own special functions and to go in for imitating something else is a derogation. No doubt there is plenty of music not originally written for the organ which lends itself to the genius of that instrument. Handel is said to have frequently used the theme of one of his grandest choruses as a subject for extemporisation. Mendelssohn used the theme of one of his sister's songs in his sonatas. He played on the organ at Buckingham Palace a chorus from one of his oratorios; but it is one thing to adapt suitable music to the organ and quite another thing to seek to adapt the organ to music properly appropriate to other instruments. When one finds organ builders devoting the ability they might bestow on the perfecting of tone and mechanism to imitating all the instruments of an orchestra, and organists doing their best to persuade their audience that it is a band they are hearing and not an organ (in which latter point they unquestionably succeed) is there room to doubt that art and skill are tending in a wrong direction?

Nov. 24. **Finem Lauda.**

HEATING WATER RAPIDLY.

[26552.]—"U. S. A."—The late counsellor, Charles Wye Williams, the founder of the City of Dublin Steam Packet Company, adopted the plan of studding over with rivets the roof of the furnaces in some of his steamers at the Clarence Dock in Liverpool, about 50 years since. It was, however, an experiment which did not last long. As well as I can recollect, the rivets projected downward about 3in., and were 4in. apart each way; that the effect was good for so much, but that the rivet heads burnt away with great rapidity.

I may here mention that the "counsellor" adopted an excellent plan with the smith's fires: by mixing Irish peat or turf from the "Bog of Allen" with the "blazey" Liverpool coal, coking the mixture in kilns constructed for the purpose. This fuel gave remarkably clean, mellow heats, much better than when using coal alone.

Nov. 24. **R. J. Lecky.**

[26553.]—THE writer of the note on p. 255 of a recent issue has evidently read only an imperfect extract from my paper on this subject. The use of studs or rivets on boiler plates to increase the heating surface is at least twenty years old in this country; but no experiments have ever been published giving the exact value and proportions of these studs, nor has their action ever been properly understood. I claim no novelty as to the use of studs; the questions which my experiments were intended to settle were the correct proportions of the studs so as to admit of flame contact, and the value of the surface in contact with the flame as compared with ordinary boiler surface. The further experiments on this subject have shown that an ordinary surface with water behind is absolutely untouched by the fiercest blast flame directed against it. The thickness of the inert space or cold zone is easily measured.

My experiments were not, as the writer appears to suppose, a recommendation of any special form of heater, but a search into the unknown space between a water-vessel and a flame. The matter is one of great practical importance; few are aware even of the existence of such a space, and none understand the condition of matters in this space. My first experiments demonstrated its existence, the possibility of passing or destroying it under certain conditions, and the results obtained in increased duty, surface for surface. The matter is by no means at an end, and my experiments are far from being concluded.

Thos. Fletcher.

"F. A. M.'s" LATHE DESIGN.

[26554.]—IN regard to "Vulcan's" letter on page 218, in which he refers again to the reversed slides of the upper part of my proposed slide-rest, I have another reason for that form. I am keeping in mind that when using the driller for slot-drilling or milling on the face-plate, it will be necessary to mount the driller so that its centre may be below the lathe centres. I think this might be done in my arrangement by winding back one or both the top slides, and then pulling them off. Pulling off the top slide would leave a platform $\frac{3}{4}$in. below the usual height, which might often be sufficient; pulling off both slides would leave a platform $1\frac{7}{8}$in. below (say 2in.), and this is half the travel of the vertical slide. I do not forget that these are scraped and fitted surfaces, but do not see why it should injure them to bore and tap two holes in their upper surfaces, and clamp down upon them a filed-up drilling spindle. The advantage of being able to take them off quickly now becomes important. "Faber" (page 265) thinks it would be better to form these slides so that the upper part should be supported upon a shelf or ledge on the lower one, as well as upon the top surface. I believe it would be better to do this for the front edges; as it would bring the rigid support $\frac{5}{8}$in. further forward towards the tool-point. It would, however, increase the cost a little.

Another correspondent thinks the upper part of the rest unequal in strength to the lower. I think that is true, and it arises from the vertical slide having been made gradually stronger to meet the criticism of several readers. I consider it now a little over-strong—a good fault, if it is one; the upper part of rest is as strong as that on my present 5in. back-geared lathe; therefore, this should surely be sufficient for a lathe without back-gear.

As to the mandrel-nose I cannot make up my own mind, and often go back to the cone fitting with wedge or screw-ferrule.

No doubt an eccentric fastening would do very well to secure the traverse-slide; I think the screw somewhat simpler, and if the handle began to come against the webs it would only be necessary to put in a thicker washer.

The taper set pins for the circular movements are good. I intended to use one to the smaller flange: it is more difficult to get it into the other, as it would have to go up from beneath, and I intend to dispense with it. I keep in mind the suggestion about fixed levers to dispense with spanners; but should be rather afraid to try the spring snaps. I am glad to have "Faber's" suggestions, and to see that he approves of the design. I have not gone forward with the other parts of the design; but intended to follow Messrs. Cooke's practice for the loose headstock, and perhaps, too, for the back motion, which they use instead of an overhead; but am not quite sufficiently clear about it yet. Perhaps "Vulcan" will kindly undertake the moving headstock design.

I saw last week the famous Cooke lathe, which has been described at length by Dr. Edmunds in these columns. I might say a good deal about it; but for the present will only say I was delighted with it, and thought if only it had our vertical-slide it would be perfect. **F. A. M.**

TRICYCLE MATTERS.

[26555.]—IN reply to "Gamma Sigma" (26536), the reasons why small wheels are preferable to large is that the tricycle can be made so much lighter, and there is less resistance by the front steering wheel. There are also other reasons. If a tricycle be 40in. from driving axle to steering axle, the driving wheel 40in., and the steering wheels 20in. diameter, the pedals being about 15in. in front of driving axle, it is obvious that when any work has to be done most of the weight is thrown on the pedals, putting too much strain on to the little wheel, causing frictional resistance on its axle. This has been altered in the new bicycle, which drives on a 30in. wheel and steers on a 31in., making it a very fast machine, as there is so little frictional resistance to the driver by the front steering wheel; but to make this change successfully in a front-steering tricycle is another matter and the subject of patents.

R. G. Bennett.

[26556.]—I SHOULD like to add my mite to this discussion, and first with respect to "Country Parson." I am glad to find he approves of the Crypto gear. I always understood it was, in addition to its expense (£6), very complicated, and likely to go out of order. I have been using Bown's two-speed gear now for 18 months. It has done many thousands of miles in that time, and never gone out of order. In a hilly country, and with wet roads, I look upon two-speed gearing as almost a necessity.

I may tell "Gamma Sigma" of a better way than pushing his machine uphill. First, you must fit your machine, if it is not already fitted, with an automatic steering apparatus. Mine is exceedingly simple, cheap, and effective. My machine is a two-track front-steerer. About the middle of the steering rod a small iron eye is clamped on with a screw. Attached to this are two pieces of round rubber $\frac{1}{4}$in. diameter, and about 9in. long. They are arranged with wire eyes at either end, like rubber door springs; they are attached by their other extremities, one to the Stanley head of steering wheel, and the other to the socket of steering handle. A little adjustment of the clamp on the steering rod makes the wheel run perfectly straight, and still the spring is not strong enough to cause any perceptible increased effort in moving the handle. It is not unsightly, and with some modification adaptable, I should think, to any front steerer. If "Gamma Sigma" will now get a strap 3ft. long, with a loop at one end for the hand and a small ring at the other, unscrew the nut on top of Stanley head, put the ring on and screw down nut again, he will be able by means of this strap, when he comes to a steep hill, to step off his horse, and without allowing it to stop, walk up pulling it after him, and so save both time and labour, for I find it is less labour to pull the machine up a hill than to push it, though I cannot tell why.

Doctor Medicinæ.

WIND POWER.

[26557.]—THERE has been a good deal said lately in the mechanical journals about wind power and horizontal windmills, and especially in your own very instructive columns, from which I glean a good deal of information that is both new and useful to me—albeit, my years would suggest my being a teacher rather than a learner in mechanical or any other science. But your contributors give us very little that is tangible upon which to exercise our invention in regard of wind-power, and this I find tantalising. They tell us something and leave us to guess the rest.

For instance, Mr. Albert Collingridge, in your impression of the 19th inst. (60817), p. 267, partially describes a model machine of that kind, which he himself set up, and which "worked very satisfactorily." He informs us that it had six horizontal arms, carrying vertical sails, *at the end;* and he gives us to understand that these sails were constructed after Mr. P. Vallance's invention on the venetian blind system, as when it was wanted to stop "one central rod opens all the louvre boards." And there he leaves us. The inquiries one would like to make of him, with your permission, are—What was the length of the arm from the centre? and what portion of it was occupied by the sail at the end—length and breadth? And is it to be seen anywhere? And what did he drive with it? Before laying down my pen, may I be permitted to call attention to the perplexing accounts we get from philosophers and experimentalists as to the force of wind? It has been understood—I need not quote authorities—that an ordinary gale of wind, or close-reefed top-sail breeze, exercises a pressure of about 8lb. to the square foot, and that below this wind-power is useful in mills down to a pressure of 1lb. to the square foot. But if I remember rightly, when the Tay bridge was destroyed, the Scotch meteorological establishment, on the Grampians, recorded a pressure that night of 11lb. to the square foot, and that was a gale which strewed the land with fallen timber. The gale of 15-16th October last has left fewer ravages after it. Yet at the meeting of the Meteorological Society on Wednesday, the 17th inst., at the Institution of Civil Engineers, Mr. C. Harding read a paper on that gale, in which he stated that in the squalls the pressure was equal to 70lb. on the square foot. Velocity, 120 miles per hour. Will nobody reconcile these contradictions for us? For myself, I may say I have watched express trains running before a strong gale in the open country, but I never saw their cloud of steam overtake them. **Raymond Browne.**

"MICROSCOPICAL ADVANCES."

[26558.]—DR. ROYSTON PIGOTT has been writing under the above heading on what he calls the transcendental definition of modern object glasses. I confess I have not been able to understand him, although there may be some who do; but I cannot help thinking that it would have been much more to the purpose had he taught the possessors of humbler glasses how to get at the best points of their definition. Microscopes are now made by the thousand in this country fitted up with two excellent object-glasses, the cost of which, with the stand, does not exceed that of a first-class $\frac{1}{4}$in. objective of wide angle with screw collar correction for covered and uncovered objects.

It is a commonplace of all the textbooks that the thickness of a glass cover will break down the corrections of a wide-angled lens; but it may not be so well known that so delicate is the working of even a cheap $\frac{1}{4}$in. of narrow angle that the difference between a thin and very thin cover on the object is quite sufficient to materially affect the definition.

My attention was lately called to this in a forcible manner when examining some living bacteria with a low-angled lens of about 80° and without correction collar. With a cover of a certain thickness the whole field sparkled as if each bacterium shone with its own light; but when a thinner cover was substituted, or the image was rendered dull and uninteresting, I certainly could see the objects, but the crispness was lost.

I am well aware that this is no new discovery, and must be known to every expert in microscopy; but that it is not known to a large number of workers in these humble instruments is probable, their very construction leading the observer astray, for if a length of body ranging from 6 to 10in. w[illegible] make no difference in the definition, surely a little difference of cover cannot affect it injuriously. That it does, I have endeavoured to show.

By the bye, Sir, what has become of all the readers of "Ours" who used to discuss matters microscopical so vigorously? That the fault is not in the Editor we know, as hardly a week passes without some article of interest on the microscope appearing; but there the matter stops, and the general contributors seem to discuss every subject but that one. **T. F. L.**

THE RELATION BETWEEN BATTERY POWER AND THE LIGHT GIVEN BY LAMPS.

[26559.]—I HAVE been very much amused in the course of the last few weeks by the very extraordinary notions that seem to prevail with regard to what light can be got out of a given battery or cell and a given lamp. We have, among others, two classes of inquirers in our paper—viz., those who expect too much, and those who doubt everything. The former remind me of the man who set his donkey to draw two tons of coal, and was surprised that it didn't. The latter, if a fact is in any way new to them, set to work to deny it, doubt it, question it, but never fairly try it. Four years ago the bona fides of Mr. Tolman and other pioneers in the way of small dynamos was actually doubted by these clever gentlemen; and the fact of the possibility of lighting four 5c.p. lamps from the lathe was set down as being "that which is not!" To the former class belong those who wish to light a palace of 15 or 20 rooms from an accumulator to be charged from a lathe, or who ask if it be possible to use a dynamo to light lamps and to work a motor which shall drive a lathe, sewing machine, and the said dynamo all at the same time, and when not wanted for the two former may be set to work a sausage-machine and charge accumulators for future use. But the doubters are infinitely more injurious to the young student than are the enthusiasts. Most of these doubters know something of the subject, and that little knowledge is to them and others a dangerous thing.

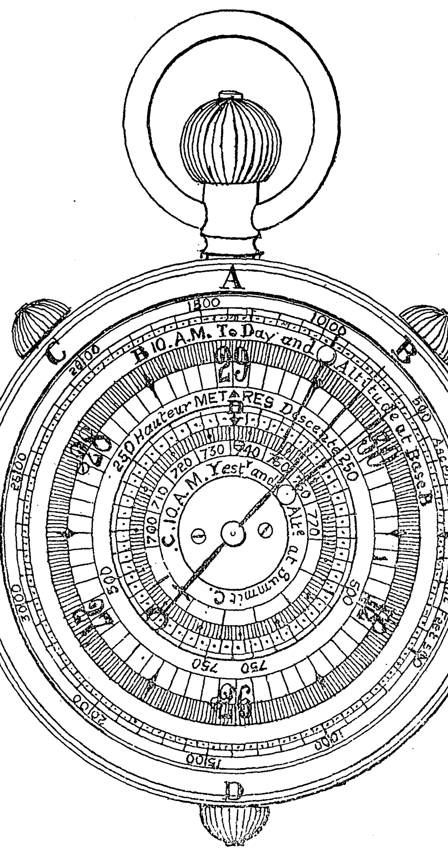
Let us take, for example, the case of the lamp which my friend Mr. Bowron honoured by calling "Wonderful." I had been making some experiments with chromic acid as compared to potassium bichromate in the single-fluid battery. Having by me a certain lamp (not for sale) by a German maker, I used that in making the comparative trials of the lighting powers of the two forms of battery. I gave the results as I found them—viz., that while with potassium bichromate I was barely able to redden this lamp, with chromic acid I was able to light it well. Now note how the doubters interpreted this. One said, "It is not chromic acid at all, it is the old red salts." Another said, "That must be a wonderful lamp, if it light up with ⅘ of an ampère," and so on. To prove my bona fides, I offered to let anyone see the experiment at my own place (I could not sell the lamp, as I had but one). Several came, and two gentlemen reported their experience in the ENGLISH MECHANIC.

I have also tried Messrs. Shippey's lamps, and though I do not consider them "wonderful," yet they are, as battery lamps, far away superior to any that I used, with the sole exception of the one which I mentioned above. Messrs. Shippey Bros. have evidently understood that with batteries it is easier to get a large current than one of high voltage, or rather, to speak more correctly, that a battery consisting of few cells is more convenient than one consisting of many. These low-resistance lamps are eminently adapted for battery work, and as long as amateurs like to use battery power for experimental work, so long will there be a demand for lamps of low resistance, even if they require a few more ampères. In purchasing incandescent lamps, special care should be taken to mention whether they are for use with dynamo or with battery. In the former case stating the E.M.F. of the dynamo, and the number of lights required; in the latter, stating the kind of battery with which it is going to be used. In this way it is possible to adapt the resistance of the lamps to the special purpose required. **S. Bottone.**

IMPROVEMENTS IN POCKET BAROMETERS AND THERMOMETERS.

[26560.]—BEING dissatisfied many years ago with the method of setting the pocket barometer by sliding round a marker on the revolving rim by the hand only, I had the pendant winder attachment applied to the marker instead (A).

I subsequently added a vis-à-vis pendant winding knob (D) which rotates a French mètre scale for altitude purposes abroad, and I also added a fixed barometrical scale in mètres. Finding these very successful and convenient, I finally added two more winding knobs (C) to mark 10 a.m. yesterday and altitude at summit and (B) to mark 10 a.m. to-day and altitude at base. It will be seen that these two markers serve over both the English and the French scales, both altitudes and barometrical. The altitude scale marks ascent to 3,000ft. and 2,000ft. of descent, and for greater heights the two scales are so arranged as to serve together up to 5,000ft. To avoid the expense of hall-marking, the case, except the back, is made by laying pure gold on a metal core by electricity until the desired weight of gold is attained; the back is sheet gold affixed to metal interior, and the whole is then coloured uniform. By this device the gold pocket barometer in the accompanying photograph—real size—is produced for £16 16s. (the last before, with its gold case made in usual way and hall-marked, having cost upwards of £22.) I have had three made in gold cases of this perfected type. I lately passed through the St. Gothard with one of these barometers in my hand, and on arriving on the Lago Maggiore the instrument recorded on its face, by means of the various markers, the respective altitudes of the Swiss level at starting, of the summit of the St. Gothard Pass, and of the Italian level on completing the descent on the other side, besides leaving pendant marker A still free to mark the variations of the barometer hand on weather account. Having the facility of comparing all local readings by its possessing the mètre scales as well as those in inches and feet, added to the interest of this most pleasant travelling companion.



In another pocket I carry a pocket thermometer which I have devised, of the size and shape of a pocket pencil-case only, consisting of a mercurial glass tube fixed in a silver tube, with a wide portion removed to show the reading engraved on the glass tube on Fahrenheit scale; alongside this scale, left and right, are engraved on the silver tube Reaumur and Centigrade scales respectively. The three scales can thus be read and compared simultaneously, while the whole slides for safety into an outer silver case. This costs about 13s. in silver; but anyone can, of course, make either of these instruments in any metal. **Montmartre.**

RATS AND HEDGEHOGS.

[26561.]—IT is only by experiment that we can learn the value of our surroundings. A short time ago the idea struck me that rats would not be amiss as an article of food, so, having procured, by the aid of my terrier, a couple of plump barn rats, I proceeded to break their necks, skin them, and presented them properly "dressed," decapitated and winged to my housekeeper. That worthy soul expressed infinite wonder at the diminutive size of the *rabbits* in question, and ventured so far as to ask what I had given for "them harticles" with that supreme contempt for my marketing shrewdness that only housekeepers can express. In explaining the genus of my "harticle," her wonder changed to horror, and it was only by the aid of "two drops on a lump of sugar" that she could be induced to proceed to the operation of cooking. I have not recovered my prestige in her eyes for even touching such "loathsome creeturs." It has in fact, been *casus belli in re rat*. But the rat made a most delicious pie, and was voted a luxury by some friends who partook unwittingly. As a trophy of my feast I have cured the skins, and kept a few embryo rats I found in one. I have since eaten a hedgehog stewed in milk and onions, and can safely recommend this dish as a real delicacy.

Nov. 25th. **W. Stanley Smith.**

DIATOMS—VEGETABLE OR NOT?

[26562.]—"LONDINIENSIS" (20539) cannot have had much experience as an observer of the lower forms of life, or he would not have been so much surprised by the movements of a *Navicula*. The power of motion is displayed more or less freely by nearly all diatoms and desmids, as well as by the zoospores of algæ.

Proof of the vegetable nature of diatoms is afforded by the facts that they derive nourishment from inorganic matter in water or air, and that under the influence of sunlight they liberate oxygen by the decomposition of carbonic acid.

There is grand unity in nature, and no hard line of demarcation can be drawn between animals and plants, for as Rolleston says, "There are organisms which at one period of their life exhibit an aggregate of phenomena such as to justify us in speaking of them as animals, whilst at another they appear to be as distinctly vegetable." However, the life-history of diatoms is known, and, by general consent, they are now considered as unicellular algæ. **W. H. Shrubsole, F.G.S.**

A DISCLAIMER — OPERA-GLASSES, MICROSCOPE LENSES, &c.—TO "PRISMATIQUE."

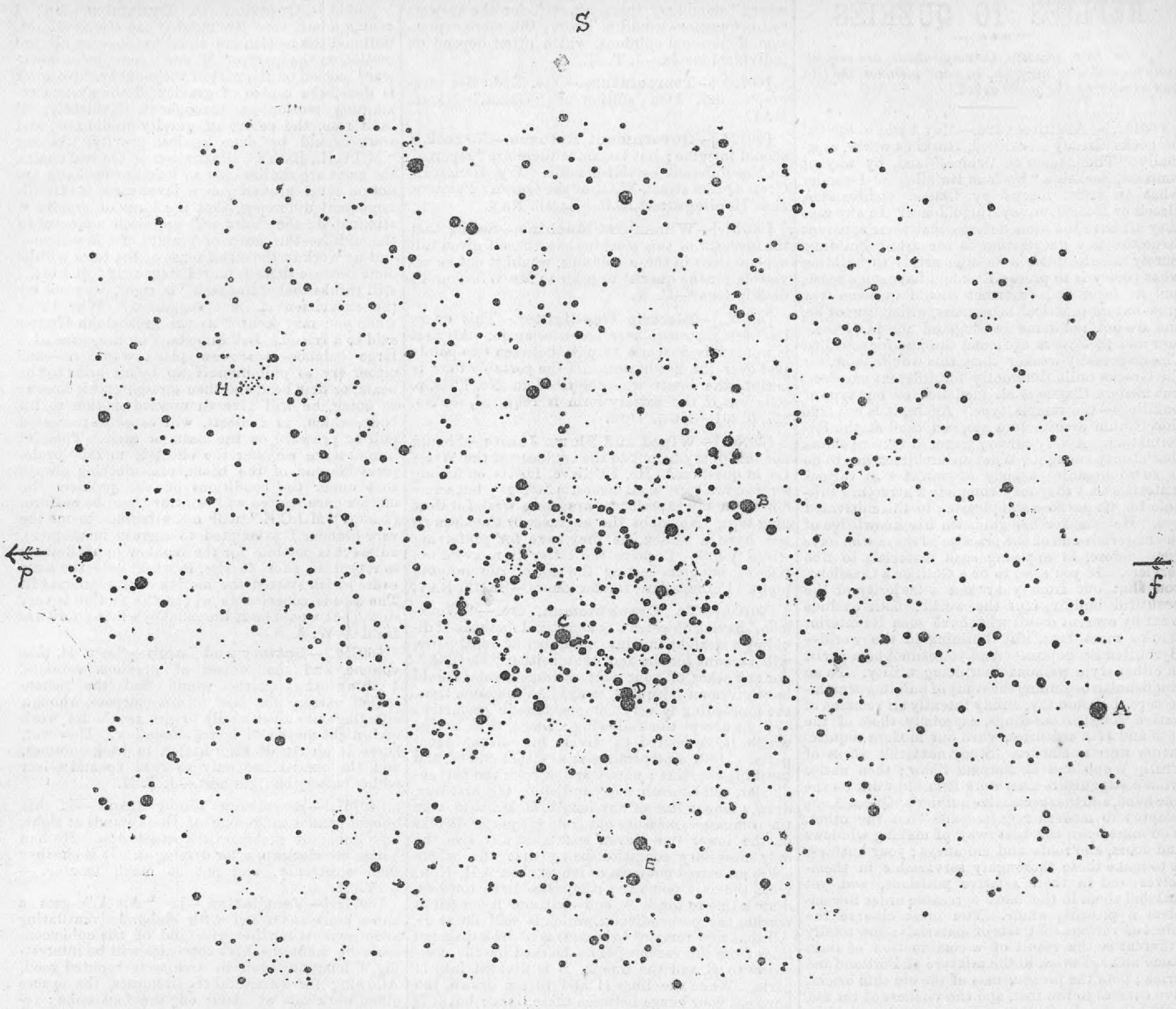
[26563.]—WILL "Prismatique" kindly refer to the leading article in the *Photographic News* for the week before last *re* micro-lenses for photo-micrography? The author of those remarks, Mr. Bolas, is a staunch upholder of Great Britain and of her productions. I note that "Prismatique" feels hurt that Mr. Holmes should think him an interested party. Will he allow me to disclaim all interest in lenses, whether opera-glass, field-glass, or microscope objectives, except *scientific interest?* **S. Bottone.**

INVENTIONS AND PATENT LAW.

[26564.]—IF "R. S. T." (letter 26533, page 285) will refer to "An Elementary Treatise on the Combustion of Coal," Weale's series, 1st edition, he will find that chapter XVII. gives an account of a method of increasing the heat-transmitting power of boiler plates by the insertion of studs in the parts exposed to flame.

The original idea seems to have been taken from the popular impression that a three-legged pot boiled sooner than one without legs. A pot with twenty legs was made, and it was found that water boiled more quickly than with three.

In the *Mechanics' Magazine* of 1842, an account will be found of experiments made with gas-



A portion of M.M. Henry's Photograph of the Cluster M 35. Geminorum (G.C. 1360) and outliers.

Diameter of Field, p to f., 1° 7'.

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burners and suitable vessels. First, without studs; second, with studs on one side of the plate only; and, third, with studs projecting on both sides of the plate, the result being the same that Mr. Fletcher has found.

The plan has been tried with success in, at least, two steamers—the *Royal William* and the P. and O. boat *Pacha*. My authority for these statements is the treatise above mentioned, and it is evident that the idea has been carried beyond the experimental stage, and that a patent would be barred.

Richard Dresser.

THE CLUSTER MESSIER 35 GEMINORUM.

[26565.]—The beautiful cluster M 35 Geminorum, (G.C.) 1360, is one of the most charming telescopic objects visible in a comparatively small instrument, owing to the size and configuration of its component stars. First noticed as a cluster on the maps of Flamsteed and Le Monnier, it is described by Messier in his celebrated catalogue of nebulæ as merely a mass some 20′ in diameter of very small stars near the left foot of Castor. It was observed on several occasions by Sir W. Herschel, and is described by his son as a "large, coarse, pretty rich cluster of 9 to 16 magnitude stars, which fills two or three fields, but chiefly one in which are about 100 stars." Smyth appears first to have noticed the remarkable curves and loops formed by the larger members of the group. "It presents," he says, "a gorgeous field of stars from the 9th to the 16th magnitude, but with the centre of the mass less rich than the rest. From the small stars being inclined to form curves of three or four, and often with a large one at the root of the curve, it somewhat reminds one of the bursting of a sky-rocket." Secchi's description of its appearance in the 9⅗in. achromatic at the Roman College is not unlike Smyth's. "Gruppo largo, e composto di belle stelle, la maggior parte delle quali sono misurabili. Ha forma curiosa di archi incrociati e fantastici; la parte principale contiene almeno un centinaio di stelle superiori alle 12ª gr.; qui ne diamo solo un cenno delle principali per servire a fare una mappa della parte più lucida. . . . . è meritamente un oggetto sorprendente e di quelli in cui, attesa la sua configurazione e la parte del cielo ove si trova, vi è speranza di trovare movimenti." He gives measures of some twenty-four stars of the group; but I am not aware that it has ever been figured as a whole. Every possessor of Webb's "Celestial Objects" must be familiar with Lassell's account of its appearance in his 2ft. reflector, while in the 6ft. at Parsonstown it was seen as a magnificent cluster in a rich field. The observer there estimated that 300 stars were visible in the finding eyepiece, diameter 26′; many of them not being below the eleventh magnitude. It has been photographed by Mr. Espin with the 4½in. camera belonging to the L.A.S., and by MM. Henry with the 13⅜in. at Paris. I append a rough tracing of its appearance in the exquisite picture obtained by the French astronomers, and I trust that the engraver may be able to produce a more satisfactory representation of the component stars of this beautiful mass than in the case of the clusters in the sword handle of Perseus, the illustration of which, on p. 65 of the present volume, is anything but a thing of beauty and a joy for ever. The star marked A is rated 6·7 mag. in the *Durchmusterung*, B 8·4 mag., C 8·5 mag.; the northern star of the wider pair, E, 9·3 mag.; and the southern one 8·5 magnitude. The pair D is OΣ 134, the northern star being rated 7·0 by OΣ, 6·8 by De, 8·2 by Argelander, and 8 by Bessel. The southern and smaller one of the pair (between which a much smaller star is visible on the photograph) is rated 8·2 mag. by De., 8·3 mag. by OΣ, and only 9·4 mag. by Arg. The smaller star is blue according to Dembowski, and is 31·0″ distant from its bright yellow neighbour, the position angle being 187·9°. The letter H points out the faint little cluster Ḥ VI. 17, termed by its discoverer a miniature of its magnificent neighbour.

November 19th. **H. Sadler.**

Chinese Edge Tools.—At a recent meeting of the Council of the Birmingham Chamber of Commerce a communication was read from the Foreign Office, accompanying a collection made by Mr. O'Connor, the British Chargé d'Affaires at Pekin, of Chinese picks, hoes, spades, hatchets, trowels, and sickles, a plough coulter, and several specimens of razors manufactured and used in China at the present day. Mr. O'Connor is of opinion that these articles could be made in England at less cost than in China and of equally good quality, and that if consigned to the care of intelligent agents in China they would find a ready sale there. The examples in several instances, more particularly the picks and hatchets, resemble patterns familiar in this country, but are of much rougher make. The spades, hoes, and trowels are the most primitive, and are very roughly fashioned, for the most part out of rough sheet iron, and there is little doubt that while preserving their general form English tool makers will be able to turn out a superior article at a lower rate than they can be produced by native hand-work. It was resolved to place the articles on view at the Birmingham exhibition, and to invite the inspection of local tool and implement makers.

The amount of crude platinum mined in America in 1885 was about 250 troy ounces, valued at 187½dol. This is exclusive of about 300 ounces of irid-osmine, for pointing pens.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60432.]—**Architecture.**—May I add to the list of books already mentioned, Ruskin's works, especially "The Stones of Venice," and, by way of contrast, Beckett's "Book on Building"? I wonder what an artist means by Classic architecture, Greek or Roman, or, say, Inigo Jones? In any case they all have the same defect—that their apparent structure has no relation to the art of building. Surely architecture, as a fine art, is to building what poetry is to prose: it should have some sense, and its form and ornament should in some way grow out of practical necessities, which cannot be, and are not, the same in England and in Greece, now and 1800 years ago; and the case for so-called Classic is really weaker than this would show, for the Greeks built differently for different purposes, but modern Classic is all modelled on one type of buildings—the temple type. Again, it is not true that Gothic architecture stopped dead at the Reformation. A very cursory glance at Oxford shows that clearly enough. What an architect has to do is so to organise a body of workers in various materials that they may complete a structure suitable for its purpose and pleasing to the cultivated eye. He has for his guidance his knowledge of the materials and of the practice of those who have gone before, in applying such materials to like services. If you elect to be a Goth or a Classicist, you shut out from your ken a majority of the beautiful buildings of the world; both exclude what by consent of all who have seen its interior is the most beautiful building in the world—Byzantian St. Sophia. And you cannot be a purist in either style without sacrificing utility. To an Englishman beginning the study of building or architecture, I should say, Study intently all remains of native English buildings, especially those of the 16th and 17th centuries, when our modern requirements were in embryo. Study next the works of Philip Webb and R. Norman Shaw; then notice what distinguishes their work from old work on the one hand, and the speculative builder's "Queen Anne adapted to modern requirements" on the other. You must learn the best way of making windows and doors, and roofs and chimneys; your business is to make these thoroughly serviceable in themselves and in their relative positions, and yet marshal them in the most agreeable order to complete a pleasing whole. You must observe the effect of various contrasts of materials; how totally different is the result of a combination of Bath stone and red brick to the mixture of Portland and brick; note the pleasantness of the old thin bricks, five courses to the foot, and the vileness of the fat, half-baked suburban, fit only to be plastered over; see with your eyes how the sunny effect of whitewash is chilled to skim milk by the addition of blue-black, and hate that penn'orth of blue black to the dozen of whiting as an inartistic, unscientific abomination, and here and everywhere strive after pure clean colour, for it is by matters of execution such as this that a design is made or marred, and not by antiquarian erudition or classicism coldly correct. Originality neither seek nor avoid; seek only the best way of doing the work, whether traditional or novel. And throughout you have got to consider not only your own likings; but the prejudices and capabilities of the workmen through whom you work, for architecture is a co-operative art, like generalship, and many of us have had to exclaim with old George Stephenson, "It's hard to engineer men!"—W. A. S. B.

[60592.]—**Setting Axle** (U.Q.)—Does the querist mean cart and waggon axles? If so, give the height of wheel, dish and spoke and length of box; I will see what I can do to help him. Say what kind of axle; if patent axle, diameter of stock.—J. C.

[60711.]—**Rendering Ground Glass Transparent.**—If this job is worth doing well, I would suggest that it might be advisable to repolish the "ground" parts, first with the very finest emery, and then with rottenstone and oil. Good pale copal varnish would do; but no doubt Canada balsam would be better. Of course, I am assuming that there is a difficulty in removing the two glass panels: otherwise it would be best of all to replace them with transparent glass.—NUN. DOR.

[60714.]—**Testing Ventilators.**—What does this querist mean by "testing"? The velocity of the air current is measured with a small anemometer.—NUN. DOR.

[60716.]—**Choral Top.**—The questions of "S. S." cannot easily be answered without inspecting the so-called choral top. If he has one, surely he ought to be able to answer several of them himself.—E. G. M.

[60720.]—**Zirconia Cylinders.**—These cylinders are in use by many lanternists; but "Limeweary" should try them himself, for the answers to his questions would be mainly the mere expression of personal opinions, which often depend on individual tastes.—J. T. M.

[60723.]—**Temperature.**—Yes, 5508. See paragraph 327, 11th edition of "Ganot."—SAML. RAY.

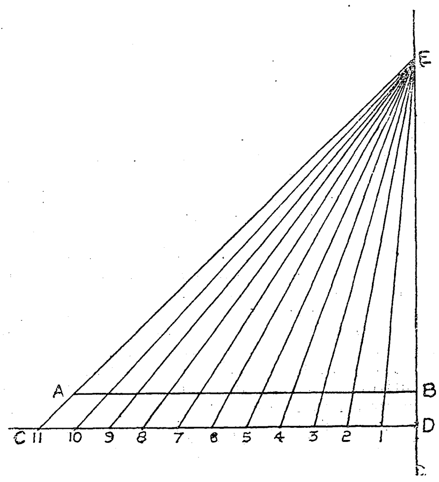
[60727.]—**Government Returns.**—No book, I should imagine; but no doubt there are "reports" on the different establishments. Try Hansard's, Great Queen-street, W.C., or the Queen's Printers, East Harding-street, E.C.—SAML. RAY.

[60734.]—**Wimshurst Machine.**—Seeing that the inventor of this machine has himself given full explanations in these columns, would it not be advisable for the querist to refer to Mr. Wimshurst's descriptions?—C. K.

[60735.]—**Electric Gas-lighter.**—This query has been answered over and over again. All that is wanted is a spark to pass between two points just over the gas-burner. If the portable form is meant, the latest was described in No. 1,033, p. 403; but if the battery form is required, see No. 927, p. 391.—NUN. DOR.

[60751.]—**Wiped and Blown Joints.**—Should not this query be put to the engineer of the Water Co. in question? He, I believe, insists on having screw-down taps to all domestic fittings; but screw downs, in my experience, are more wasteful than plug taps. No doubt the engineer or the authorities have a reason, as they have for preferring wiped joints. Perhaps the latter is to avoid the risk of bunglers letting the metal run into the pipes. Perhaps Mr. Davies knows.—SAML. RAY.

[60700.]—**To Draughtsmen, &c.**—"Workman," having objected to geometrical methods of dividing a straight line into a number of equal parts, will account for the fact that neither "E. L. G.," nor any other of your able correspondents, should have given an adequate reply. At the same time, the proceeding is very simple, though geometric. Will he accept the following: Let A B be a line which it is desired to divide into eleven equal parts. Draw a perpendicular at either end of, and touching the, line; now, starting from the perpendicular, and beneath, and parallel to the first line, draw a longer line of any length, C D; then take the compasses, measure out from the perpendicular on the lower line eleven spaces of any size, the only necessary condition being that the whole space measured out must be longer than A B. Now, from the last point the compasses have touched, draw a line to touch A, and continue it on till it reaches the perpendicular, which it will do at E. All that now remains to be done is to draw diagonal lines from the various points marked by the compasses to E, and the line A B is divided into 11 parts. When the lines 11 and 10 are drawn, you have got your gauge between these lines; but it is as well to draw the others, because you have thus the means of dividing into 10, 9, 8, &c., parts, according to the line you measure from. You can also divide shorter lines by adjusting them higher up against the diagram, or lines of any length by prolonging the diagonals downwards. This would be a useful gauge to keep in the workshop; but would be better with 12 divisions. This is extensively available, even for high numbers. Supposing we wanted 56, we should take 7 and 8, and, having first divided the line by one of these numbers, we should take one of the divisions, and divide that with the other number, and there we



have our gauge. High prime numbers would require a separate diagram, the five lines of which could be constructed in two or three minutes. I have written at a greater length than I intended, and so must defer the division of circles to another occasion, should it be desired.—F.R.C.S., Eng.

[60744.]—**Question in Dynamics.**—No; I cannot admit that the monkey can rise at all; his pull and the motion are simultaneous—an upward motion on the part of M, and a consequent downward motion on the part of the monkey. No work is done, the centre of gravity of the system remaining motionless throughout. Evidently, if both rose, the centre of gravity would rise, and work would be done against gravity. As for "M.I.C.E., Bath's," illustration of the two chairs, the cases are similar only so long as the chairs are not on level ground; on a level there is this all-important difference, that the force of gravity is eliminated; the chairs will approach and meet in the middle—the centre of gravity of the system—but no work in the strict sense of the term will be done because there is no resistance. If "M.I.C.E." still thinks that "Nephesh" is right, why not try the experiment I have suggested? Why think when you may know? as the great John Hunter said to a friend. Let him stand on the scale of a large balance—a see-saw plank would do—and either try to pull himself up by his arms to the beam, or first bend and then straighten his knees; so doing, he will give an upward motion to his body, which, as I assert, will cause an increased pull or pressure on the beam or scale. Then let him observe whether the effect is to raise or depress his end of the beam, remembering always that under the conditions of the problem the motion once started will continue and be uniform (I hope "M.I.C.E." will not attribute to me the very blunder I attempted to correct in another), unless it is possible for the monkey in his descent to repeat his effort to rise, in which case the same cause which started the motion will accelerate it. The case is conceivable where the motion is very slow, as it would be if the monkey's first effort was feeble.—W. A. S.

[60756.]—**Battery and Lamp.**—See p. 44, this volume, and the indices of previous volumes. I think the querist would find the Schanschieff battery the best for his purpose, though charging once a week only to give two hours' work each night means 14 hours altogether. However, there is plenty of information in back volumes, and the querist has only to read up and select which battery he likes best.—J. T. M.

[60757.]—**Revolving Wood Stand.**—If this querist cannot make one of these stands at sight, no number of sketches will assist him. He had better use clockwork for driving it. It is cheaper than electricity, and not so much trouble.—J. T. M.

[60771.]—**Ventilation.**—If "A. A." gets a house built and fitted with elaborate ventilating arrangements for the price and of the cubic contents he mentions, his experience will be interesting, I imagine, even to architects reputed good. Allowing for structural requirements, the spaces given work out at about 5d. the foot cube; remarkably low for bespoke goods. I have never had the luck to meet with a scientifically ventilated room; it is very common to see an unsightly patch in the wall which represents an Arnott outlet; but I never observed that they were effective. The plan suggested by "Medium" and "Sigma" of openings in door heads may often succeed, especially for bedrooms; but if the staircase is heated there is a risk of the pull of the air in it overcoming the draught in the fireplaces, I quote from Dr. Galton's article in "Our Homes." The fact is that there is usually little trouble from foul air during daylight. When rooms are shut up, lighted, and perhaps crowded, it is then that the ordinary provision of fresh air becomes inadequate. One hint I have to offer is, open the lower sash 6in. or so, and close a half shutter against the sash bead, with its top from 6ft. to 7ft. from the floor. A piece of stout cloth, which might be of an ornamental fabric, pinned to the bead with drawing pins does instead of a shutter. To a bedroom I have just fitted an arrangement of double windows, which appears likely to answer several requirements. I have a gas burner with an escape flue between the two frames; but the experiment is of too short duration for a full report as yet.—W. A. S. B.

[60803.]—**Wheels and Axle.**—I would advise you to get a good wheelwright to help you, and let him take the lead of the work. You will see how he does the work, and it will pay you better than to spoil good timber for a pair of wheels. As you say you are a novice in the trade, there are cross lines and V lines used in setting axles. If you give the height of wheels, dish and spoke and length of box, if patent axle, diameter of stock, I will see if I can help you.—J. C.

[60855.]—**Pulleys.**—If the planing machine is for metal, why not fit it with a clutch reversing motion? To drive it with a flywheel and pulleys is a roundabout proceeding, and causes a loss of power through friction. There are not enough particulars to enable one to advise in the matter.—A. F. SHAKESPEAR, Lüttichaustrasse 14 III., Dresden.

[60856.]—**Battery.**—TO MR. BOTTONE.—Many thanks for description of battery. If it is not in-

truding too much, I should be glad of dimensions of a different sort of battery, as I am afraid the contents would run out in my pocket from the bottle. As to size, nothing could be more desirable. If there is no other sort available, I should like to know how long the battery described will run with one charge, and can carbon be replaced by copper in the sulphate of mercury cell?—ROUGE GORGE.

[60862.]—**Parallel Motion.**—TO "GLATTON" AND "T. C., BRISTOL."—Thanks for your kindness in answering my query. You were quite right—it should have been 16ft. 8in., half-length of beam; the brasses are very little the worse for wear. It has been working like this ever since it started new. The piston rod is $\frac{3}{4}$in. out of upright towards centre of beam when out of cylinder, and goes in the same direction at the bottom, as far as glass will let it. I do not know how to carry out your instructions, as it is difficult to keep the engine still with 50 tons of rods pulling at it.—C. ENSOR.

[60883.]—**Building Amateur Workshop.**—As you do not give the lengths of the "two or three lathes, gas-engine, bench, &c.," it is quite impossible to say what space is required. Iron buildings for workshop are best lined with wood, with a space of, say, $\frac{3}{4}$in. between. You must expect to see quite as much rust in it as in the house, and perhaps more, unless you have a cement floor. Engines are always best on a solid foundation; it had better stand on brick foundation. If you must have a wooden floor, let it be not less than 18in. from the ground. Bricks covered with Portland cement would be much better, and would keep the damp down.—A. F. SHAKESPEAR, Lüttichaustrasse 14 III., Dresden.

[60884.]—**Textbook on Mechanics.**—I do not think you will obtain any book that will give what you require; the market is flooded with books on lathes, but there is not one book on either planing, shaping, or milling machines, though planing and shaping is more difficult to do well than turning. Even if you get a book, it will not give you confidence, and I know by experience how much nervousness is conducive to failure. I have been in your position, and I know pretty well where the shoe pinches.—A. F. SHAKESPEAR, Lüttichaustrasse 14 III., Dresden.

[60894.]—**Varnish Brush.**—Put the brushes into alcohol. If the brushes have got hard and dry, heat the alcohol, but be careful and not bring a light anywhere near it.—A. F. SHAKESPEAR, Lüttichaustrasse 14 III., Dresden.

[60903.]—**Motions of Earth and Moon.**—I see on referring to Chambers's "Descriptive Astronomy" that my explanation on page 269 is incorrect. I found it stated in Routledge's "History of Science," page 200, that the earth's mass is forty times that of the moon, and naturally supposed it was correct. The author seems to have confused its *volume* with its *mass*, the former being ·02034 of earth, the latter only ·0128. No one has yet pointed out the error, so I hasten to correct it.—R. E. F.

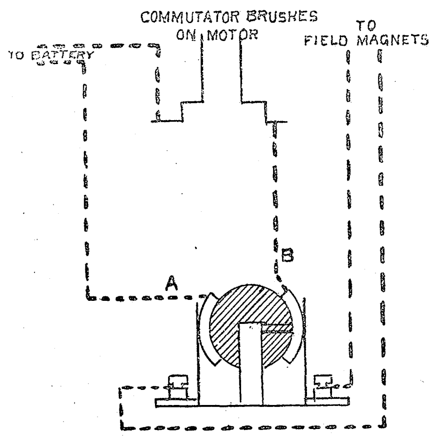
[60906.]—**Lens.**—TO T. PERKINS.—Wray's 5in. by 4in. rapid rectilinear is well suited for ordinary landscape work, as well as instantaneous effects. Using the smallest stop but one, $\frac{f}{16}$, it will cover a half plate well. The definition is excellent. The front combination will screw off, leaving the stops in the slot and the back lens intact. This forms an excellent landscape lens of about 11in. focus, and will cover a whole plate; this whole plate will contain exactly the same amount of the landscape as the lens in its ordinary condition would give on a quarter plate, the objects being doubled in size in every direction. The exposure, using the same stop, must be quadrupled, as since the focal length is doubled, the light is spread over an area four times as large. The advantage of using the back lens alone is not only that it covers a larger plate if desired, but that if we use a small plate, distant objects come out so much bigger, less of the landscape, of course, being included. The back combination alone is not rectilinear; but this is of no importance unless the subject is purely architectural. The outside diameter of lens mount is $1\frac{1}{2}$in.—T. PERKINS, M.A., Shaftesbury.

[60927.]—**Re-cutting Chasers.**—There is only one satisfactory way of doing it, i.e., on a hob.—A. F. SHAKESPEAR, Lüttichaustrasse 14 III., Dresden.

[60929.]—**Aluminium.**—TO "DAVID."—In this week's *Electrician* (or rather last week's by the time this appears in print) you will find a description of the "Brush Colossus" at work, which will probably interest you. The article referred to will be found on page 50.—W. HOLDER, Newport, Mon.

[60929.]—**Nickel-Plating.**—Nickel may be dissolved in hydrochloric acid, and then by addition of potassic cyanide, a ppt. is formed soluble in excess of the potash salt. This would answer the purpose; but the article to be nickel-plated must be removed now and again and polished, as nickel has a tendency to deposit unevenly. I do not think aluminium has been deposited.—E. F. S.

[60928.]—**Reversing Gear to Motor.**—If a "Country Parson" will get a barrel commutator (such as are put on Ruhmkorff coils to reverse current), and connect it the way shown in sketch,



he will find that on turning the commutator half round, it will reverse his motor. Wires marked A and B should be connected to supports of commutator.—JOHN H. B. GARBUTT, Leeds.

[60932.]—**Inlaid Veneers.**—I have read somewhere of a simple process by which cheap veneers can be, and perhaps, are, made; the pattern is cut out of a sheet of zinc. The sheet of veneer is laid on the plank destined for the table-top, and the zinc pattern on this; then the three together are passed through a powerful rolling press, so that the pressure forces the zinc and that portion of the veneer under it into the plank. The zinc is then picked out and will serve again, and a few strokes of the plane over the wood remove the ragged edges of veneer and disclose the inlaid design.—CALCULUS.

[60935.]—**Aluminium.**—Books of aluminium leaf may be obtained; but I cannot say whether suitable for gilding. They appear from catalogues about three-fourth price of same in gold.—E. F. S.

[60936.]—**Oxygen.**—Put MnO_2 in iron retort, and heat in fire to dull red. The gas is equally valuable as that from $KClO_3$, and need not be purified.—E. F. S.

[60944.]—**Copper Green.**—Procure either arsenite of copper (Scheele's green) or oxychloride of copper (Brunswick green), and bring to a state of fine powder, and mix with candle material.—E. F. S.

[60949.]—**Repolishing Gunstock.**—With some small pieces of window glass scrape off all the old polish. Next dip a piece of rag in water and wet your stock all over, and allow it to dry. But the way we do in the trade is to light a handful of shavings and run the stock through the blaze. But to let it stand and dry will do. Now, when dry, go over the stock with a 2nd cut file (or bastard), then with a smooth. Of course you will want two or three different kinds of files. This done, take some No. 2 glasspaper, and with it take out all the marks left from the smooth file. Now No. $1\frac{1}{2}$ glasspaper, then No. 1, and so on down to No. 0. About using the glasspaper, you may use it doubled three or four times to about 4in. square. But we use pieces of flat cork, round which we wrap the paper; but you may do it with your hand. A good substitute for the cork is a piece of $\frac{3}{4}$in. deal, about 3in. or 4in. square, around which wrap three or four thicknesses of flannel or baize, then round that put your paper. For round the corners you may use your finger, or a piece of wood or cork filed to suit the shape of work. Now, if you wish to make a good job of your work, never leave off till the present tool has removed all the marks of the previous one. This is the real secret of well finished work, whether applied to metal or wood. When you have done your last glasspapering, take a piece of wood harder than the stock, no matter what shape or size, for the plain part of the stock—for the corners you will know what to do—and well burnish your stock (with the grain); you ought now to have a fine gloss on. Now oil your stock with raw linseed oil, and let it stand all night. To-morrow proceed to French-polish just as you would a piece of furniture. If you don't understand polishing let me know, and I will give the key. You want to know the way in which the stock is cut. I suppose you mean those little lozenge-shaped figures on the part of the stock which is grasped by the hands when in the act of firing? We, in the trade, call it chequering. I can't draw much, I am not good at description. Give your name and address, and I will lend you one of the tools, from which you will be able to make your own. That will beat a wheelbarrow full of talking. Now for the *red* substance which you think is run into the *nicks* or *cuts*. The red substance you mention is the most sure sign of a common gun. If ever you are about to buy a gun, and you see that red substance about the chequering, take my advice and turn down or up another street. I hope I shall not be misunderstood. I don't mean that common guns won't shoot, or that they are not safe. What I mean is, if you want a gun that will not be always taking you to the gunsmith's, shun those with the red about them. That red is nothing more than the so-called dragon's blood put into the polish for redness sake. There should be nothing run into the cuts of the chequering. And now allow me to tell you that at the present day no good gunstock is ever French polished. There is a fashion even in gunstocks. Here is how modern gunstocks are polished—I mean good ones, and those pretending to be good—viz., when you have prepared your stock for polishing, put a pinch or two of powdered rottenstone in your hand or on the stock. Mix with raw linseed-oil, and simply rub up and down with your hand round the corners with your finger. You must have patience, and you will get that quiet modest polish which you may see on the good gunstock of the day—a polish which will not fade or chip, and which can always be improved by an occasional rub with the hand and a few drops of oil.—ARMOURER.

[60952.]—**Lathe Matters.**—With deference to Mr. F. R. Davis, I think he is in error. An eccentric cannot, of course, convert reciprocating into rotary motion when arranged as in the steam-engine, the friction is, of course, too great; but when the strap of the eccentric is replaced by a band or chain which runs on a roller playing loosely on an axle in the treadle of a lathe, the eccentric will certainly drive very well; the only (sliding) friction here being that of the roller on its axle.—CALCULUS.

[60953.]—**Lathe Matters.**—The substitution of an eccentric for the crank, as suggested by "S. H. R.," is not new to me, as it is used by a German firm. I don't know how it answers; but I should fancy it increased the friction. Have thought of trying it once, but had no opportunity.—A. F. SHAKESPEAR, Lüttichaustrasse 14 III., Dresden.

[60954.]—**John Wilkinson, Iron Master.**—I think I have one, too. Mr. Wilkinson was so fond of his iron that he had his coffin made of it; but, strange to say, although he invented and introduced a new boring machine, and cast cylinders for Watt, and was first of the great iron masters, he did not have it made large enough, for when he came to be placed in his narrow bed it was found too small, so he had to be temporarily interred till another could be made. When placed in the ground a second time, it was found the grave was not deep enough; it had to be taken up, and an excavation made in the rock, when it was buried a third time, within thirty yards of his mansion at Castlehead. The Castlehead estates were sold in 1828, when the coffin was taken up and buried a fourth time, but in the chapel yard of Lindale.—EDWARD R. DALE, F.S.Sc.

[60956.]—**Corn Thresher.**—Perhaps the following may be of use to "J. P." Procure two pieces of round-edged spring steel 2in. in width and, say, 2ft. long; two pieces of wood, say, $3\frac{1}{2}$in. or 4in. broad and 3in. thick. Groove them to suit the steel, and fasten the steel in the groove by means of tabs at the ends. When the foregoing apparatus is completed, get two trestles, place the blocks on the tops (of the trestles), and set them at the proper distance to receive the journals of the drum-shaft; level them perfectly. Now take your drum properly keyed on the shaft, and place it on the pieces of steel so that the journals will run on the steels (which, you will understand, must be edgeways in the wood blocks). The heaviest side will, of course, fall to the bottom. Get some pieces of lead and nail on to the light beaters, and proceed in the same manner till your drum will stand with any one beater at the top.—STOKER.

[60959.]—**Chuck.**—How would the "Hartford" or "Little Giant" suit you?—A. F. SHAKESPEAR, Lüttichaustrasse 14 III., Dresden.

[60965.]—**Saxophone.**—In reply to "Sax's" query, he had better buy Book 6 of "The Bandsman," published by Rudall, Carte, and Co., in which he will find a diagram of the instrument and full directions for learning it.—GERION.

[60967.]—**Revitalising the Ferrous Oxalate Developer.**—There are several methods by which the photographer may restore the energy of his developer, one and all of which are conducted by a process called "reduction," and he may be right in believing that "if any simple or compound body accelerates or restores this developer, it must

be accompanied by reduction." The first process of restoring energy is conducted by following out these principles:—Into a stoppered bottle pour a sample of the spent developer, previously acidified by means of oxalic acid, snap off a dozen or more pieces of clean iron piano wire, introduce these into the bottle (which, by the bye, should be filled to the stopper), leave to digest for 24 hours, frequently shaking at intervals so as to detach the ferrous oxalate from the iron wire as it is reduced from the solution, giving fresh surface to the wire for further reduction. If an element is liberated in the elementary state from a compound body it is termed "nascent," or said to exist in a "nascent condition," and in this state it possesses a greater affinity for other bodies than it does normally. Nascent hydrogen shows a marked degree in its reducing powers, removing the whole of the C_2O_4 molecule present, and reducing ferric salts to ferrous. If we pass hydrogen gas through a solution of ferric oxalate we fail to reduce it; but if we generate it in the solution itself, reduction takes place, the nascent gas uniting with the C_2O_4 molecule, and thus this change must inevitably ensue:—

$$\overbrace{Fe_2(C_2O_4)_3}^{\text{Ferric oxalate.}} + \overbrace{H_2C_2O_4}^{\text{Hydrogen oxalate.}} + \overbrace{Fe}^{\text{Iron.}} = \overbrace{3FeC_2O_4}^{\text{Ferrous oxalate.}} + \overbrace{H_2C_2O_4}^{\text{Hydrogen oxalate.}}$$

Now I think I have made this perfectly clear that the increased affinity of nascent hydrogen for the C_2O_4 molecule brings about a rearrangement atomically, and yet molecularly, which we may theoretically assume is due to the hydrogen atoms that are vastly superior in power, and that have not yet partly spent their energies in coupling together to form bonded atoms or, more correctly, molecules. Another mode of revitalising our developer is as follows:—Expose the sample of spent developer to strong sunlight, previously acidified with tartaric acid (this acid is added to prevent precipitation), for 24 hours or more. One grain to a pint of developer may be used. Below will be seen what reaction occurs when ferric oxalate (which is the result of the ferrous oxalate developer) is exposed to sunlight:—

$$* \overbrace{Fe_2(C_2O_4)}^{\text{Ferric oxalate.}} + \text{light} = \overbrace{2FeC_2O_4}^{\text{Ferrous oxalate.}} + \overbrace{2CO_2}^{\text{Carbonic anhydride evolved.}}$$

(* Slightly corrected from "Treatise on Photography," by Capt. Abney.)

The carbonic anhydride evolved escapes in the form of hundreds of minute bubbles rising from the bottom of the containing vessel, and when this action has apparently ceased, after being exposed to further sunlight we may conclude that our developer is again fit for use. I may say that, if exposed to weak diffused daylight, this decomposition of light-shaken molecules takes place much more slowly than in strong sunlight. Still another and yet more perfect way, which will be more fully dwelt upon in the subject of an article to the coming *Year Book*, and that is the precipitation of the developing principle in this specific developer, whilst ferric oxalate, its resultant, remains in solution, thereby effecting a total separation.—A. TREYER EVANS, Newport, Mon.

[60982.]—**Chronic Inflammation of the Nostrils.**—"Misery" may perhaps find relief from aconite (homœopathic tincture 3) and arsenicum tinct. 3; but he should consult a qualified homœopathic medical man.—PONTO.

[60982.]—**Chronic Inflammation of Nostrils.**—Get a nasal douche or syringe and syringe the nasal passages twice a day. Whilst engaged in the Paris hospitals I found iodoform snuff useful. Recipe as follows:—Iodoform, two drachms; camphor, one drachm; gum arabic, one drachm. Pulverise very fine, and snuff every half-hour.—B.SC., Plymouth,

[60982.]—**Chronic Inflammation of Nostrils.**—Try washing out the cavity by means of the nasal douche with water containing two grains of sulphate of zinc to the ounce, and at the same time improve the general health by means of tonics. Any medical man would show you how to use the douche, after which you can use it yourself. The inflammation proves very intractable after it has been long neglected.—R. E. F.

[60982.]—**Chronic Inflammation of Nostrils.**—I am troubled similarly to "Misery"; but not so badly perhaps. I consulted a surgeon of eminence, and he prescribed benzoated zinc ointment; it cured me for a long time, but a recent cold left me as bad as ever. I obtain relief from a course of aperient pills and the zinc ointment. I fancy, like many others, I am afflicted with a humour which must have (and had better have) a vent somewhere. I should be grateful if some doctor among your readers would kindly advise whether having the ears bored would be likely to divert the ailment from the respiratory passages. I believe ears are pierced to ameliorate chronic inflammation of the eyelids.—A. E. O.

[60982.]—**Chronic Inflammation of Nostrils.**—Querist is evidently suffering from an unhealthy condition of the nasal mucous membrane, and in the absence of evidence as to the hereditary or acquired taint, gouty, tubercular, or such like, it is difficult to advise him. If there is any constitutional disease, the local one is secondary to it, and the former must be treated first. However, I may suggest a few remedies: astringent snuffs, e.g., alum, tannin; painting with glycerine of tannic acid, solution of biborate of soda, nitrate of silver, sulphate of zinc. Internally, arsenic and cod-liver oil. If querist finds his influenza cold coming on, he should try to cut it short by small and repeated doses of aconite; ten grains of Dover's powder at bed-time, or some similar remedy. In any case, he will derive more benefit from the judicious treatment of his medical attendant than from remedies prescribed by those who cannot see him.—DOCTOR MEDICINÆ.

[60982.]—**Chronic Inflammation of Nostrils.**—I think "Misery" has got hold of the right remedies if he uses them right. Like "Misery," I was a martyr to this complaint; but by having a cold bath every morning, and injecting oil of eucalyptus up the nostril once every twelve hours or so when inflammation comes on, I have quite regained my former health. To apply the eucalyptus, get a small piece of glass tube drawn out to a point; break off the point, and fix a bit of indiarubber tube tied up at one end to the other end of glass tube; press the indiarubber tube, dip point of glass tube into eucalyptus, release rubber tube, and several drops of oil will be drawn up into glass tube. Now insert glass tube in nostril as far up as possible, and press rubber tube sharply. This will send oil well up the nostril. Now snuff the oil up into the back nasal passages.—CURED AND THANKFUL.

[60983.]—**Chloride Battery.**—This battery, also known as the "Fuller" cell, is stated in advertisements to remain in action for three months. Practically, its duration depends upon whether it is worked much or little. My own experience is, that when used for lighting lamps it completely runs down in about 30 or 35 hours. Local action does take place; but not very much.—S. BOTTONE.

[60983.]—**Chloride Battery.**—This is a ridiculous name to give to a cell which is purely a bichromate of potash one, in which hydrochloric acid is used instead of sulphuric. The chloride of zinc takes no part in the action except that of conductor of current and keeping the nitric acid out of contact with the zinc. It cannot be usefully compared with the Leclanché, as the properties of the two cells are entirely unlike. The Leclanché has no local action to speak of, and can only give a small and intermittent current. The other has a great deal of local action, and will entirely waste itself away, in no long time, without doing any work; but it can give a much greater current. The advantage it has over the sulphuric-acid form is that the solutions do not crystallise; but, on the other hand some acid fumes are given off. As I have been asked in a private letter to give this reply, and the writer refers to my "Electricity," I may say that the whole of the facts concerning this battery are fully explained there; seeing someone is every day inventing what he calls a new battery and gives a special name to, if he does not patent, it, it is useless to look in any book for a special mention of any special form; but I have not yet seen anything new in any recent battery, or anything the full explanation of which will not be found in my chapter on Batteries. On p. 146 I show why hydrochloric acid and chloride of zinc may be used. In reply to a further question, salammoniac would not be good: it would creep and produce crystals as it does in the Leclanché; the chloride of zinc, being highly deliquescent, does neither. The strength of solution should be such as to bring the specific gravity of both solutions nearly alike, so as to resist endosmose.—SIGMA.

[60986.]—**Waggon Grease.**—I take the following from "Barry's Railway Appliances"; perhaps it may suit "R. J. C.":—Russian tallow, 214lb.; palm oil, 240lb.; soda (? caustic), 20lb.; water, 640lb.; above is for winter. For summer, the quantities given are: 322lb., 210lb., 18lb., and 480lb. respectively.—T. C., Bristol.

[60986.]—**Waggon Grease.**—"R. J. C." should have stated whether he wants to make waggon grease for sale or only for his own occasional use. For a common grease, dissolve half a pound of soda in a gallon of water, add 4lb. of tallow, 6lb. of palm oil, and a gallon of mineral oil. Melt and mix all together in a boiler in a safe place. A much superior "grease" is composed of tallow 8lb., palm oil 1 gallon, mineral oil 1 gallon, and plumbago 1lb.—SAML. RAY.

[60987.]—**Organ Query.**—I would recommend you to have the following stops—viz., open diapason to tenor C, carried down with open or stopped wood pipes; gedact, through; gamba to tenor C; flute, wood or metal, to C C, with stopt bass, and a small pedal bourdon. It is not advisable to build one-manual organs; but, if you wish to do so, inclose all but the open diapason in a box, with vertical shutters at each. There is great objection to the reservoir being under the soundboard, and to be any use it must be made as ordinary, and properly weighted with iron or lead. If you have the reservoir attached under the soundboard, you will require springs, when your pipes will never be in tune. Always make the bellows as large as possible. I would rather lose a stop than be "scant o' wind." If your available space is 4ft. 6in. by 2ft. 3in., make the bellows 2ft. by 3ft. 9in. This sized bellows, when fully inflated, would require 2ft. 2in. in height, including two feeders and weights. The underside of the keyframe may be 2ft. 8in. from the floor, which will leave room for keys to project backwards over bellows, and also for manual to pedal coupler. A small oboe might be added if you inclose in swell box.—URANIUM.

[60988.]—**Loans to Building Societies.**—To answer this query thoroughly one would require to see the rules of the building society referred to, the mortgage signed by A., and the agreement relative thereto. Roughly, however, I would say (following upon a decision given by the Supreme Court in Scotland), that if the society becomes insolvent, A. can claim his property on paying up the balance of his shares. The society cannot make over to B. more than it legally possesses, consequently he (B.) will be bound to disencumber A.'s property on the same terms.—B.SC., Plymouth.

[60989.]—**To Mr. Wimshurst and Others.**—"N. P., London," says: "He has made an influence machine, as described in the 'E. M.' a few weeks ago." This is too indefinite, and, furthermore, must be wrong, because if he had followed all the instructions it is simply impossible for it to remain without full excitement after about two revolutions, notwithstanding it being in the cold and on a November day. The warming and the duster are not needed in a properly fitted machine. The combs are by no means necessary to the working of the machine; but there is no reason why it should not work with them in place. It may be that in addition to the combs you short-circuited the machine by closing the terminals; if short-circuited, the degree of excitement is very much reduced. The bosses very clearly are not true, a professional wood-turner would no doubt finish them up prettily; but the truth part of the business I should try myself before accepting it as a fact. It is very well to try experiments with cements, even though it costs us a few glasses. In the description I think it was stated that a vulcanised fibre washer was to be cemented to the glass, and then the washer to be screwed on to the boss; but be particular to follow the description, and use Rockhill's tricycle cement. The fact is, that unequal-sized balls on the terminals give the best results; the why, no person knows. I have no agent; each maker uses his own pleasure freely: hence the ungainly forms of the machine which may daily be seen. It would require many of your pages to contain the theories in respect to "How is the Electricity Formed"; besides, after giving the theories, it seems to me we should still be in ignorance as to what electricity is. We should first settle that point—that is, if we can. It may be a "manifestation of energy"; but admit even that, and the view carries us no further. Your non-success seems to me to arise from want of actual metal connection between the brushes. Make quite sure of this; it may be a little lacquer, or polish, breaks the metal contact. Have actual metal touch, and even that under pressure.—J. W.

[60993.]—**Permanent Way.**—One of the places where stone sleepers were used, before it was found that they knocked the plant to pieces, was the Edinburgh and Glasgow, now North British Railway. I recollect about 40 years ago being jolted along this line in an open carriage with seats. The old stone sleepers are still to be seen in many places along the line, being used up for repairs.—B.SC., Plymouth.

[60997.]—**Cranks.**—Providing the length of spoke also $= r$, the cases would be exactly the same as regards the moment $w\ r$, and the very slight side twist which results if either w overhangs but a little may be neglected; results, therefore, are the same.—T. C., Bristol.

[60999.]—**Condensing Engine.**—If you have a sufficient supply of condensing water ($=$ 30 times amount of feed per hour) you can have a separate air-pump and condenser, the pump being driven by means of a strap and a pulley with crank. I remember seeing a compact combined condenser and pump in Tangye's small catalogue. I should advise you to get this, as it will also give you some idea of probable outlay.—T. C., Bristol.

[61000.]—**Pipe Moulding.**—If you will refer back to Vol. XXXVIII. Nos. 978, p. 334; 981, p. 400; and 985, p. 493, I think you will find your queries answered.—J. H.

[61001.] — **Landscape Painting in Oil Colours.**—A very excellent guide for a beginner

is "The Art of Landscape Painting in Oil Colours,' one of the shilling handbooks on art, published by Winsor and Newton, Rathbone-place, London, also a "Guide to Oil Painting" in two parts, G. Rowney and Co., Rathbone-place. The former I found most useful when I commenced without the help of a teacher. Both firms have good illustrated catalogues of artist's materials.—BRUSH.

[61001.] — **Landscape Painting in Oil Colours.**—As a beginner, "Welsh Hog-air" may purchase the following elementary books: "Hints on Sketching from Nature," in three parts, or the three bound in one volume, by Green; "Guide to Oil Painting" in two parts, published by Rowney, 29, Oxford-street, London, W., price 1s. a part. The oil colours can be used, as they come out of the tube, occasionally softening them if hard from age or other causes, with a little linseed oil. As a rule, no other vehicle is now used, megilp and other mediums being discarded, as pictures painted with them invariably crack after the lapse of a few years. For outdoor sketching, however, where rapid drying is desirable, some drier must be used, among the best of which is *Siccatif de Courtrai*. Still, like all other arts, more of the handling, and use of the materials, can be learnt in a few hours with a master, than in lengthened periods of practice based only on a knowledge derived from reading.—EYE-WITNESS.

[61001.]—**Landscape, &c., Painting in Oil-Colours.**—It is a great pity that "Welsh Hog-hair" cannot get a few lessons from a practical hand. It would save him from many a heartache, as well as a great loss of time and material, because printed instructions are really of little or no use to a beginner in such a difficult art as painting in oil-colours. As it is, I would recommend him to begin by practising the laying-in of sky, middle distance, and foreground in flat, even tints on oil-sketching paper with French tools, flat, Nos. 0 to 9, along with a badger, softened about 8 or 9 (sables, megilp, and gold size are for afterwards). "A Guide to Landscape in Oils" can be got from any artists' colourman for 1s. and postage; but for practical use "Hog-hair" should get the numbers of Vere Foster's "Landscape in Water-Colours," as also those of the Messrs. Cassell, Galpin, and Co. (they do just as well for oils), which contain a series of sketches from the first ground-tint to the finished picture, along with directions as to the colours needed and the order of using them. As they are done in a fine, free, broad style without much detail, a six months' practice would bring "Hog-hair" on so far as to enable him to begin the study of trees. Tree studies are to be had in numbers belonging to the same series. The only mediums required are light drying oil and spirits of turpentine. Given the ability to draw well, the great desideratum in oil-painting is to be able to handle the brushes—as purely a mechanical art as learning to use tools in a workshop, combined with the ability to lay-in the different tones flat, even, and free from smudge, only to be acquired by long, patient, determined practice. And it is the want of that severe training that makes the pictures of so many amateurs so feeble and raw, and "Hog-hair" should take at least two years on oil-paper and academy boards before taking to canvas. It will give me much pleasure to answer any questions or give further information.—DENS.

[61002.]—**Dynamo and Storage Battery.**—We should say that you would find it hard work to charge a storage battery from a foot-lathe. If you have not a gas-engine or power of some kind, we are afraid you will not find any satisfactory means of charging your cells. Why not try lamps of lower candle-power, and more of them? Light with a Bunsen battery; but you must not expect a 30 hours' light.—WARNE AND CO.

[61002.]—**Dynamo and Storage Battery.**—TO MR. BOTTONE.—You will find a description of a very efficient form of storage battery, the making of which is well within the grasp of an amateur, in the ENGLISH MECHANIC, Vol. XL., page 28. If you had a good dynamo that you could drive from the lathe (and the utmost you could get would be about 140 watts), you would need to treadle away for about 45 consecutive hours to light the lamps for 30.—S. BOTTONE.

[61002.]—**Dynamo and Storage Battery.**—Two 16c.p. lamps would (taking them at about the lowest generally-used resistance) require a current of over two ampères at an E.M.F. of something like 40 volts. Thus, for 30 hours you would require about 70 ampères at 40 volts, for which you would want 20 storage cells each of 70 ampères capacity—that is to say, you would want a cell with, say, 15 plates, seven positive and eight negative, each of about 12in. by 18in. immersed surface. You would have to "form" your plates from the plain lead; for putting on minium is protected under the E.P.S. Co.'s patents, which they are very rigorous in guarding. With no other motive power than a treadle-lathe, the formation of these cells would be such a long job as to be practically impossible—it would take years to do. If you can avail yourself of steam or water power, that is another matter altogether, and I can then send you all necessary instructions; but for the present will forbear describing a dynamo for the purpose, as you could not work it with a treadle-lathe, for to put into the storage cells a charge sufficient to enable them to give 70 ampère hours out, you would require to put 100 ampère hours in, and this with well-constructed cells. This would require, even spread over a period of 10 hours' charging, the continuous exertion for that time of $\frac{3}{4}$H.P., which is about five times the strength of an average man; and this is allowing nothing for loss of power in its conversion from mechanical to electrical force through the dynamo; so you see the treadle-lathe is out of the hunt altogether. If, however, you bring steam or water power into the case, it is another story altogether. A very small engine, a veritable mite of a thing, would put your 100 ampères into the storage cells in five hours with an exertion of only about 2H.P., which, for a steam-engine is little indeed, and with a more powerful one you could, in one hour, put enough into the cells to light the two 16c.p. lamps for 30 hours, though such heavy charging would not be advisable at all.—E. CONRY.

[61003.]—**Boiler Flue.** — If no flame could touch girders, they would be quite safe, and the draught would not be affected if you did not contract area of flue. Heat in chimney is about 600° F.; but much more in the first flue, probably 800° F.—T. C., Bristol.

[61004.]—**Italian Language.**—TO MR. BOTTONE.—The *s* is called impure when it is followed by a consonant. In the regular verbs the present participle is formed from the infinitive by striking off the terminations *are*, *ere*, and *ire*, and substituting for them *ando* for the first, and *endo* for the two latter. But the present participle is not always used in Italian where it is in English. It is generally translated by the infinitive. The past participles, in the same manner, are formed from the infinitive by the substitution of *ato*, *uto*, or *ito*. The personal pronoun is left out at all times, unless it be desired to emphasise the person. *Coloro* is third person plural of either gender; *eglino* is masculine only; *elleno*, feminine. *Da* means "at the house of," the same as *chez* in French. A very excellent grammar, if you can get it, is Angelo Cerutti's "Abridgment of the New Italian Grammar." Biajoli's is also a good one. As for reading books, try Goldoni's "Commedie," Botta's "Guerra d'America," Bentivoglio's "Guerra di Fiandra," Darra, "Republica di Venezia."—S. BOTTONE.

[61006.]—**Influence Machine.**—If one terminal ball be large, and the other ball be small (say, $1\frac{1}{2}$in., $1\frac{3}{8}$in.), the sparks, or brush discharge, ought to be fully 3in. in length. Then, for condensers, "Nil" should use two 2oz. phials of good quality glass, the tinfoil being about $1\frac{1}{2}$in. only in height. With these in circuit he should get snapping sparks from 5 to 6in. in length, with less than two revolutions of the handle. Of course, this all depends upon the proper design of the machine: he should refer to your back pages, see where his may differ from those described, and, if necessary, alter till his works essentially the same.—J. W.

[61008.]—**Length of Belting.**—Reducing all dimensions to inches, $D = 79$, $d = 41$, and $c = 145$. Sin. $\phi = \frac{120}{290} = \cdot41379$, whence $\phi = 24° 26'$, and cos. $\phi = \cdot91044$, and $\phi = \cdot42644$. Then $60\,\pi + 120\,\phi + 290 \text{ cos. } \phi = 188{\cdot}49 + 51{\cdot}17 + 264{\cdot}03 = 503{\cdot}69$ inches. The length of the belt will therefore be 41ft. $11\frac{1}{2}$in.—R. E. F.

[61008.]—**Length of Belting.**—A "Chap," of Oldham or anywhere else, may well be puzzled by the slovenly users of that most careless jargon, "circular measure," misapplied to what is the least circular, or differs from ordinary use by substituting a straight unit for a circularly curved one! When we call a right angle or a quadrant 90°, that measurement, if any, is "circular," at least circumferential. When we have to turn 180° into 3·14159, &c., or 1° into ·01745329, &c., we make the radius our unit, and are surely going from "circular" to straight or "radial" measure. In the wheels of "Oldham Chap," $D + d$ being 120in., and $C = 145$in., we may as well work in inches. Then the two straight lines are plainly $= 290 \text{ cos. } \phi$, the two semicircles $= 60\,\pi$, and the excess curves over them $= 60 \times 2\,\phi$, or 120 arc ϕ. We find ϕ by its being the arc whose sine is $60 \div 145 = 12 \div 29$.

From log. 12 =	1·07918125
Take log. 29 =	1·46239800
	9·61678325
	= log. sin. 24° 26′ 36″
To corresponding log. cos. =	9·9592184
Add log. 290 =	2·4623980
	2·4216164
	= log. 264·002in.

This is the length of the two straight parts. That of the two semicircles is $60 \times 3{\cdot}14159$, &c. $= 188{\cdot}49556$in., and that of the four arcs of 24° 26′ 36″ is $60 \times$ arc 48° 53′ 12″. Most trigonometric tables give such values as—

48° =	0·837758, &c.
53′ =	·015417, &c.
12″ =	·000058, &c.
	·853233
	60
	51·193998
Add semicircles =	188·495559
And straight parts =	264·002
Total length =	503·691in.

The two axes should be inclined at a small angle so as to have the wheels not in one plane. This is supposing the belt of the common kind, having two surfaces. But you may make a belt with only one surface, which will do for two wheels at right angles to each other's planes, or the more inclined the better.—E. L. G.

[61008.]—**Length of Belting.**—From $\frac{D + d}{2\,c} = \text{sin. } \phi = 0{\cdot}4$ or 24°; so that arc embraced of each pulley $= 180° + 48° = 228° = \frac{228}{360}\,(3{\cdot}1416 \times 10) = 19{\cdot}9$ft., including both pulleys, to which must be added $2c = 24'24''$, or 44ft. in all.—T. C., Bristol.

[61009.]—**Induction Coil**—TO MR. BOTTONE.—Primary, four layers of No. 16; secondary, 4lb. of No. 38 silk covered, most carefully insulated. Length of iron core, 12in.; diameter, $1\frac{1}{2}$in.; diameter of circular heads, $4\frac{1}{2}$in.; six or eight quart bichromates.—S. BOTTONE.

[61011.]—**Faulty Dynamo.**—Expect you are driving dynamo the wrong way. The question is very vague. You say the F.M.'s have 6in. jaws (we presume you mean pole-pieces), and the armature is 2ft. 6in. There is a considerable discount to be taken off somewhere. If you like to send us full particulars, we shall be pleased to put you right if possible; or, if in London, will send and examine machine for you gratis. Address, see Sale Column.—WARNE AND CO.

[61011.]—**Faulty Dynamo.**—I presume the armature dimensions given are wrong. Should they not be 2in. by 6in.? If so, the amount of wire is about right. Supposing you have everything really well insulated, then the fault may depend upon one of three things. 1. It is a series-wound dynamo, and you have not connected the terminals whilst running it, or else have used too great a resistance. 2. The brushes are placed at the wrong angle of commutation. 3. You are driving the dynamo the wrong way. Try to reverse the direction of rotation.—S. BOTTONE.

[61013.]—**Physics.**—Woodward's "Arithmetical Chemistry" is published in London by Simpkin Marshall; also, in Birmingham, by Cornish Bros., 37, New-street.—KENSINGTONIAN.

[61013.]—**Physics.**—Presumably the querist desires the co-efficients of "cubical" as distinguished from those of "linear" expansion. If so, he need only multiply the linear co-efficient as given in Ganot by 3 to obtain approximately the corresponding cubical one. If, however, he desires the precise figures as determined by experiment, I may refer him to Balfour Stewart's excellent "Elementary Treatise on Heat," pp. 35 to 38, where he will find numerous tables and comparisons. The publishers of Woodward's "Arithmetical Chemistry" are Simpkin, Marshall, and Co., of London, and Cornish Brothers, of Birmingham.—B. A., Handsworth.

[61013.]—**Physics.**—If a length, 1, of a substance at 0° centigrade becomes $1 + 8$ at 1° centigrade, and then its volume evidently increases to $1 + 38 + 38^2 + 8^3$; but 8 is a very small number, so small that its square, and still more its cube, may be neglected in practice. Hence, it is customary to take only the second term of the above expression, and to say that the co-efficient of cubical expansion of a substance is thrice its linear co-efficient. The density as compared with water at 4° will, of course, be inversely as the volume. In the case of silver, for example, the density is 10·5, its co-efficient of linear expansion is ·000019 (approximately); hence its cubical expansion is ·000057, and its density at a temperature t as compared with water at 4° centigrade is $= \frac{10{\cdot}5}{1 + (\cdot000057 \times t)}$. This expression is, however, only an approximation, for the co-efficient of expansion is not uniform, but increases with the temperature. The exact value in the case of silver is given by the formula

$$E = \cdot00001809\ t + \cdot0000000135\ t^2.$$

I do not know who are the publishers of Mr. Woodward's book, but that gentleman's address is given in a reply to query 60940, p. 290.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[61015.]—**Magnets.**—It will make all the difference. The leg with double the quantity of wire will have greatly increased power—not exactly double, but something like it.—E. CONRY.

[61015.]—**Magnets.**—Certainly not. The force of the magnet depends on the number of ampère turns, and if short magnets, it matters but little where the coils are located.—S. BOTTONE.

[61016.]—**Organ.**—I advise "J. H. C." to make his wood pipes of the best material—pine for the sides, back, and front; for the blocks, solid mahogany from tenor C, and from tenor C to CC face them with ½in. mahogany upon good foreign oak or pine, the material to be thoroughly well seasoned, or good results may not be expected. Let your wood be well stoved for two or three weeks before put together. You can cut your stuff out for all your pipes, which will be far much the better. The feet of pipes to be turned out of mahogany 6 or 7in. long from tenor C up, and from tenor C to CC down deal. Have nothing to do with paper tubes, nor yet zinc, but get organ metal for them, which one may do anything with. In regard to the notching, I have seen it done both ways in England and America. I hardly know which is the best. I have seen vertical notches made with a fine tenon saw about $\frac{1}{16}$in. deep, 1in. long, and about ½in. apart for CC, which gave good results—a fine, round tone. Can give "J. H. C." more if he requires, with our kind Editor's permission.—S. ARLIDGE.

[61017.]—**Incandescent.**—I do not know about this being a "German invention"; but I know that an Englishman residing at Southampton has discovered some such device. Whether it is a commercial success I am at present unable to decide. I have been promised a sight and description of it, and live in hopes.—S. BOTTONE.

[61019.]—**Brazing Band Saws.**—An answer to this query will be found in the same number, on p. 278. The method has also been frequently described in back volumes.—SAML. RAY.

[61019.]—**Brazing Band Saws.**—Prepare the ends in the usual way with spelter and borax, and squeeze them together with a pair of heavy tongs made red hot. There is no better way than this.—998.

[61019.]—**Brazing Saws.** — "G. M. W. W.' will have noticed that in the articles on "Amateur Workshop" the very information for which he asks appears in the same number as his query, so far, at least, as writing can do so.—T. C., Bristol.

[61019.]—**Brazing.**—You will find instructions for brazing in the number in which your query appeared, under the head of "Amateur Workshop." There are special appliances for brazing; but they are to be regarded as compact conveniences, rather than necessaries. An ordinary piece of apparatus consists of a small portable forge, comprising a spring circular bellows, worked by treadle placed underneath an iron forge top or table, containing hollowed out receptacles for water and charcoal, and the little hearth in which the saws to be brazed are laid after being bound round in the manner described in "Amateur Workshop." The blast is then directed on the joint, and being concentrated more than in an ordinary forge, there is less risk of burning the adjacent portions of the blade.—J. H.

[61019.]—**Brazing.**—The apparatus used our way for brazing saws is what the blacksmiths call "lump tongs," and the jaws of the tongs are made very thick so as to retain the heat. The ends of the saw are filed down thin, and placed one on the other, which part will then, if properly done, be of the same thickness as the rest of the saw. On this place a strip of thin brass, bind the parts together with thin iron wire. Sprinkle a little borax over part to be joined, then heat the tongs to a white heat, and hold the saw between the jaws till brass is melted. A friend of mine who had no tongs or proper forge has lately brazed some band saws with an arrangement he made himself. He had a small tinpot concern in which he put some charcoal, and cut a notch each side of tin in order that saw (which he held in a little iron frame) might come on the charcoal; he also cut a hole near the bottom of the tin in which he placed the nozzle of a home-made fan, lit the fire and began to blow, and in a few minutes was agreeably surprised (it was the first attempt) to find the saw properly joined. The fan he made some years ago out of wood and sheet iron; it is driven by a set of wood wheels covered with rubber on the friction principle and is self-contained; so much so, in fact, that his dear missus takes it on her lap to blow the fire with instead of a pair of bellows. I must tell you that the beef-tin looking arrangement that held the charcoal had such a scorch as to render it unfit for further service. The man now uses firebrick hooped with a little band of sheet iron, but still sticks to the same little fan.—ROUGE GORGE.

[61020.]—**Electrical Paper.**—Soaking the paper in nitrate of silver solution might do, if it did not destroy the fabric of the paper altogether. For the surface conductor, rub the paper well with plumbago dust if you want a partial conductor, or paste thin tinfoil on to it for an entire conductor. For a partial conductor, note also the tinned paper with which tea-packets are lined. — E. CONRY.

[61021.]—**Induction Coil.**—(1) No. 20 iron wire; (2) No. 18 silk covered; (3) No. 36, if a thick, fat spark be desired; No. 38, if a longer, but thinner, spark is the desideratum, about 1lb.; (4) two layers of good, stout cartridge paper, laid on so as to break joint between each layer of secondary; nearly $\frac{1}{16}$ thick between primary and secondary; (5) you will probably get 1in. spark.—S. BOTTONE.

[61021.]—**Induction Coil.**—(1) For core, 20in. wire. (2) For primary, 18 single silk-covered; double-covered may reduce the efficiency of the coil, as the thick insulation increases the distance between the wire and the core. (3) For secondary, 36 or 38 silk-covered; the quantity cannot be stated; it is usual to fill the reel. (4) Having thoroughly baked the secondary before winding, and painted each layer with shellac varnish, one thickness of paraffined paper will be enough; between primary and secondary, two thicknesses. (5) Length of spark depends upon length of secondary and battery power. 1in. per mile is the result usually expected, but not always reached. Efficient insulation of the secondary layers is the main thing.—BOBADIL.

[61023.]—**Reducer.**—I have found the following formula very good: Ozone bleach, 1oz.; water, 4oz. It is rapid in action, and must therefore be carefully watched; the negative should be well washed afterwards.—GLAUCUS.

[61023.]—**Reducer.**—I have used most of the reducers, and find none to equal the one sent out with the Paget plates. Not having their instructions in front of me, I can only give a brief outline of the process which I believe was introduced by Mr. Farmer. Immerse the negative in a solution of ferricyanide of potash, leaving it for, say, three or four minutes, drain or blot off with bibulous paper the surface moisture; then, by means of a camel's-hair brush dipped into a weak solution of sodium thiosulphate, touch out those portions that have to be removed or reduced; and at the same time remembering that the stronger the solutions used the more intense their action upon the silver particles with which the developed image is composed.—A. TREYER EVANS, Newport, Mon.

[61024.]—**Sensitising Drawing Paper.**—The paper is first of all floated upon a bath of plain albumen made as follows. Beat up to a froth the whites of six eggs, allow to settle, mix with one drachm of alcohol, and filter into the dish to be used. When the sheets are dry, float upon the following bath, which, of course, must be kept hot during the operation, as the gelatine will set if allowed to cool: ammonium chloride, 150gr.; gelatine, 10gr.; water, 10oz. Dry the sheets thus coated with the warm gelatino-saline solution, float upon a 50 or 60gr. bath of silver nitrate, and dry. This last bath renders them sensitive to white light, therefore should be conducted in a yellow light; ruby glass will do, but yellow is sufficiently non-actinic, and at the same time allows the maximum of light, so that the sheets can be manipulated more easily. Difficulty will be found in floating upon the gelatine solution, as air-bubbles prevent it uniformly covering the paper. This may be overcome by "scraping" the sheet over the edge of the dish.—A. TREYER EVANS, Newport, Mon.

[61025.]—**Platinotype Printing.**—Yes, the quality of daylight does affect printing by this process, as ferric oxalate has its maximum intensity between the G. and F. lines of the solar spectrum —*id est*, the blue portion, whence it is more sensitive to the blue rays than any other part. In winter, when the sun is near the horizon, his rays have to penetrate a much greater stratum of atmosphere than in summer time, when it will be seen that the atmosphere cuts off the rays of high refrangibility: hence a relative diminution of blue-violet rays, and consequently a longer exposure is necessary. It may be noted that feebly actinic light is favourable for printing from weak negatives, and vice versâ, when the picture is contrasted and harsh.—A. TREYER EVANS, Newport, Mon.

[61026.]—**Smoking Fish, &c.**—The sawdust used is either damp or spread out too thinly. Try a thicker layer, and start the fire with some sticks. —W. H. S.

[61026.]—**Smoking Fish, &c.**—Steep a small quantity of the sawdust in a saturated solution of saltpetre, allow it to dry, and then mix with the plain. I have forgotten the exact proportions, but these will be easily found by experiment. Say you dissolve two-pennyworth of saltpetre in half a pint of water, and then put in a good handful of sawdust, you will find this when dried about right for half a pail of plain sawdust if well mixed. If it burns too fast add the plain; if too slow, add the salted stuff, until you have a nice slow smoulder in a mixture.—H. S.

[61028.]—**Etching.**—Hydrofluoric acid which I have, sold by Townson and Co., bites easily enough if the glass is clean—i.e., free from oil or grease or other foreign matter, which may be wax. If you want to make your own acid, take some fluor spar (blue John is one name) and put it into a beaker, then pour strong sulphuric acid on to it; then put the glass to be etched face downwards over the beaker and leave it. It will do its work and eat the beaker as well. So if you like, use a gutta-percha vessel instead of glass.—R. S. T.

[61030.] — **Cleaning and Tapping Brass Nuts.**—Pass a bolt through a dozen or more at a time, screw up tight face to face, and plane off all together, setting the angles with a gauge. Tap the threads by hand.—J. H.

[61030.]—**Cleaning and Tapping Nuts.**—Have a special tap for these, having room at the small end for, say, half a dozen nuts, put tap in lathe, and run nuts right off tap. Take tap out and repeat. You must face each up separately on a stud fixed in chuck. Now thread a lot—say eight or a dozen—on a steel screw held between milling centres on machine, and plane each lot of flats, having a division plate on screw for angles. T. C., Bristol.

[61030.] — **Cleaning and Tapping Brass Nuts.**—The best method that can be adopted is—Tighten as many nuts under the clamps of the tool rest as possible, then put a mandrel through them the same size as tapping hole to see if they are square with the centres, then get a tap true in the bell chuck and put a train of wheels on as though you were going to cut a ½in. pitch screw, then proceed at slow speed with back gear. Get a long taper tap. For cleaning them, put as many as you can on a screwed mandrel and put the mandrel between the centres of the shaping machine, and then proceed.—WALLACE NEWLAND.

[61031.]—**Brass Boiler.**—How on earth can anyone answer this question when even size, to say nothing of shape of boiler, is omitted?—T. C., Bristol.

[61032.]—**Winding Dynamo.**—TO MR. BOTTONE.—Theoretically, a dynamo double the size of any given one gives 32 times the current. Practically, we may say it should give about 16 times the current. Hence, if you double the linear dimensions of the dynamo described in my book, "The Dynamo: How Made and How Used," you should be able to light easily 64 5c.p. lamps. You would want No. 16 wire on the armature, between 2lb. and 3lb., and No. 12 on the fields, say about 20lb. It would need from 1 to 1½H.P. engine to drive it. —S. BOTTONE.

[61033.] — **Ampere's Theory.** — Neither Ampère himself nor anyone else explained the origin of the imaginary currents. All that Ampère did was to show that if such currents existed they would explain magnetic actions; that is to say, as he saw certain results from currents circulating around helices, he said that the same results would arise from infinitesimal molecular currents, if such existed. Others assume that they do exist, and profess to explain magnetism: they assume that they are part of the constitution of matter, or, in other words, they create a form of matter which will suit their purposes. This is the regular process of hypothesis, and it is always going on. Sir W. Thomson, for instance, who never saw or handled a particle of "ether," says that it acts like a jelly, filling space; then others, equally ignorant whether such a thing as ether exists at all, say that it is a jelly-like substance, not having any of the other known properties of matter; then someone says that electricity is probably the same thing as ether, and a lot of "professors" begin to calculate out what other properties must be attributed to this precious jelly, in order to explain the facts of electrical action. They have a perfectly unlimited credit on the Bank of Imagination, so they need not restrain themselves. Having thus constructed a perfectly imaginary matter, and given it whatever properties they choose, they are good enough to present it to the world as explaining all about electricity. Why not? If any difficulty arises, they have only to tack another property on to their jelly, and people will swallow it.—SIGMA.

[61034.]—**Boiler.**—The feed-valve is exactly like a stop-valve, except that the spindle is not fixed to valve, and so can only press it down, but is unable to lift it—the water does that. You, therefore, screw the spindle down, so that valve can only lift a certain height and so regulates quantity of water to that boiler, there being probably more than one, and a safety-valve on supply main. Only one pump required to economiser, and that must be engine side of economiser.—T. C., Bristol.

[61035.]—**Observatory Shutter.**—I do not quite understand "C. T.'s" query. If he will send sketch to 28, East Claremont-street, I will try to help him.—H. A.

[61037.]—**Marking Ink.**—TO MR. SAMUEL RAY.—The only further information desired is as to the best mode of thickening the ink, so that it may

not run when used with a pen on linen. It is supposed that gum might interfere in its permanency, and I am in doubt whether more gelatine may be added without adding a proportionate quantity of bichromate of potash.—L.

[61038.]—**Ampere's Theory.**—Prof. Marco Felice propounded (1860) a theory to account for all the "imponderables," which briefly is as follows:—"Each atom possesses motion on its axis; this motion manifests itself, according to its direction, as heat, light, electricity, or magnetism. When the atoms are rotating all in the same direction, and with their axes all directed to the same point, then, as the electric current is flowing in the same direction, magnetism is displayed at right angles to this flow, or, to speak more correctly, at right angles to the direction of the rotation of the particles." I shall be happy to lend J. J. H., Prof. Marco's work, if he cares to advertise his address; the work is in Italian.—S. BOTTONE.

[61039.]—**Electric Light Battery.**—An ordinary double-fluid bichromate will do it as well as almost anything else; but to light 10 lamps for 60 hours should be rather larger than 1 cubic foot, 12in. × 12in. × 18in., so that each would contain two carbon plates, say, 15in. × 5in. each, and three zincs.—E. CONRY.

[61039.]—**Electric Light Battery.**—I believe no battery yet made will, in practice, light ten 15-candle lamps for seventy hours at a stretch; still, although the Daniell cell is low in E.M.F. and rather high in resistance, it would be to this, or some similar battery to which I should have recourse, if I wished to perform the feat regardless of cost. Large cells, so as to contain large zincs, and to expose a large surface of negative element, would be necessary. It would be well to couple them partly in series and partly in parallel, so as to bring the E.M.F. up to the requisite point.—S. BOTTONE.

[61040.]—**Levelling Glass Cells.**—Put in a layer of warm dry sand, and then saturate it with melted paraffin wax.—SIGMA.

[61040.]—**Levelling Glass Cells.**—May I venture to suggest pitch or marine glue for this purpose, as I am told these are used in battery boxes, and that the solutions generally used have no effect on them.—ROUGE GORGE.

[61040.]—**Levelling Glass Cells.**—I should suggest powdered chalk mixed with just as much hot paraffin wax as will consolidate it, and put in hot into heated cells and allowed to cool, or else hot pitch with plumbago dusted over the top after it has cooled.—E. CONRY.

[61044.]—**Band Saws.**—I should think two months a reasonable period; but it depends on what you mean by "life," since you could go on mending *ad infinitum*. I seldom find new band saws run more than two or three weeks at the most without breaking, and after the first fracture they go more rapidly in other parts (seldom in the brazed joints) due to crystallisation; and I should say that after two months there would be little economy in rejointing and continued running of a saw.—J. H.

[61047.]—**Multiplex Copying Ink.**—I have used the following with success:—Nelson's gelatine, 2oz.; water, 4 fluid ounces; glycerine, 8 fluid ounces. Macerate together for four hours, then melt at a low temperature and pour into a shallow tin to set. For the ink, use either Judson's liquid violet dye *per se*, or aniline violet (powder), one ounce dissolved in half a pint of water.—S. HENRY SMITH.

[61047.]—**Multiplex Copying Ink.**—In which number did this "Sigma" (he is evidently not a reader, or he would use another signature) find any mention of "violet methylated aniline"? However, all he need do is to procure some aniline violet and dissolve it in methylated alcohol (he can use spirits of wine, if he likes) and dilute it with water—not much. The writing, when dry and ready for transferring to the "jelly," should have a greenish-gold metallic lustre. The recipe for preparing the "jelly" has been given many times since Vol. XXIX., wherein it first appeared. Briefly, it is one part of good pale glue soaked in water until soft (water to be poured away) and then melted with four parts of glycerine; add sufficient whiting to make it the colour of cream, and a few drops of carbolic acid to preserve it.—SAML. RAY.

THE Mont Cenis and Mont St. Gothard Railway crosses the Alps at elevations of 4,379ft., with ruling gradients of 1 in 33 in the case of the Mont Cenis line, and 1 in 40 and 1 in 38 in that of the St. Gothard. The Brenner and the Semmering Railway have ruling gradients of 1 in 40 to 1 in 43. The railway over the Blue Mountains, Australia, attains the summit by an almost continuous gradient of 1 in 30 to 1 in 33.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "J. C." has replied to 60592.

60445. G.W.R. Engines, p. 95.
60461. Starch in Yeast, 96.
60471. Electric Clock, 96.
60486. Oscillating Engines, 96.

60709. Electro-Metallurgy, p. 182.
60712. M.R. Engines, 182.
60719. Balance.—To "Fellow Workman," 183.
60712. Push.—To Mr. E. Thornton, 183.
60739. Continued Fractions, 183.
60749. Chamber Organs.—To "G. S.," 183.
60755. Prof. Trusses' Valves.—To P. J. Davies, 183.
60760. Boehm Flute Making, 183.

QUERIES.

[61048.]—**Electric Conductors.**—I shall be obliged if someone will kindly give information as to size of conductors and leakage of electricity in the case stated below. The main conductor would be 25 miles long, supplied with electricity, conducted to it through branch conductors from dynamos driven by turbines of various power, and at various distances—viz., one turbine of 60 H.P. at four miles from the main; one of 40 H.P. at two miles; one of 30 H.P. at one mile; and two of 20 H.P. each at half a mile from the main; total, 170 H.P. given off at the turbines. The main conductor must not be coated with a non-conducting substance, but the branches may be. Required to know—1. The best material, size, and shape of such a main conductor for supplying the motors of a tramcar or train. 2. Sizes and kind of branch conductors (coated) for conveying electricity from dynamos at the turbines to the main conductor. 3. Loss of power from that given off at the turbines; *a*, through or at the dynamos; *b*, leakage from the branch conductors; and, *c*, leakage from the main conductor (or formula for *a*, *b*, *c*), so that I may calculate the available power at the main conductor. The terms I have used above will probably betray my ignorance in electrical engineering.—ACIER.

[61049.]—**Electric Lighting.**—To F. L. STRIFFLER.—I read your description (26479, No. 1,129) of the "Scrap Daniell cell" with interest, and should feel much obliged if you could help me in the following:—For some time past I have been using a 5 volt Woodhouse and Rawson lamp to light my bedroom, worked by four small accumulators, so giving it 8 volts. I charge the accumulators by means of 6 Daniell cells, consisting of small zinc rod in porous pot, 6in. high, inside a glass jar containing a copper cylinder. On reading your letter I coupled up the six Daniells in series and tried the effect on the 5 volt lamp, but it did not even turn the colour of the carbon. I have never been able to get more than 4 or 5 minutes' work out of the accumulators, after having charged them each for twelve hours with three of the Daniells—i.e., three Daniells on each of two accumulators for twelve hours, and then on the other two for the next twelve hours, and the Daniells are always getting out of order. Now, should I get a better result if I converted them into "scrap cells," or would the six so converted be strong enough to work direct, dispensing with the accumulators altogether? I forgot to say that my porous pots are very narrow, only about $1\frac{1}{4}$in., How is the zinc kept from touching F (in your drawing) by a wooden cap? If I make the outside cell of copper by soldering a bottom to it, could I use ordinary solder or would it be affected by the sulphate? I quite agree with you about overworking lamps slightly, and have always found it economical where battery power is used. I may mention that after working for a day or two I always find that the liquid in the porous pot has sunk below the level of the outside jar liquid. Can you explain it? It is more marked in narrow pots than in wider ones.—HARRY.

[61050.]—**Pigs.**—My house is in a public street, the back yard of which I have kept pigs in for ten years without any complaint from the neighbours; but the other day a friend living opposite told me he could remove my pigs any time he wished as they were too near the houses. Is this true? If so, how many yards should they be from any house? My yard is 15 yards long and sty very clean. Also, if he failed to get the inspector to remove them, could he go to anyone higher than him and demand it?—ONE WILLING TO LEARN.

[61051.]—**Lens Shutter.**—I use a large French portrait lens in studio. I want to fix a flap shutter to use regularly instead of cap; but the hood of lens is 6in. diam., and to fix it on this would make such a ponderous affair, as well as very heavy. If I do away with hood, and fix the flap shutter on the lens where the hood screws on, will it answer and work properly?—COUNTRY PHOTOGRAPHER.

[61052.]—**Accumulators.**—To "SIGMA" OR OTHERS.—Can "Sigma," or any other of the correspondents of the "E. M.," kindly give me any rough rule for judging the amount of current necessary to be put, by the regular process of reversal, through accumulators formed of the plain lead plates, in order to produce a certain discharge when the practical maximum of formation is reached—some such rule, for example, as: If 2,000 amp. hours are put through, assuming the best treatment, they will then be in a condition to return a discharge of 100 ampère hours upon receiving a charge of the same quantity, + the necessary margin to allow for loss in the accumulators. I have not been able to get any data as to the amount of electrical current that it will take to form a set of accumulators to give, say, 80 ampère hours, and, consequently, cannot calculate what the approximate cost of forming any particular set would be. I see in *E. Review*, 13, 377, "To transform by electrolysis 1 kilogramme of lead into binoxide of lead, it requires 1,855,000 coulombs of electricity. . . . The plates of the + electrode are formed of two parts of lead and one part of minium; therefore, in order to completely peroxidise 1 kilog. of the + electrode, it would require 1,425,000 coulombs of electricity"; but this does not say what charge such kilog. would hold if so treated, or what discharge it could be got to give. Again (also from *E. Review*): "However, when the external approaches the internal resistance, the E.M.F. of the cells will be reduced, and if the external was made = to the internal resistance, the E.M.F. would be but half that indicated when the external resistance is high." How is this? I thought the E.M.F. of an accumulator was always 2 volts—in fact, I understood from more than one source, including the "E. M.," that the E.M.F. of any cell depended solely on the materials composing the two plates, and the composition of the battery acid as representing electro-chemical actions of various kinds, each of which produced its own particular E.M.F. I could understand the "total output" varying with the external resistance. Will someone be good enough to enlighten me?—TORBAY.

[61053.]—**Preparation for Mixing Bronze Powders.**—Will someone kindly give the composition of the preparation used in mixing bronze powders, such as Judson's gold paint? Also composition of any kind of varnish to protect the gold paint when used for outside work?—SHODOONKEH.

[61054.]—**Magnets and the North Pole.**—Why do magnets always turn towards the north in preference to the other points of the compass when floated in water or nicely balanced in air?—SHODOONKEH.

[61055.]—**Varnish for the Bright Parts of Bicycles.**—Anyone who can give the composition of a varnish for varnishing the bright parts of bicycles to prevent them from rust will be conferring a boon on some readers of this paper, not excluding—SHODOONKEH.

[61056.]—**Connection of Hasp and Staple of Door with Galvanic Battery for Shocks.**—To MR. BOTTONE, MR. LANCASTER, AND OTHERS.—The door of my laboratory, being fastened with a hasp and staples, is always invaded by the curious when I am absent. I wish to prevent them doing so by giving them a shock whenever they lay hands on the hasp to open the door. How shall I proceed? Shall I connect the staple of the post with the carbon and zinc wires of the battery, so as anyone putting on or taking off the hasp will receive a shock, or can I fix an electric bell, and connect the staple with it by means of a wire from a burglar alarm, made to form contact when the door is fastened, or lead two wires to the staple from a charged Leyden jar or magneto-electric machine? In any case I shall be glad to receive details of procedure. What cells will be best—Leclanché or bottle bichromate? What size and how many cells shall I form the battery of, size of wire, &c.? I shall be glad to be able to regulate the current.—SHODOONKEH.

[61057.]—**Steam Launch.**—I have a sailing yacht 22ft. 8in. stempost to sternpost, and 8ft. beam, displacement, 4 tons, which I wish to convert into a steam launch to run at about 7 knots an hour. I propose a single high-pressure engine, and want somebody to help me as to dimensions of boiler, engine, and propeller, and show how each result is arrived at.—ITCHEN.

[61058.]—**Glass Embossing.**—I am an engraver and thoroughly understand the art of etching on copper and am desirous of learning glass embossing. I have tried many processes as described in various encyclopædias, &c., but with no satisfactory results, the varnish given for the protection of the glass having in every experiment "lifted" bodily off the face soon after the application of the acid. Can any of your readers tell me the cause, or help me in any way to overcome the difficulty? If so, I shall be very grateful.—PERSEVERANCE.

[61059.]—**Photography.**—Thanks to "B.SC." for his reply to my query; but he only says Dallmeyer R.R. and Ross R.S. are equal in angle, without saying what the angle is. Can he or any other expert photo. give me an opinion as to comparative quality of the above lenses and Lancaster's new "Rectigraph"? I should prefer the wet collodion process; but for me it is almost impossible, as, travelling in the interior of Asia Minor, I sometimes do 12 hours' journey on horseback, and have to carry my baggage in pack-saddle. A tourist camera and a few plates is all very well, but bottles are troublesome companions on such a journey. I have just found a German work by Schnauss, in which he recommends, after washing the gelatine emulsion, to re-dissolve and pour out on a glass plate very thin, allow to dry, scratch together, and keep in dry form till required. Has anyone tried this? If so, what result?—HAZIR-IM.

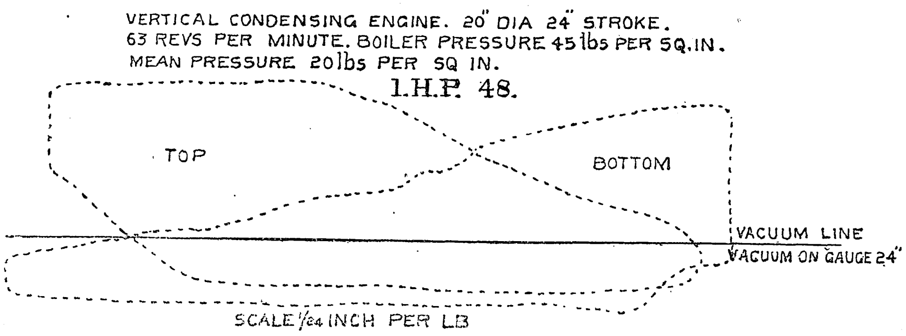
[61060.]—**Gut v. Leather Bands.**—Which will give most driving power—two bands of $\frac{5}{8}$in. gut running in double-grooved pulleys, or one 1in. flat leather belt on flat pulley, the above to be used for the slow motion of a foot lathe? Also, is there any kind of fastening for leather belts which can be attached and detached with the same facility as the ordinary hooks and eyes for gut?—OMNIUM GATHERUM.

[61061.]—**Engine and Boiler.**—Can any kind reader inform me if steam from a locomotive engine would do to test a small boiler with to turn it on gently, and what amount of pressure would it stand with safety? It is cylinder shaped, 3ft. long, 14in. diam., made of iron $\frac{1}{8}$in. thick. It is well riveted, and a $\frac{5}{8}$in. iron stay goes from end to end. I have a small horizontal engine, $3\frac{1}{4}$in. cylinder, 5in. stroke, 16in. flywheel, 4st. weight. What size circular saw would be suitable for it to drive to split beech wood 7in. square?—NOVICE.

[61062.]—**Cheap Dynamo.**—To MR. BOTTONE.—As I am unable to get the numbers you mention in Edinburgh, I have got your book on the dynamo; but should like something, as I stated in the last issue, that would be of more use than just experimenting. Would you kindly describe a good way of lighting up an office 44ft. sq. on the primary system? Would it do to charge secondary from primary cells?—C. GUNN.

[61063.]—**Wheat Straw.**—Will some chemical friend kindly tell me how to make short pieces of straw permanently flexible? Damping with water answers for a time, but they soon become dry and are brittle again.—A. B. C.

[61064.]—**Vertical Engine.**—I shall feel obliged if any of your readers will kindly inform me how to increase the power of the vertical condensing engine; diagrams and particulars I inclose. I cannot increase the boiler pressure; and there is no room in chest to put on a cut-off valve.



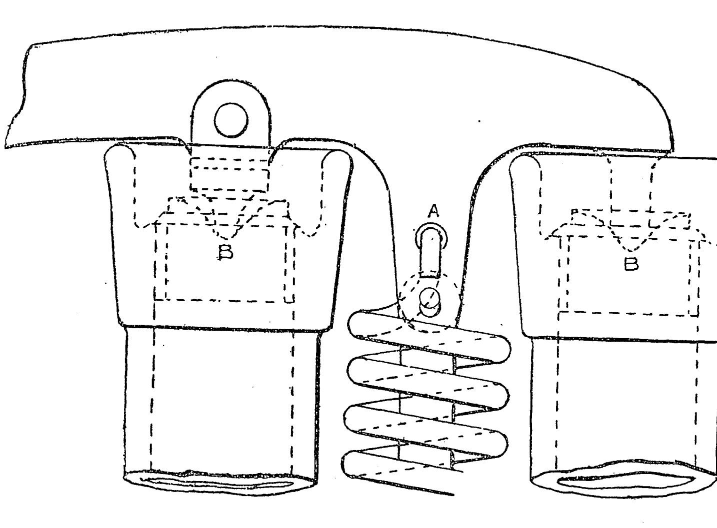
The pressure in the cylinder is only a little more than half of that in boiler. This I attribute to throttling by the governor, which is one of the old type. This I thought of replacing by a high-speed one, and shall be obliged if any of your engineering readers will kindly give opinions on this point and any others that may occur to them, the object being to increase the power and save fuel. Present consumption of good coal is 6lb. per I.H.P. per hour. Single-acting vertical air-pump, 10in. dia. by 12in. stroke. Is this large enough?—J. W. R.

[61065.]—**Electrical.**—Will some reader kindly tell me how to solve these two problems? (1) A sphere is charged with a given quantity of electricity. Show that the work done in moving a particle from an external point to an infinite distance is $\frac{a m^2}{2(f^2 - a^2)} - \frac{Q m}{2 f^2 (2 f + a)}$, Q being the charge, a radius of sphere, f the distance of the point from the centre of the circle. (2) An insulated, but unelectrified, sphere is brought near an electrified particle. Show that distance of line of neutral electrification from the point is $\sqrt[3]{f (f^2 - a^2)}$. Notation as before.—NO SIG.

[61066.]—**Electric Lighting.**—I have now made a dynamo that will work, thanks to ENGLISH MECHANIC friends who gave some useful information through your columns. I now want to arrange wires and lamps to light up the house. Suppose I have 20 lamps, each 20c.p., what size of wire should I use for the leads, or main wires, and will it do to have the main wires of the same thickness from beginning to end? What size of wire should I use from the leads to the lamps? If I want to light, say, 10c.p. lamps off the same main wires, should I use a finer wire than for a 20c.p., and of what size?—BRIAN BORU.

[61067.]—**Casting Name Plates.**—Will some kind friend tell me how to make moulds for casting name plates, same as used for boilers, engines, &c., in brass?—CEDAR.

[61068.]—**Ramsbottom Safety Valve.**—I have seen these constructed with the suspension point of the spring somewhat above the bearing point of lever on the valves; but have recently seen the statement that it should be about the same height—that is, in the sketch



herewith, the point A should be level with the points B B. Is this correct, and, if so, for what reason should they be so placed?—W. H. THURLOW.

[61069.]—**Telegraph Wires.**—When going over Glossop Moor some time ago, I noticed, in the open and exposed situations, some metal flaps suspended on the telegraph wires. Are they for any purpose connected with the telegraph linemen, or are they for preventing the lodgment of snow by the wind causing them to keep the wires in a constant state of vibration?—W. H. THURLOW.

[61070.]—**Lathe.**—Would "J. H." kindly say how to make a reversing gear to a screw-cutting lathe? I don't see anything about it in articles which appeared lately.—A. F. SHAKESPEAR.

[61071.]—**Planing-Machine Tools.**—Will "J. H.," or some other reader, kindly tell me why curved right and left-handed tools while cutting vertically will not lift properly during the return of table, but bind hard against the work, causing gashes. I have one right-handed tool which lifts all right; but its pair will do nothing of the sort. I find I am not the only one who has experienced this defect in this town; but no one can tell the cause or the cure. At present I have to lift the tool-box by hand during the return to avoid damage.—A. F. SHAKESPEAR.

[61072.]—**Motor for Bottle Brush.**—I am desirous of getting a machine that will rotate a spindle carrying a brush for washing bottles. What will be the relative cost of an electric and a water motor? I do not know how to estimate the water pressure available, and I have applied in vain to the officials of the water company for information on this point.—S. H. W.

[61073.]—**Electric Boat.**—I am going to make an electric boat, but before commencing I would like to have the following queries answered. (1) What would be the best dimensions for one 2ft. long? (2) Would the motor described on Oct. 1st do if made less (it is rather discouraging to make one like this when we hear that "it will not work, much less drive a boat")? (3) Would it be better to use secondary, or primary batteries? I may say that I have a fairish knowledge of electricity.—E. D. C.

[61074.]—**Organ Tremulant.**—Would some kind correspondent give me particulars to make a tremulant for a 10-stop pipe organ, which will have good effect, and whether the wind trunk is the best place to fix it? My pressure of wind is 3in. A small diagram would be of valuable advantage, if some of our organ students would oblige—BELL DIAPASON.

[61075.]—**Magneto-Electric Machine.**—TO MR. BOTTONE.—Could you or anyone kindly give me a diagram and description of a commutator for a small magneto-electric machine, to give a continuous current required for small experiments where no battery can be used?—AMATEUR.

[61076.]—**Typewriting Ribbons.**—Can anyone inform me how to manufacture these, and whether the aniline red and blue can be used as well as the purple? When one expends such a sum as £20 on a Caligraph or Remington, he ought not to be always dependent on the makers for the use of it, as is now the case, by having to buy his ribbons from them.—J. W.

[61077.]—**Sympathetic Vibration.**—Prof. Tyndall in his work on "Sound" says that if two clocks with pendulums of the same period of vibration be placed against a wall, and one be set going and the other not, the tick of the going clock will so act on the other as to set it going when sufficient impulse has accumulated. Has anyone repeated this experiment? I have been trying very carefully, but with only partial success.—S. H. W.

[61078.]—**Red Rust from Sheet Tin.**—Can any of your numerous correspondents inform me whether rust can be removed from sheet tin with anything like cleanness? Perhaps some reader of the "E.M." knows of some recipe for same?—J. C. MORRIS.

[61079.]—**Lathe.**—In turning studs or shafting after I have finished with scraper, the surface is all scratched. It seems to me the fault is in the tool, for it goes too deep in some places, so that the scraper does not take it out. Perhaps some kind reader will explain.—BURGH.

[61080.]—**Small Organ.**—Will anyone kindly give me the most suitable scale for a barrel organ with 18 levers, and for sacred music? I have thought of having it in C. This applies to what reeds to use only.—J. C.

[61081.]—**L. and N.W. and G.W.R. Co.'s Engines.**—Would any reader kindly inform me how many engines the above companies have got, and also the approximate cost of a G.W.R. double bogie carriage?—KNOCKHAM.

[61082.]—**Embryo Rats.**—Can some correspondent inform me if I can dissolve the shell that covers the above, and how to determine the age?—W. S. S.

[61083.]—**Axles Breaking.**—Would Mr. C.E. Stretton kindly say if his patent system of crank-webs is in practice somewhere? Meanwhile, as he is one of the principal officers of the A.S.R.S., would he please to say if the president of that society has received my letter of the 31st July last, of which I received no acknowledgment? In several of his writings, Mr. C.E.S. said: "There will be growing flaws." Admitting the existence of flaws in the metal, is it impossible to prevent their growing? Should a means exist of preventing it, would it be of any value? Although the thing may appear impossible, let us suppose that there exists a means of rendering axles, cranks, webs, piston and connecting rods, rails, &c., unbreakable under the circumstances in which they actually break, would it deserve attention?—CH. RABACHE.

[61084.]—**Fireclay.**—Would any reader who knows kindly give the chemical composition of the best British fireclay, such as is used for retorts, crucibles, bricks, &c.? Where is it to be found?—M. E.

[61085.]—**Flameless Combustion.**—Some time ago, Mr. T. Fletcher, of Warrington, made experiments on flameless combustion at Owens College which were very successful. Can any fellow reader say if there has been any industrial application of the process, and what were the results?—A FOREIGNER ANXIOUS TO KNOW.

[61086.]—**Wimshurst Electric Machine.**—I thank Mr. J. W. for his answer to my query (No. 60780, Oct. 29), but I am sorry he did not reply fully. I have got the pamphlet on the Wimshurst machine by Mr. Thos. Gray, and I have been fully satisfied with the results obtained from my machine after following the instructions therein contained; but, if possible, I would like to arrange my machine in such a manner as to obtain a shock from it similar to that got from the medical or shocking coil (this part of my last query Mr. J. W. omitted replying to). Could such a result be obtained from it, and, if so, how shall I arrange matters? Could a coil be attached somewhat on the same principle as the electro-medical apparatus? Can any reader enlighten me?—ELECTRIC.

[61087.]—**Metallic Fire-Alarms.**—TO MR. BOTTONE AND OTHERS.—I want to make some electrical fire-alarms, based upon the principle of the unequal expansion of two metals, for my own use. What metals are used and how arranged to make them very sensitive?—ELECTRICAL.

[61088.]—**Dynamo.**—In the MECHANIC for April 23rd Mr. Bottone gave dimensions of two dynamos. I am making one on size of the smaller machine, a 50c.p. Instead of castings I am constructing it of wrought-iron, and the field-magnets are 1½in. diameter instead of 1¼in. I want to know if I shall have to make any alteration in the quantities of wire given or the speed, so as to give 60c.p., which I should like to get instead of 50c.p. Will you kindly give sketch of the method of joining coils on armature as I am unable to find out? I have been told that one end of a coil is joined at the pulley end, to the end of the coil opposite, and then the other ends of the two coils are fixed to two sections of commutator, which are also opposite each other, but should like to be sure.—ST. ANDREW'S CROSS.

[61089.]—**Coils.**—Which of the undermentioned coils will give the strongest shock?—First coil, primary ¼lb. B.W.G. 20, core 4in., secondary ½lb. 38; second coil, primary four turns of 18 B.W.G., core 4in., secondary ½lb. 38; third coil, primary ½lb. 24, core 4in., secondary ½lb. 36; excited with one battery.—R. M.

[61090.]—**Electric Scarf-Pin.**—TO MR. BOTTONE AND OTHERS.—I have tried the semi-dry sulphate of mercury battery with the above, but find that after working well for about a quarter of an hour, it dims and ultimately extinguishes. Is it because the batteries are not large enough (I use two with plates 4in. by 1¾in., and the lamp requires about two volts), or that they get dry? Or do I not use enough paste (about ¼in. thick)? I shall be obliged for any suggestion on the subject.—AERONAUT.

[61091.]—**Curious Phosphorescent Insect.**—While sitting in the dark in my garden one night early in November, my attention was attracted to a small luminous object in gradual motion near my feet. I found it to be an insect about 1in. long, and as big round as an ordinary pin. It had about a hundred short legs, and its back was curiously raised or "humped" in the middle. I brought it indoors, and found that in the dark it glowed most perceptibly, and as it wriggled about it occasionally radiated sparks of phosphorescence. Can "F.R.A.S." or some other naturalist give me some information as to the singular creature I have described?—W. E. D.

[61092.]—**Hot-Air Motor.**—TO MR. SEAL.—Having made a small dynamo, I should like to make a hot-air motor, as illustrated on p. 148 of "Ours" of April last. Will you please give dimensions of cylinders suitable for driving the same? I think half-man power would be sufficient.—S. HEVEY.

[61093.]—**Hexagonal Nuts.**—I would be much obliged if any readers of the MECHANIC could inform me where I could obtain an absolutely correct list of Whitworth's standard sizes for hexagonal nuts.—BEN BOLT.

[61094.]—**Æolian Harp.**—I have an Æolian harp for repair; will some correspondent give me a little instruction? There are twelve pegs to pull up the strings, but only one bridge. Ought there be two—viz., one at either end? Should the strings be all of gut, or are there some wire-covered ones? How is it tuned—that is to say, in thirds, fifths, or one note after the other—and in what key?—COUNTRY WATCHMAKER.

[61095.]—**Incandescent Light.**—I am wanting to light my two shop-windows with the incandescent light for Christmas. I should want about 24c.p., and wish to light them by batteries. Would Mr. Bottone or Mr. Eaves kindly tell me how many batteries I shall want, and what sort, and how to make them? The lights would be lit for about three hours.—NO SIG.

[61096.]—**Organ Building.**—I am building a small organ containing open diapason 44 pipes, dulciana 44 pipes, clarabella 44 pipes, stop diapason (bass) 12 pipes, and I wish to arrange it so that the stop diapason (bass) will be acted upon (i.e., either opened or closed) by any of the treble stops, so that whichever treble-stop is being used it will appear to run through to CC. I see this plan adopted by organ-builders, but do not know how it is managed. I should be glad if some kind contributor would favour me with a sketch of the arrangement of slides or other required mechanism.—PEDAL.

[61097.]—**Coil.**—Have made a coil two layers No. 24 and 4oz. 38 silk-covered, insulation between each layer

one sheet shellac-varnished paper. Am driving it with a pint bichromate battery, two carbons, one zinc. I want it to give an irresistible shock, but it does not. Can it be expected? Would a 3in. square condenser make sufficient difference, have no room for larger? Will some kind reader come to my aid?—NOVICE.

[61098.]—**Invalid Carriages.**—How can a person whose legs are both useless steer one of these, and at the same time propel it himself by means of two hand-levers? I have heard it is done by means of a kind of swivel handle attached to one of the hand-levers. Can anyone kindly tell me how this works?—COTTON.

[61099.]—**A Rule of Grammar.**—I am anxious to obtain the opinion of the readers of "E.M.," especially the philological ones, upon a rule of grammar. Does the verb "to be" always take the same case after it as it has before it? Should we say "It is I," or "It is me." "That is him," or "That is he," or are both modes of speech correct? Strict grammarians abhor such forms of speech as "It is me," while custom certainly favours this expression. When the monks of Rheims, "Regardless of grammar . . . cried 'That's him,'" it has often struck me if grammar did not agree with them. So much the worse for grammar; custom certainly does. This fighting against custom appears to me to be absurd. The grammarians among our Anglo-Saxon forefathers fought equally hard, I suppose, against the dropping of inflexions, and regarded those who disused them as beneath contempt, and yet custom conquered, and the inflexion only survived in a very modified form. Will anyone assert that "you was" was bad grammar in the latter part of the 18th century, when, if I mistake not, the best authors employed it, and I have often wondered why it fell into disuse. It appears to me that grammar is only a theory constructed to describe, arrange, and systematise spoken and written language, just as logic systematises modes of thought; but that as we never think in syllogisms, so we never speak with the rules of grammar before us, and that modes of speech are no more to be governed by the hard-and-fast rules of grammarians than modes of thought are by the fancies of the school men.—DOCTOR MEDICINÆ.

[61100.]—**Thin Steel Pipes.**—Could any of your numerous readers kindly give me any information as to steel pipes, or where I can find information on the subject? I would also like to know if they are used to any extent in England, and where?—F. H. S.

[61101.]—**Stars Visible from Bottom of Well.**—What stars would be visible from the bottom of a well in the daytime and during an eclipse of the sun in our latitudes?—FACIEBAT.

[61102.]—**Bending Beech.**—I have a quantity of thin strips of Beachwood $\frac{1}{8} \times \frac{5}{8}$ to bend in circles of 5in. Which is the best way to proceed?—S. HEVEY.

[61103.]—**Bath Chair.**—Can any of your readers furnish a rough drawing of an invalid's bath chair, to double up? I only want sufficient indication to make a sketch for me to work from, as I can understand the principle, but have no opportunity of getting the proper distances of the bolts, &c.—S. STEVENS.

[61104.]—**Steel Band.**—Will someone say what is the smallest size pulley I can with safety run a band 2in. broad and 32in. thick? It has to do work somewhat after the manner of a band saw, and should like to run it on 4in. and 12in. pulleys. Length of band 7ft., and as it is somewhat costly I fear to destroy it on too small pulley.—BAND.

[61105.]—**Exhaust Pipe.**—I have a 4H.P. vertical boiler with exhaust pipe from cylinder opening into chimney. When engine is started the water from exhaust comes down and puts out the fire. The same thing occurs when steam is drawn off for boiling water. There is no hollow in exhaust where condensed water could lodge. Can any correspondent tell me the cause or suggest a remedy? Would there be draught enough if exhaust was removed from chimney?—DOCTOR MEDICINÆ.

[61106.]—**Cheap Disinfectant.**—Half a drachm of nitrate of lead dissolved in a pint of boiling water to be mixed in a pail of water in which two drachms of common salt have been dissolved. Will someone kindly say if the above ingredients will keep mixed as one powder, and be equally effective if the mixture be simply dissolved in water as wanted? If so, it would be more simple to weigh up a quantity of single powders and keep for use as wanted than to make up a quantity of double powders. An expression of opinion as to the value of the above for sinks, drains, &c., would be valued. Also information as to the compounds formed by the mixed solutions.—SANITARY.

[61107.]—**Small Coils.**—Will Mr. P. Ward or others inform me what is the smallest section-wound spark coil I can make? I wish to use No. 40 wire as secondary. Should the primary be wound in the partitions or grooves? What number wire should be used for primary, and how many layers? When the secondary is wound in the first groove, how is it brought into the next? Should the sections be the same diameter as the reel ends? The above information would much oblige.—COIL MAKER.

[61108.]—**Oil for Cycles.**—Can anyone give me a recipe for removing the disgusting smell from sperm oil without injuring its quality, or tell me of a suitable oil not liable to become thick and clog, and at the same time free from offensive odour? Rangoon oil is too thin, and when thickened with vaseline is a failure.—LUBRICATOR.

[61109.]—**Defective Brickwork.**—I have a coach-house, on one side of which some of the bricks are both sandy and imperfectly baked. In consequence of this the whitewash is constantly peeling or scaling off, leaving ugly patches of red brick, and in no very long time many of the bricks will evidently perish entirely. Can anyone oblige by informing me how this can be prevented? I have tried thin shellac varnish applied after well brushing the defective bricks, but this coating only lasts a few months. Something seems to be needed which will soak in and combine with the sand and clay of the bricks so as to form a durable surface. As the area of defective wall does not amount to many square yards, a remedy which would be too expensive to use on a large scale will serve my purpose.—CLAYFIELD.

[61110.]—**Dynamo.**—I have a dynamo of a capacity of 100 volts and 50 ampères charging at a distance of 335 yards through No. 5 solid wire, 27 accumulators. The lamps are 52 volts. What is the formula for ascertaining the size and length of iron wire coil to act as a resistance coil so as to run lamps direct from dynamo, and how can the various circuits be coupled so as to charge the accumulators and run the lamps at the same time?—STELLA.

[61111.]—**Hand-Saw.**—Can the contributor of the clever and useful paper on Saw-Teeth (page 233), or any other correspondent, tell us the difference, if any, in form or method of using, between the ordinary hand-saw of our British workman and that of an Eastern one? The teeth of our saw lean at an angle inclined from the handle; as if we refer back to engraving 328, p. 233, and imagine the handle to be on the left-hand side, where the figures are; but the teeth of the saw represented in the large picture, "The Shadow of Death," by Holman Hunt, are leaning in the opposite direction, that is, assuming the handle to be at our right-hand side of above engraving, thus requiring the acting force to be applied in the direction of a pull, and not as a thrust, as in the case of our hand-saw.—T. P.

[61112.]—**Fletcher's Muffle and Air Furnaces.**—These I have had some years—say, four or five, and perhaps more. The other day I had new grids from Fletcher, and they came with gauge of a larger mesh. First time of lighting a blow-down; but on stopping off the air they lighted well, and then—oh! the heat was splendid. Last night I took 550 grains of Brazilian pebble, a piece of large crystal of quartz, and I put this and 2,250 grains of dry carbonate of soda into a platinum cup and put all into the muffle. This was at a quarter-past ten p.m., and at eleven the contents of the P. crucible were all melted—i.e., to the eye. Shortly afterwards boiling commenced, and as the crucible was full I had to lower the heat to prevent boiling over. After a time I put on again full gas, and at 12 p.m. (one hour and three-quarters after starting from the cold) all was quiet, and I stopped all action. On dissolving in water I found all the pebble (quartz) dissolved except a few grains, which are pure white water-worn (like) pieces of quartz. Never have I seen quartz thus treated, which show a crystal properly-shaped left. The fracture of quartz is conchoidal.—Question: Do quartz crystals grow?—R. S. T.

[61113.]—**White Enamel Paint.**—What can I use to rub down the work with that will not discolour it? I have tried the finer pumice or glass paper, but both slightly stain.—DANDIE DINMONT.

ANSWERS TO CORRESPONDENTS.

⁎⁎ All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁎⁎ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 1, and unacknowledged elsewhere:—

LT. BASSET.—W. Coleman.—J. Boggis.—M. W. Stevens.—J. Mason.—J. and H. Grace.—T. Plunkett.—Amateur.—Chaser.—Ajax.—G. H. V.—Short Spark.—W. W. N.—One in a Fix.—Electricity.—Poor Potter.—A. J. W.—A Dunlop Steward.—J. C., Southport.—A Young Fitter.—Sodium.—Milverton.—G. M. S.—J. G. Winton.—N. H.—T. Prince.—C. M. Gaudibert.

G. CHARLTON. (If you refer to Langdon's "Application of Electricity to Railway Working," you will find illustrations of various forms of repeaters. They all work on the same principle—that is to say, the arms of the indicator or repeater in the signal cabin are actuated by the armature of an electro-magnet. To take the simplest form, the heel of the semaphore arm has a contact piece so placed that when the arm is down (signal off), the spring piece attached to the post is free, and no current passes through the wire connecting the post to the repeater. When the arm is raised contact is made with the spring piece; a current traverses the wire, excites the electro-magnet of the repeater, which attracts its armature, and so the miniature signal is put "on" in the repeater.)—C. W. V. (The sun does not put out a fire upon which it shines brightly.)—BRUSH. ("Case-hardening" means technically converting the surface of cast or wrought iron into hard steel The term cannot be appropriately applied to hardening steel, which is "tempered" by having its hardness reduced.)—A ANXSOWS SUBSCRIBER. (The liquid you saw used to harden iron equal to case-hardening was probably made by adding a pint of oil of vitriol and a quarter of a pound of saltpetre to six gallons of water. Heat the iron to a cherry-red and dip as usual.)—W. NICHOL. (The *American Monthly Microscopical Journal* can be had in this country of W. P. Collins, 157, Great Portland-street, W., 5s per annum.)—ZERO. (There is no other substitute than that mentioned. Old vulcanised rubber is mixed with fresh caoutchouc for some purposes. See indices. 2. There is no useful dipping process for nickel-plating. A dynamo is the only cheap agent in the plating of such goods. Battery work is expensive. See indices.)—J. G. J. G. (Surely you do not want an 8 horse-power engine to drive a wood lathe! A vertical boiler would probably be the best to supply an 8-horse engine; but it depends on conditions, which you do not state. 2. We think you can get all the information required about the lantern from Lancaster and Son, Birmingham.)—T. J. L. (If you cannot see back volumes, refer to Molesworth's Pocketbook for the required data. You do not give the maximum gradient, or is the load always on the level? Compressed air would give sufficient power, but how you are to compress it depends on circumstances. Water power would probably be cheapest; but at any rate you must have air-pumps, and some kind of engine to drive them.)—LIMELIGHT. (See what was printed about the ethoxo-limelight in No. 887, 889, 892. The inventor's description appeared in No. 832.)—AN INQUIRER. (You will probably be able to remove the varnish from the globes by means of warm alcohol.)—S. B. R. M. (No, not if silk-covered wire is used; but it is advisable to do so in the case of motors. 2. No.)—PHOTO. (See indices and recent back numbers. You should use a primary battery for such purposes, unless you have a dynamo to charge the secondary battery.)—FRED. (See pp. 73, 93, this volume. You could probably do what you want by drawing air through a coil of pipe immersed in a freezing mixture.)—PHOSPHORUS. (You can keep phosphorus under water and in sealed bottles from which the air has been extracted, provided they are stored in a cold place.)—FRANK GILBERT. (The vibrations of the diaphragm of the transmitter set up undulations in the current, and the vibrations are consequently reproduced by the diaphragm of the receiver. See indices. Du Moncel's "Telephone, Microphone, and Phonograph," Kegan Paul and Co., 5s., will possibly suit you.)—ALICE. (Do you mean the black japan or the light-coloured enamel inside? It would scarcely pay to re-enamel; but a substitute for the japan will be found in Brunswick black.)—W. M. (Glass is frosted by exposing to the fumes of strong fluoric acid. If immersed in the acid it is dissolved. Watch for replies to query 61028, inserted last week.)—PLATO. (See p. 158, this volume, for a horizontal sundial, p. 394, No. 1058, p. 316, No. 924, and many other back numbers.) CLANDEBOYE. (The process of preserving has been frequently described. In addition, the meat is pressed into the tins. See p. 42, this volume.)—EM QUAD. (It would be better to place the flywheel in the position designed, unless the shaft can have another bearing beyond the wheel; but it is really a matter for experiment.)—ALTROY. (There are many recipes in back volumes; but you must say what it is to "cement" before an answer can be given. Perhaps plaster of Paris would do, perhaps Portland cement; and perhaps, again, only solder.)—FRANCOIS. (Given many times. See replies in this No.)—X. (Bicarbonate of soda $\frac{1}{2}$lb., tartaric acid $7\frac{1}{2}$oz., pure chlorate of potash $2\frac{1}{2}$ drachms. Powder and dry thoroughly; mix intimately; keep in well corked bottles. No doubt you would find yourself a great deal better if you lived on simple wholesome food and took plenty of outdoor exercise. At any rate, quinine and saline are not articles of diet, and are useless, if not worse, when taken regularly.)—A YOUNG BEGINNER. (What battery is used? See No. 1088, p. 454, and the indices generally of the last nineteen volumes. 2. Thompson's or Guthrie's; but if you want to go thoroughly into the matter, procure Sprague's "Electricity: its Theory, Sources, and Application," E. and F. N. Spon, 125, Strand, W.C.)—DRYSALTER. (Slater's "Manual of Colours and Drywares," Crosby Lockwood and Co., 7s. 6d., may suit you; but we suspect you are seeking for something which does not exist.)—VARNISH. (Stain and French polish, or procure some of the varnish sold by Mr. Wood, post-master, Blindley Heath.)—ALPHA. (Geikie's "Lessons in Physical Geography," and Huxley's "Physiography," both published by Macmillan and Co. 2. Wright's book on "Poultry," published by Cassell and Co.)—RICARDO. (See indices. Before a remedy can be devised, the cause must be known. You already object to the best. 2. Procure the catalogues of makers who advertised in these pages, or look through back volumes.)—C. E. ABBOTT. (We have not had experience with all; but think that illustrated in No. 928 as good as any.)—IGNORANTIA. (The only way is to be apprenticed, and you are rather too old for that, especially as there are plenty of younger candidates.)—SCOTCHMAN. (If you cannot refer to back volumes, you should procure Graham's "Brass Founders' Manual," 2s., Crosby Lockwood and Co. See indices to Vols. XL. and XLII.)—AERONAUT. (Much useful information about "Analytical Chemist" was given so recently as the last volume. See pp. 421, 443, 465, 486. 2. Reckon 14 cubic feet of hydrogen to each pound weight. If coal-gas is used more will be necessary. We never heard of a "balloon factory," but no doubt a small advertisement in the Wanted Column would produce plenty of offers to construct any number of balloons.)—WOLLASTON. (Remedies for worms given many times; but as you do not say what worms you mean, you had better consult a medical man.)—C. K. C. (You cannot make it. You will find something about it in Vol. XXX. p. 570.)—GAS-FITTER. (Simple photometer described in any textbook of physics. See back numbers. 2. It consists in charging the gas with naphthaline, a wax-like substance put into little reservoirs, which act as carburetters. See indices.)—OMICRON. (Use a pale lacquer.)—PERPLEXED. (See p. 564, No. 988, for something about consumption, and pp. 477, 527, Vol. XXXIII., for new inhaler.)—COIL MAKER. (You require nothing more than a roller on which the bobbin can be slipped, and to which a crank can be attached. That is supported in two end pieces on a base, one of the end pieces being made removable so as to enable the

bobbin to be put on and taken off.)—EBONITE MAKER. (Ebonite is made from indiarubber and sulphur, just the same as vulcanised rubber, but the curing temperature is much higher—up to 350° Fahr. Rather brown than black when cut. Cannot be joined. The tubes must be moulded up before the composition is cured.) — VESUVIANS. (Made of charcoal, saltpetre, and gum water, scented with Cascarilla tincture or infusion.)—BARIUM. (Yes, just the same. Strength will come in time; but you should not practise after the lip fails.)—I. C. (Why not read an elementary textbook of physics? No; heat is not a substance, and it has no weight of its own. Heat is a "mode of motion.")—A CONSTANT SUBSCRIBER. (The blades are rubbed on strong glass plates, with fine emery and oil. Of course, it requires some little practice.)—INQUIRER. (Answered many times. See indices. You must specify the resistance of the lamps before a definite answer can be given. 2. To show vacuum tube effects to perfection, a coil giving an inch spark is advisable; but smaller ones will answer many purposes.)—R. H. (Answered recently. See pp. 43, 244, this volume, and refer to other replies of same numbers.)—CHEMIST. (You do not say what quantity is required. If small, use an ordinary glass retort with water case to cool the long limb; if large, use a copper still and worm, or tinplate. Drawings in any catalogue of chemical apparatus.)—E. J. DAVIS. (We do not know the actual importers; but a little inquiry in Hatton-garden or Clerkenwell would, no doubt, be successful. A sixpenny advertisement in the "Wanted" column would probably procure you the desired information.)—FORCE. (Yes, it was used for boring the tunnels through the Alps and at the Channel Tunnel Works. You will probably find some information of a suitable kind in the *Transactions* of the Institute of Civil Engineers; but a scheme for supplying Birmingham with compressed air is on foot. See indices. It does not compete with steam when that can be applied direct.)—EDWARD M. NELSON. (Manuscript to hand with thanks; but you have only sent sketch of Fig. 3. Please send Figs. 1 and 2.)—VULCAN AND OTHERS. (We have really had enough of the Falling Bodies discussion. Some of our readers—you and "Dubliniensis" among them—would do well to remember that queries are put in to elicit replies, not to furnish pegs round which to twist and untwist endless knots. Our space is too precious.)

USEFUL AND SCIENTIFIC NOTES.

The Work of the Heart.—In Dr. B. W. Richardson's recent Cantor Lectures on "Animal Mechanics," speaking of the mechanism of the heart, he described the number of the pulsations of the heart in different animals—in fish, frog, bird, rabbit, cat, dog, sheep, horse—and made a few comments on the remarkable slowness of the heart —40 strokes per minute—in the horse. Then the number of pulsations in man at various periods of life and at different levels, from the level of the sea up to 4,000ft. above sea-level, was brought under review, and was followed by a computation of the average work performed by the heart in a healthy adult man. The work was traced out by the minute, the hour, and the day, and was shown to equal the feat of raising 5tons 4cwt. one foot per hour, or 125 tons in twenty-four hours. The excess of this work under alcohol in varying quantities formed a corollary to the history of the work of the heart, Parkes's calculation showing an excess of 24 foot-tons from the imbibition of eight fluid ounces of alcohol. The facts relating to the work of the heart by the weight of work accomplished was supplemented by a new calculation, in which the course of calculation was explained by mileage. Presuming that the blood was thrown out of the heart at each pulsation in the proportion of 69 strokes per minute, and at the assumed force of 9ft., the mileage of the blood through the body might be taken at 207 yards per minute, 7 miles per hour, 168 miles per day, 61,320 miles per year, or 5,150,880 miles in a lifetime of eighty-four years. The number of *beats* of the heart in the same long life would reach the grand total of 2,869,776,000.

THE production of metallic aluminium in America last year increased from 1,800 troy ounces in 1884 to 3,400 ounces in 1886, valued at 2,550dol. Aluminium bronze, containing 10 per cent. aluminium was made to the amount of about 4,500lb., valued at 1,800dols.

IT is reported that street car directors in Brooklyn, U.S., are considering the adoption of electric motors. The question of establishing an electric railway to connect Cedarhurst, the Isle of Wight, and Far Rockaway, the terminus of the latter to be somewhere near the Long Island Railroad station, is also being discussed.

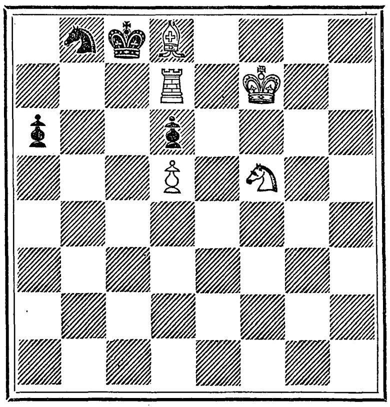
THE production in the United States last year of Portland cement amounted to 150,000 barrels of 400lb. each, with a total value of 292,500 dols. The total production of cement of all kinds was 4,150,000 barrels, valued at 3,492,500 dols., against 3,720,000 dols. in 1884.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXX.—BY BABUMAL (of Delhi, India).

Black.



White. [5 + 4

White to play and mate in three moves.

SOLUTION TO 1,018.

White.	*Black.*
1. Q-Q B sq.	1. B-R 8.
2. Q takes P.	2. Anything.
3. Mates accordingly.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,018, by G. A. A. Walker, A. Bolus, F. Krasser, A Beginner (but main play omitted); to 1,017, by A. Bolus (very interesting); to 1,019, by Black Pawn.

G. A. A. WALKER.—We regret that we shall not be able to adopt your suggestion. A Game Tourney lasts about two years.

BLACK PAWN.—Problem received, last version.

J. MACKENZIE AND T. H. BILLINGTON.—Names entered for A and B; A. Bolus for A, Captain Pochin for B. At present 10 have entered for A and 11 for B, so that the numbers are not yet quite complete.

V. S. P.—Thanks for suggestions, which shall have due consideration.

A. BOLUS.—The solution shows that in 267 the K at K R sq. should be White.

LINK.—How do you mate in your attempt at 1,017 if $1. \frac{}{B\ Q\ 5}$?

A. DEAN.—You have overlooked in 1,018, if $1. \frac{B\text{-}Kt\ 6}{R\ takes\ Kt}$ $2. \frac{Kt\ takes\ R}{P\ takes\ Kt}$.

HAMPSTEAD HEATHER.—In 1,019, if $1. \frac{Q\ takes\ P}{B\text{-}Kt\ 3}$ $2. \frac{Q\ Q\ 4}{B\text{-}K\ 8\ (ch)}$. The problem cannot be done this way.

J. MACKENZIE.—If in 1,017 $1. \frac{}{R\text{-}Q\ 5}$ there is mate next move by Q-K 6.

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Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

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Tricycle, Coventry lever, double steering, two track, adjustable pedals, cushioned seat, good condition, newly painted, Offers.—FORD, 75, St. Paul's-road, Camden, N.W.

Wanted, **Launch Boiler**, Engine, Propeller, &c., for 16 by 5ft. boat. Can offer lot new Hammers, Axes, Planes, Ironmongery, Cutlery, &c.—HARRISON, Devoran, Cornwall.

Seven volumes of "**The Engineer**," range from 1860 to 1867, well bound and clean. What offers?—W. MOSS, 18, Croton-place, Armley-road, New Wortley, Leeds.

Sewing Machines, fifty, by various makers, Thomas, Wheeler, and Singer systems. Must be sold. What offers to one-third value.—GOLDEN SHUTTLE, Colchester.

Electromotive Power.—A series of Experimental Models, which cost £100, offered for £20, or exchange anything useful.—Wellesley House, Colchester.

Dynamo, laminated armature, 4½in. by 5½in., splendid machine. Photo., 6 stamps. Good exchange.—E. THORNTON Barrow-in-Furness.

Aconite, strong tincture. Grand remedy for toothache, Neuralgia. Exchanged for Aconite Seeds by the MEDICO-BOTANICAL GARDENS AND FREE DISPENSARY COMPANY, Lydney.

Aconite, strong tincture. Grand remedy for urinary troubles. Exchange for Aconite Seeds by the MEDICO-BOTANICAL GARDENS AND FREE DISPENSARY COMPANY, Lydney.

One 4in. **Electric Bell**, 3-cell battery indicator, 8 holes, 9 china pushes, all new. What offers? — BARNS, 13, Remington-street, City-road, London.

38in. Facile Safety **Bicycle**, thorough condition, all accessories. Offers.—F. STRANGE, 92, Hatcham Park-road, New Cross.

Gas-Engine (Bisschop). 1 man power, cost £25; Water Engine, 1 horse, by Ramsbottom, working order; 2,000c.p. Arc Lamp. Offers.—W. HUTCHINSON, Liversedge.

Dynamos, four, two by British Electric Light Coy.; 3 Serrin Arc Lamps, switch boards, brushes, carbon, speed indicator, coil, &c. Offers.—W. HUTCHINSON, Liversedge.

Will give a three-cell **Bichromate Battery**, with lifting apparatus, cost 25s., for a good set of boxing gloves.—MACGEORGE, School House, Sevenoaks.

Wanted a 4½in. or 4in. Iron **Lathe**, or pair 4½in. Lathe Heads, cheap, in good condition, in part exchange and part cash.—A. TURNER, Roydon, Ware, Herts.

Offers in **Lantern Accessories** wanted (Gas-bag, slides, &c.) for following:—lantern, 2¾in. condenser, and 1 doz. slides, splendid concert flute, silver keys, about 4 doz. lantern photographs, or singly. — Address G. M., care of Edgar Neale, Chippenham.

Exchange **Biunial Lantern**, 3½ condensers, splendid jets, lot of slides, want Facile bicycle, 40in. or 42in. What offers?—PRICE, 28, Mayer-street, Hanley, Stoke-on-Trent.

English Concertina, 48 keys, in mahogany box, cost 4 guineas. Wanted small bench lathe. No cards. — C. BLANCHARD.

Diamond Drills for china, glass, stone, &c., as used by china riveters.—C. BLANCHARD, 29, Earl-street, Lisson-grove, London.

Pipe Organ, 3 stops, £25; Harmonium, 8 stops, £10; Cottage Piano, £15, in good order; wanted in exchange good sitting or bedroom furniture.—JOHN H. FAWCETT, St. James'-green, Thirsk, Yorks.

"**English Mechanic**," last 8 Vols., two bound, others unbound. Exchange "Amateur Work," up to date, or cash offers.—W. PREWETT, Winton, Bournemouth.

Photographic Rolling Press, size of steel plate 18in. by 12in.; exchange for back-geared lathe, 5in. centres, iron bed with slide-rest.—C. H. HATCH, Photographer, Alderley Edge.

Wanted, **Double-barrelled Gun**; exchange tools, excellent books, £7 worth. Send stamp and details for list.—BLAND, 182, Regent-street, South Shields.

Wimshurst **Electric Machine**, will give a 5in. spark, with four condensers, cost short time £3 8s. What offers?—R., 64, High-street, Clapham.

Dynamo (6-c.p.) and Electromotor (powerful); also 6 powerful batteries and several incandescent lamps. Offers.—CHARCOAL WORKS, Hodson-street, Liverpool.

[*Continued on page* viii.]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 10, 1886.

HAND-PLANING MACHINE CONSTRUCTION.—II.

THE first step towards making the machine illustrated in the number for Nov. 26th is to get out a set of working drawings, complete in all details, so as to know exactly really what is to be done. These drawings must show the form and sizes of each part, and then there will be no occasion to waste time in trying fits whilst the work is progressing. Highly-finished drawings are not at all necessary, and neatly-drawn figured sketches will answer every purpose, providing they completely indicate every detail. The printed illustrations, published in connection with these articles, would serve most purposes, if all the dimensions given in the text are carefully figured, so as to show sizes to work to.

Planing the castings will be the first procedure. The bed will be the piece to be first operated upon. Place the casting, top upwards, on the table of the planing machine on which it is to be fixed, see that there are no fins in the casting to prevent it bedding fairly, and with a surface gauge try the height of the top all round, using wedges where necessary to level it and to make fair bearings; then fix to the table. Use a firmly-fixed stop to plane against, and do not screw the bolts very tight, or the casting will be strained. See that each clip takes a firm hold and has a solid bearing under it, but do not bend the casting by overtightening the bolts. Take one rough-cut all over the surface of the casting, this will be over the tops of the brackets and over the ways on which the table will slide. These parts form one level plane. Use a broad round-nosed tool, see that it is set to cut below the skin all over, give it a cross feed of about 3-16in., bevel off those edges where the tool will finish its cut, so as to save breakage at the end of each trip, and start the planing machine. One cut all over should leave the surface a series of somewhat coarse furrows. If the tool has a wide cutting edge, and has been set deep enough, the surface will give a good bearing all over when turned upside down on the table. But a second cut may be requisite: if so, it should be made with the tool acting midway between its former trips. When all the skin has been cut off the top of the casting, unfix it, and clear the chips off the planer. Refix the casting upside down, resting fairly on the planer table, and plane those parts of the bottom which bolt against the standards. One rough-cut set deep enough and one finishing cut will suffice; then remove.

The bed casting has now to be carefully fixed right side up and parallel with the ways of the machine, so that its undercut slides may be planed and the top surface finished. Use a pair of side, or knife, tools to plane down the inner sides of the slides. Set the vertical slide of the planer over 35° from the perpendicular, so as to make the dovetails an angle of 55°; also set the tool-box over in the same direction to allow the tool to clear during the back traverse. Two or three cuts may be necessary to finish one side; a keen tool should be used for the last. Then shift the vertical slide over to the corresponding angle in the opposite direction, alter the swing of the tool-box, replace the tool by its fellow, and plane the other side. The surface has next to be finished. If every trace of the skin of the casting has been removed in the first rough cuts, a finishing tool may be used at once. A strong tool $\frac{1}{2}$in. wide, with a straight cutting edge, finely set on an oilstone, will produce a better surface than a spring tool. The inner arrises are cut off both sides, to leave a facet about $\frac{1}{8}$in. wide. This is best done with side tools. The bed will now be finished so far as planing is concerned.

The table will be the next casting for treatment. Place it on the planing machine bottom upwards; level the outer surfaces by aid of a surface gauge and wedges, and fix—always recollecting to have a good firm stop to plane against. Take a rough-cut all over the two projecting strips deep enough to get them quite clean. Unfix, and turn over the casting. Take a rough-cut all over the top surface, and then with a grooving tool, $\frac{1}{2}$in. wide, plough out the grooves of the four ⊥ slots, making a plain slot 1in. deep, without any undercutting. Then with a pair of L tools, barely $\frac{1}{4}$in. wide on the edge, undercut the grooves $\frac{1}{4}$in. on each side, making the wide part of the ⊥ 1in. All these ⊥ slots will be finished to size when the bed is fitted on its place, and our hand planing-machine is complete; but the bulk of the metal would be cut out with considerably less labour on a heavier machine. The side-edge of the table should then be planed with a knife tool, and if the top surface is not smooth take another cut over it, and make it so. Remove the table, turn it over, and refix carefully with the planed edge parallel with the ways of the machine; then with a pair of bent tools, rough plane the surfaces on both sides which will form the bearings of the table on the bed. Get as far under the angle as possible, but do not expect to finish right in the corner with rough cuts. A knife tool will plane the side of the under cut, and the reverse knife tool will plane the side of the rib against which the loose strip will bear when bolted in position; this right angle must be finished before the table is removed. The central part against which the rack is to be screwed may also be planed smooth, and the table may then be put aside till the loose strip is planed.

This strip must have a rough-cut taken all over it, and must have the edge opposite the slant and both sides finished, making it the correct thickness to lie level with the rib against which it rests. It is then ready for bolting on the table. Mark the positions for the six $\frac{3}{8}$in. bolts, placing two within an inch of each end, and the other four equidistant between—viz., about 5$\frac{5}{8}$in. apart. It will be best to mark these centres on the narrow side of the strip, and to place them $\frac{1}{4}$in. from the obtuse angle; use a fine prick punch and scribe the circumference of each hole to see that it is correctly placed, then enlarge the centre dots with a strong punch. Drill through the strip to clear the $\frac{3}{8}$in. bolts; 1-64in. is enough clearance, if the tapping holes in the table are drilled exactly in position, but a hole 13-32in. diameter will be less likely to give trouble. See that no burrs are left round the edges of the drilled holes, and file off that corner of the strip which fits in the angle of the table. The strip may be conveniently drilled in the lathe, but the table is too heavy and too awkward to handle nicely on most lathes. A vertical drilling machine will do the work best; but, failing that, a ratchet brace may be used. Place the drilled strip in its place on the table, and fix with a couple of clamps close against the rib; then mark the positions of the tapping holes for the bolts in the table. A centring drill is best to use for this purpose: its shank should fit the clearing holes drilled in the strip, and its point should drill a hole about $\frac{1}{8}$in. diam. and $\frac{1}{8}$in. deep. Having centred the six holes, remove the strip, and drill each to the tapping size for $\frac{3}{8}$in.—viz., 9-32in. and 1in. deep. The three holes for the screws that hold the rack should be drilled at the same time. They are $\frac{1}{2}$in. diam.; one through the exact centre of the table, the other two, 2in. from each end. See that all the holes for the fixing bolts on the loose strip have gone in fairly, according to the marking, and tap straightly one of the best placed. To fix the strip, six $\frac{3}{8}$in. by 1$\frac{1}{2}$in. bolts will be wanted. Machine-made, bright finished, mild steel, hexagon-headed bolts, to Whitworth's dimensions, can be bought for much less than the cost of making by hand. Fix the strip close against the rib with one bolt, and tap the other holes, proceeding first with those that are best placed, and screwing in a bolt as each hole is threaded. Should either hole be misplaced so much as to prevent the tap screwing in upright, it will be best, before proceeding to tap, to ease the hole in the strip with a round file as large as the hole will admit. The hole in the strip assists in showing the uprightness of the tap.

Having bolted the strip firmly on the table, this will be ready to be completely planed, so as to finish the surfaces and the undercut dovetails which form the sliding-fit of the table. Fix the table very carefully, the planed edge parallel with the ways of the machine, and with a pair of knife tools plane both the undercut surfaces, so that the table will very nearly fit in its place on the bed; then a special tool is wanted, having a broad edge that will reach under the dovetails, and finish both surfaces at one setting, and so insure their absolute levelness. The table should now fit very tightly on the bed. The bulk of the metal may be ploughed out to form the small ⊥ groove in the edge of the table, using an L-shaped tool, and cutting a straight groove $\frac{1}{4}$in. wide and $\frac{1}{2}$in. deep. The undercutting of this groove can be done at the same time that the other ⊥ grooves are finished—viz., when the machine is complete.

The pair of standards may next be planed. Commence by tooling the surfaces against which the ends of the cross-bar will bear; then bolt the two standards very firmly together with these two faces in contact, and the lower parts separated the requisite space by packing. The two standards thus bolted together are thenceforward in planing treated as one piece. The bases may be planed first, and then the front faces against which the cross-slide rests. There is a channel cast in this face where it joins the base (shown in the side view, page 374), which allows the planing tool to drop out of cut at the end of each stroke. By planing the pair of standards together as one, any slight error in the uprightness of the planed faces, caused by want of accuracy in setting them for planing, is of no consequence, since the error must be alike in both. The cross-bar to connect the standards is planed at both ends to an exact length (as shown in the drawing). The bolts to fix the bar to the standards are $\frac{1}{2}$in. diameter put through the ends of the bar and tapped into the standards. Fix these together tightly and see that their bases stand level. The bolt-holes in the cross-bar will most likely require enlarging considerably to allow this, as it is rather awkward to mark the positions of the holes quite truly. Pins may be put in after the standards are bolted on the bed to insure the accurate replacing of the cross-bar.

The main cross-slide may be planed next. Fix it level face upwards, and plane the surface, always using a stop to plane against; then turn over, and plane the high parts at each end which rest against the standards. Again reverse the casting, and fix carefully parallel with the ways of the machine, and plane the slide part, undercutting both sides to the angle of 55°, same as on the bed. The saddle for the main slide, having a large round hole in the middle, has the loose strip fixed with three $\frac{3}{8}$in. bolts, and has to be planed all over. The back, with the under-cut dovetails to fit on the cross-

slide, is most important, as the front may be finished on the lathe when the casting is chucked for turning out the central hole. The four edges, also, should be planed. The fiddle piece has its front and its inner slides planed; but its back is finished on the lathe when the central disc is turned to fit the hole in the saddle. The slider in the fiddle and its loose strip is planed all over. The strip is fastened by three ¼in. screws tapped into it, and having their heads sunk in the front side of the slider. The cradle is planed all over, as is also the swinging plate which carries the tool-holder. The planing of the castings is now completed.

The boring has next to be done. The bed requires a ⅜in. hole near each corner, for four bolts to fix it to the standards. The holes for the main spindle, through the bosses in the sides of the bed, may be located in the middle of the bosses, but must be quite in line and opposite, so that the spindle will stand square with the planed parts. With a boring bar on a horizontal machine, this is easily insured. But failing that, a hole about ⅜in. diam. should be made first, and the oppositeness of the holes tested by putting a straight rod through both. Either, or both holes, if slightly out, may be drawn a trifle by filing; or, if much out, may be plugged with a wrought-iron pin, and re-drilled. Having got these small holes in position, they may be enlarged by a pin-drill to very nearly full size; but a reamer should be used to finish the holes, and it should be used from the inside, with the opposite hole as a guide to the shank. It is usually necessary, and always well worth while, to make a special bar to lengthen the shank of the reamer, and a split collar to fit the holes and form a bearing for the bar. Without this, or some adequate contrivance, the holes will most likely be out of line, and so fail to form good bearings for the spindle. The horizontal holes in the bosses, at the upper parts of the standards, which form the bearings for the cross spindle carrying two mitre wheels, are marked as fairly as possible in the middle of their respective bosses, but they must be in line. The way to insure this is by using a reamer with a long shank, guided by the corresponding opposite hole. These holes, however, are not to be reamed till the standards are firmly bolted on their places. The vertical holes which form the bearings of the elevating screws are made quite large so as to leave play for the screws to adjust themselves to suit positions of the nuts. These screws merely require smooth surfaces for their collars to bear upon when supporting the cross-slide and its attachments. The four bolt-holes in the bases of the two standards are marked on the planed base in the positions shown in the drawings, and are bored through to clear ⅜in. For marking the holes in the brackets on the bed the standards are fixed together by the cross-bar, and also by the cross-slide, which is bolted on near the lower part, and stood in position. These four holes are bored ½in. diameter, and tapped with ⅝ threads. The remainder of the holes are small, and are more conveniently bored in the lathe.

The castings have now been planed and bored so as to allow the large parts of the machine to be got together. The remainder of the work to complete the machine is turning and fitting, and this point forms a convenient stage for concluding this article.

REVIEWS.

Modern Steam Engines. By JOSHUA ROSE, M.E. Philadelphia: Henry Carey Baird and Co. London: Sampson Low and Co.

THIS work is called an "elementary" treatise by its author; but in reality it gives full explanations of the construction of modern steam-engines, including diagrams showing their actual operation. It is elementary in the sense that it is written in the language of the workshop, and while intended for those who desire to acquire a knowledge of the construction of steam-engines, is of the greatest value to the practical engineer. Mr. Rose illustrates a considerable number of different engines, and to facilitate comparison of the action of different valve motions, has made the diagrams as nearly as possible of uniform size. The various slide-valve motions now in use have been treated very fully, for in them are found the distinguishing features of most engines, and this branch of the subject may be said to form the distinguishing feature of Mr. Rose's work; for the diagrams have been obtained by moving the engines throughout a revolution, and measuring the port openings at each inch of piston travel. These diagrams show the actual working of the valves, and the mind is enabled to grasp at once the effects produced. When a special form of engine is described the engravings show it as a whole, and its general action is explained. It is then treated in detail, separate engravings being given of the parts, which are shown in various positions. We need scarcely say that this is an admirable method, and a reader who cannot comprehend must be sadly wanting in the perceptive faculty. Commencing with a classification of the various kinds of steam-engines, Mr. Rose follows with a description of the common slide-valve example, and then we have lap and lead, the eccentric and its throw, cushioning and clearance fully explained. The distribution of the steam is shown by diagrams, with instructions for drawing them, and then we come to expansion and the Allen valve, which is chosen to show the effects of cutting off. Chapter II. is rather a long one, as it deals with the important subject of designing valve motions. Chapter III. treats of link motions and reversing gears, the so-called Stephenson link being the example chosen for general description. This subject runs over two chapters, and if all the different link motions are not illustrated, the principles are fully explained. As a matter of fact, nearly all the good valve-gears are described and illustrated in some portion of this work; for when they do not appear in the general explanation, they are described in connection with some one of the many engines which Mr. Rose has chosen as examples. The work is illustrated by 422 engravings, which include most of the modern steam-engines of American make, and sundry pumps and other machines which are intimately connected with engines. The student who makes himself master of the contents of this volume will have a fairly complete knowledge of the steam-engine in theory and practice, and will be fully prepared to take up any investigation or research connected with the utilisation of heat in the production of motive power.

The Life and Labours of John Mercer, F.R.S. By EDWARD A. PARNELL. London: Longmans.

TWENTY years have elapsed since the death of John Mercer, the "self-taught chemical philosopher," and his biography, which will be read with interest by calico printers, though delayed by the death of his two sons, has recently made a tardy appearance, the Misses Mercer having placed all the available information in the hands of Mr. Parnell. John Mercer was born at Dean, near Blackburn, in 1791, his father being the owner of a small spinning mill by the side of Dean Brook, who unfortunately died when his son had reached the age of nine years. John commenced life as a bobbin winder, and was ten years old before he learned the "rudiments," speedily developing, however, an "aptitude for figures," and also an aptitude for something else. Having determined to learn dyeing, he visited Blackburn and called on a druggist, from whom he purchased a small quantity of each of the dyestuffs then in use. Without any knowledge whatever he commenced experiments with his dyes, and naturally acquired a good deal of "rule-of-thumb" knowledge, his first important discovery being a means of dyeing with indigo. Whilst still a boy he started in business with a partner as dyers, and was so successful that the Messrs. Fort, of the Oakenshaw Print Works, offered him a post in their colour shop, stipulating that he should serve for a certain period as an apprentice. This arrangement did not last long, however; but in 1813 Mercer started again as a dyer, and succeeded in utilising with profit the imperfectly-spent materials of the printworks. Parkinson's "Chemical Pocket-book" was his first book on chemistry, and that he "devoured" with such success that he soon afterwards made his first important discovery—antimony orange, which was followed by the utilisation of chromate of potash. At this time Mercer had accepted a post at the Oakenshaw Works again, and his labours resulted in so much benefit to the proprietors that in 1825 he was admitted into partnership. Thenceforward a life of research in the laboratory and a study of books on chemistry resulted in the discovery or invention of numerous dyeing recipes, and Mercer, who was one of the original Fellows of the Chemical Society, was elected a Fellow of the Royal Society in 1852. A man who by investigation added largely to the number of dyestuffs, and in several respects revolutionised the calico-printing and dyeing industries, naturally went outside his special branches, and Mercer, we find, was an early worker in photography, and so far back as 1843 in a letter to Dr. Lyon Playfair hinted at the germ theory of disease. An appendix contains notes from Mercer's papers, and numerous recipes for colour preparations, some of which having never before been published may be found useful. A photographic portrait of this "worthy"—a worthy in more senses than one—forms a suitable frontispiece to a biography of another self-taught man.

Commercial Organic Analysis: a Treatise of the Properties, Modes of Assaying, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicine, &c.; with Concise Methods for the Detection and Determination of their Impurities, Adulterations, and Products of Decomposition. By ALFRED H. ALLEN, F.I.C., F.C.S., Public Analyst for the West Riding of Yorkshire, Borough of Sheffield, &c. Second edition, revised and enlarged. Volume II. Fixed Oils and Fats, Hydrocarbons, Phenols, &c. London: J. and A. Churchill.

WHEN the first edition of this book was published it was duly reviewed in our columns, and we expressed our very high appreciation of the care, industry, and discretion shown by the author in the production of his work. On the appearance of the first instalment of the long-called-for second edition, we further congratulated Mr. Allen on the improved arrangement of the subject-matter. The volume now under notice shows no falling off in these respects. In his preface, the author apologises for the delay in the appearance of the book, which has been out of print for some years, and states that the subject-matter has been more than doubled in extent by the incorporation of the results of recent investigations by himself and others. He mentions as a further cause of delay the discovery of the maximum limit of his strength—a cause which we fancy may account for the rarity with which his name has of late appeared as a correspondent in our columns, where it was once seen so regularly. In the section of the volume treating of Fixed Oils and Fats, which now extends to 318

pages, Mr. Allen appears to have collected every scrap of reliable information, and with the aid of his own numerous and well-known investigations has transformed the subject of "oils" from one approaching chaos to a fairly orderly and systematic chapter of organic chemistry. Although much still remains to be done in this direction, Mr. Allen has shown that, by the industrious and intelligent use of the methods and facts now available, the difficulties formerly attending the investigation of oils are, in many cases, no longer insuperable. While giving general methods of analysing and examining oils, the author also devotes special sub-articles to each of the more important oils, fats, &c., employed in commerce, and in these a mass of valuable information is given respecting the adulterations and impurities peculiar to each oil, and the methods of detecting them. On page 113, the author remarks that "refined cottonseed oil is usually very free from acid, and when properly prepared is of pleasant taste and admirably adapted for edible and culinary purposes, for which it is now extensively employed, both with and without its nature being acknowledged. It is now substituted for olive oil in some of the liniments of the 'United States Pharmacopœia'; but its principal applications are in soap-making and the manufacture of factitious butter." In a valuable article on the Examination of Lubricating Oils, Mr. Allen remarks that "the presence or formation of free acid in an oil being the chief, if not the only, cause of its tendency to act on metals, the results published by various observers, showing the amounts of iron and copper dissolved in equal times by different oils, have no interest or meaning apart from the particular samples of oils examined, the action on the metals being simply a function of the free acid the oils happened to contain." The section on Oils proper concludes with articles on fatty acids, soaps, glycerin, and cholesterin, in all of which much valuable matter will be found. On page 249 the author states that "an admixture of glycerin in excess of that found in the process of saponification must be considered a valuable ingredient in certain classes of soaps. The same remark cannot be made of the large proportion of cane-sugar which replaces glycerin in some of the much-advertised transparent toilet soaps, as it simply dilutes the true soap material as so much water would do, without communicating any corresponding property of value." The section of the volume treating of Hydrocarbons exhibits many extensions from the first edition, some of the articles now appearing for the first time. Among these are the subsections treating of crude shale oil, coal-tar, asphalt, menthol, naphthalene oils, and naphthols. On pages 354, 355 there is an ingenious tabular view of the whole of the recognised constituents of coal-tar, so arranged that the fraction in which each one occurs is at once evident. The article on shale and petroleum products has been carefully written up to date, the author acknowledging his indebtedness to Mr. Boverton Redwood for a perusal and revision of this chapter. The section on Phenols, though shorter than those preceding, contains much information now for the first time brought together. It contains methods for examining crude carbolic acid, carbolic powders, creosote oils, wood-creosote, &c. Although the work requires some knowledge of chemistry on the part of those who use it, still the analytical tests and processes are so fully and lucidly described that no one possessed of a moderate experience in general chemical manipulation will find much difficulty in applying them. Mr. Allen has not contented himself by merely collecting a number of analytical methods, but has added such information respecting the origin, reactions, and properties of the substances described as will materially assist those who may require to examine them. The volume may be broadly described as a monograph on oils of all kinds, and we are confident that it will become a standard work.

Heroes of Science: Physicists. By WILLIAM GARNETT, M.A., D.C.L. London: Society for Promoting Christian Knowledge.

THIS volume forms one of a series, and its object is apparently to bring within the ken of school boys and girls material which is otherwise available only to those who have extensive libraries at command. In the lives of Robert Boyle, Benjamin Franklin, Henry Cavendish, Count Rumford, Thomas Young, Michael Faraday, and Clerk Maxwell, as depicted in this volume, we have also a history of the progress of physical science. Dr. Garnett modestly says his pages claim no originality, and although the stories of the lives of his heroes of science have been told before, they have never, we believe, been so told as to give, by way of an under-current, a connected account of the gradual development of such subjects as electricity, the mechanical theory of heat, the undulatory theory of light, &c. The "lives" themselves are epitomes of the biographies of the "heroes," and in an introduction and a conclusion Dr. Garnett gathers up the threads of the history of scientific discovery which run through them. In the lives of Franklin and Rumford there is much that has no connection, direct or remote, with science; but the volume altogether may be commended as an excellent reading-book for schools and for private students, as its contents cannot fail to be instructive and interesting.

We have also received *The Modern Practice of Shipbuilding in Iron and Steel*, by SAMUEL J. P. THEARLE (London: Collins, Sons, and Co.), comprised in an illustrated octavo volume of text and a quarto volume of plates. The author's "Practical Naval Architecture" is a well-known work; but wood and composite ships are rarely built nowadays, and examinations in naval architecture refer as a rule to iron and steel ships. Mr. Thearle's new treatise may take its place in the series issued by the Messrs. Collins as a work that can be trusted by the candidate for examination.——*Outlines of the Geology of Northumberland and Durham*, by G. A. LEBOUR, M.A., F.G.S. (Newcastle-on-Tyne: Lambert and Co.), is a little work originally prepared for the class of geological surveying which Prof. Lebour conducted in the Newcastle College of Physical Science. The present issue is a new edition in which matter has been inserted referring to Durham and Cleveland, and it is a useful little book, which will be welcomed by geologists, miners, and others interested in the northern counties of England. —— *The Century Almanack and Calendar*, by G. R. J. COMONT (Camberwell, 32, Parkhouse-street), is a useful "card" with a sliding slip and tables, by means of which we can set the calendar to any year between 1800 and 1906, and find the day of the month or the day of the week. It is a handy and useful device. ——*The Asclepiad*, by BENJAMIN WARD RICHARDSON, M.D. (London: Longmans), is, as usual, full of matter of more or less interest to medical readers, with papers which will be read by students of science—including one on "Ambrose Paré, and the Birth of French Surgery."

EARLY TELEPHONES.

WHATEVER may be the ultimate result of the suits now pending in the United States Courts in connection with the Bell telephone patent, it is certain that they have assisted in bringing to light many ingenious inventions which might otherwise have been altogether forgotten. A good deal of feeling has been imparted into the legal question on the other side of the Atlantic, because a suspicion exists that the American Patent Office authorities did not act altogether fairly in connection with rival claims (Gray's, for instance); while the courts have, so far, construed Bell's patent in a much wider and more liberal sense than they did Morse's important invention in connection with electric telegraphy. Bell's patent in the United States is, in fact, construed to cover the transmission of speech by an "undulatory current"; and in this country, any telephone with a diaphragm is an infringement of Bell's patent, with one exception—that known as the English Mechanic telephone, described in our columns August 11th, 1876. The question, "What is a diaphragm?" has not yet been answered within rigid legal limits, and probably will only be decided on the merits of specific cases. But whatever may be said by the friends of rival inventors, Bell and Edison both referred to the work of Reis, and tacitly acknowledged that he had taken some steps towards perfecting a telephone. A reference to Vol. XXV. p. 449, will show that so long ago as 1870 Mr. C. F. Varley had obtained a patent in which the use of rapid undulations, to produce audible signals, was clearly defined, although no mention of a speaking telephone was made. Mr. Varley, like other inventors, does not seem to have been aware of the potentialities of his musical telephone in 1870, nor was Mr. Royal E. House, in 1865 and 1868, when he patented in the United States what he termed improvements in "electro-phonetic telegraphs." Mr. House invented, in 1846, the printing telegraph, which has been widely used in America, and in 1868 he patented an "electro-phonetic receiver" for use in telegraphy, which, it is now known, is a very excellent telephone, superior to the early devices of Bell, and as good, it is stated, as the present Bell receiver and Blake transmitter. Mr. House is happily still alive, though nearly eighty years old; and it would be a curious termination to the Bell monopoly, as it is called, if his instruments should be employed to oust the more modern devices. We understand that large numbers of them are being manufactured, probably with some modification in constructive detail from the drawings deposited with the patent specification, but still accurate reproductions of the instrument described in 1868, eight years before Bell, Gray, and the others lodged their applications. If the House "electro-phonetic receiver" should prove to be an efficient telephone, there will be an end to the monopoly, and some curious results may follow in the law courts of the United States. The substance of the description extracted from the specifications, about which there can be no doubt whatever, shows that House's receiver, of 1868, consisted of a box—generally cubical in form—with one end closed by a diaphragm. Two slender bars of metal are attached to the diaphragm—one near the centre, the other below it. These bars the inventor terms "limiters." The upper "limiter" limits the motion of an armature working over a magnet, so that it cannot come in contact with the poles. The other limiter prevents the armature from receding too far from the poles. The armature is pivoted at one end: its inner and free end strikes the lower limiter; it is provided with an extension at the pivoted end that extends upwards at right angles to the armature. The end of this arm bears against the upper limiter. An electro-magnet operates this armature, and is situated below it in the bottom of the box, and is connected to binding posts. A tension spring is used to adjust the pull of the pivoted armature away from the magnet. Attached to the cubical box is an ear-trumpet, or receiver, and the directions specify that the interior surface of this receiver should be of such a form as to reflect the sound waves to a focus which is occupied by the ear of the listener. The model deposited by Mr. House, in accordance with United States law, was destroyed in the fire at the Patent Office; but the drawings accompanying the specification are still available, and render the evidence complete. Any suitable substance can be used as a diaphragm; but in the instruments now being constructed, metal is employed. The frame or body, indeed, is made of cast iron, and an ebonite ear or mouthpiece screws on the open end and clamps the diaphragm in position. In the original drawing both "limiters" have adjusting screws, by which their freedom of movement may be varied. They can be adjusted so that they will be in

contact one at a time only with the armature and arm. In this case a make and subsequent break, or corresponding and considerable changes in intensity of current, will produce two blows—the first on the upper limiter, and the second on the lower. However, by screwing out the limiter screws to a fuller extent, this oscillation is gradually reduced until no break is possible. Then makes and breaks of the current, or variations in intensity, will no longer produce blows, but a true telephonic sound from the diaphragm. If connected in circuit with a microphone transmitter, it will talk; and if two are connected having closed or ground circuit with battery, or if steel or cast-iron magnet cores are used without any battery, they will act as receivers or transmitters, and form a complete telephonic system. Probably, before long, instruments of this kind will be on sale in this country, and as they work well, both as transmitters and receivers, with four Leclanchés, will be found useful.

ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—XII.*

By S. R. Bottone.

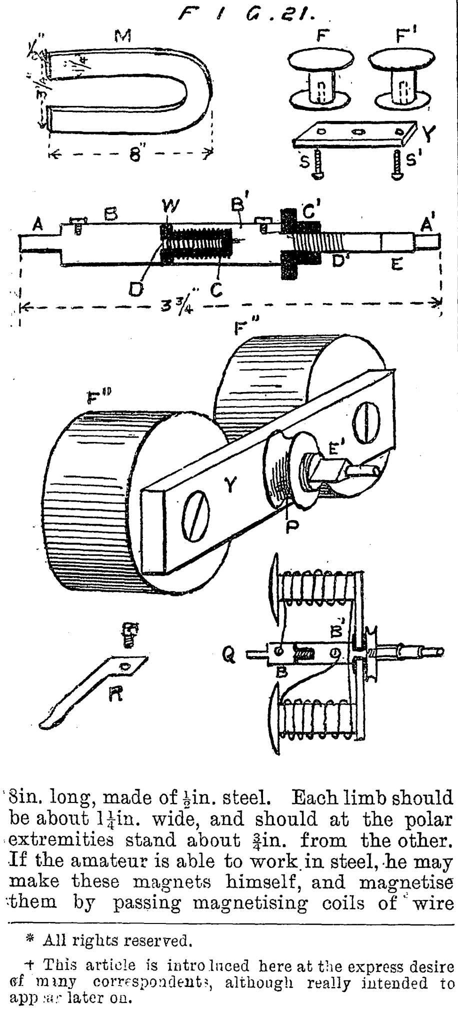
§ 42. **The Magneto-Electric Machine.**†

THIS is the first form of *dynamo* which the inventive genius of Faraday placed before the scientific world. It had its origin in the discovery "that a conductor moving before the poles of a magnet, in such a direction as to cut the lines of force of the said magnet, had its electrical condition upset, so that a flow of electricity was produced within it"; and this could be rendered evident by suitable means. Two forms of magneto-electric machines will be described: *firstly*, the ordinary "medical" or "shocking" machine; and, *secondly*, a rather more scientific instrument, which can be used for many experiments, for which the former would be totally useless.

§ 43. **The "Shocking" Machine.**

The amateur will need a pretty powerful horseshoe magnet, as shown at Fig. 21 M, about

FIG. 21.

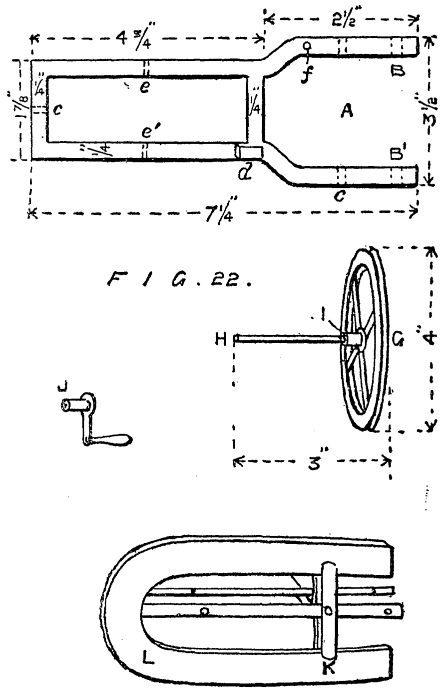


3in. long, made of $\frac{1}{2}$in. steel. Each limb should be about 1$\frac{1}{4}$in. wide, and should at the polar extremities stand about $\frac{3}{8}$in. from the other. If the amateur is able to work in steel, he may make these magnets himself, and magnetise them by passing magnetising coils of wire round each limb, and sending a powerful current of electricity through the coils, until the magnet is sufficiently strong. For the purpose required, the magnets should pull easily a weight of 10lb.; but it will, in most cases, be found cheaper to buy these magnets ready-made. The armature can be readily constructed at home. It consists in two iron bobbins, F F', screwed on to an iron yoke, or cross-piece Y; these bobbins should be turned up out of the very best soft iron circular rod, about 1$\frac{3}{4}$in. diameter. The centres, or cores, should be turned down to about $\frac{1}{2}$in. in diameter, a flange about $\frac{1}{16}$in. in thickness being left at both ends. A hole must be drilled up the centre of each bobbin, and this hole must be tapped to receive an iron screw about 1in. long, $\frac{3}{16}$in. diameter. These screws serve to clamp the bobbins to the yoke. Owing to the weight of the coiled bobbins, and the high speed at which they must be driven, it is needful that these screws should be strong to resist the centrifugal tendency. The length of the bobbins, including flanges, is 1$\frac{5}{8}$in. If the operator has not a lathe, he may make a fair substitute for the turned bobbins by putting a screw-thread on the top and bottom of two pieces of $\frac{1}{2}$in. iron rod, 1$\frac{5}{8}$in. in length, and screwing thereto discs of soft iron, $\frac{1}{16}$in. in thickness, 1$\frac{3}{4}$in. in diameter, having holes drilled and tapped in their centres to take the extremities of the rods. The yoke Y has in its centre a $\frac{3}{8}$in. hole, which must be carefully bushed with black ebonite, ivory, or boxwood soaked in paraffin wax, or some other good, hard insulator.

§ 44. The shaft or spindle on which the armature revolves constitutes the distinguishing feature of this particular form of magneto machine. It must be compact, easy to construct, strong, and well insulated in its two halves. It must also have some device whereby contact can be made and broken two or three times during each revolution. To this end an iron rod, about 5in. long and $\frac{1}{4}$in. in diameter, is turned down at both ends for a length of $\frac{1}{4}$in., to about $\frac{3}{32}$in. in diameter. This is to produce a shoulder at each end for the spindle to rest in its bearings. These thinner ends are shown at A and A'. Another, $\frac{1}{32}$in., is taken off at one end for about $\frac{1}{2}$in., say, at the end A'. Then a screw-thread of about $\frac{1}{2}$in. in length is run on at D'. The rod is then in cut in two at D, and a length of about $\frac{1}{2}$in. is turned down to about $\frac{1}{8}$in. in diameter. A screw must be formed on this thinner portion, as shown at D. The portion B' has then a hole about $\frac{3}{8}$in. in depth drilled in it, and about $\frac{3}{16}$in. in diameter. A female screw must be cut in this, and the hole bushed with ivory or ebonite, as shown at C. Great care must be taken in tapping this to receive the screwed end of D that the two halves of the divided rod are perfectly insulated from one another. To this end an ebonite washer is placed at W. It is well to test for insulation by inserting the spindle at this point, in the circuit between a galvanometer and a battery. If any current passes so as to produce a deflection, the hole C must be cleaned out and replugged, until perfect insulation has been effected. Two small holes, to take short screws about $\frac{1}{16}$in. diameter by $\frac{1}{8}$in. in length, must be drilled and tapped, near B and B'. These are intended to make connection with the two ends of the wire coming from the bobbins, as shown at Q. The next operation is to turn up a small brass pulley, about $\frac{3}{16}$in. in thickness, by about $\frac{1}{2}$in. in diameter, which must have a female screw put in it to fit over D', as illustrated at P. This pulley serves at one time to clamp the yoke Y in its place on the spindle, and to communicate the motion from the little driving-wheeel to the armature spindle. All that now remains to be done to the spindle is to file about $\frac{1}{2}$in. of its length, just beyond the screw-thread D', into a triangular form, like the Grecian letter Δ, as shown at E' and E. The length of the finished spindle should be 3$\frac{3}{4}$in.

§ 45. A brass frame, of the form and dimensions figured at Fig. 22 A, must now be provided. For substance it should be $\frac{1}{4}$in. wide by $\frac{1}{2}$in. deep. At the point *d* the frame expands both above and below so as to form a lug, projecting about $\frac{1}{2}$in. on either side, against which can be clamped the magnet M (Fig. 21). The amateur should construct a pattern of this frame in wood a trifle larger than it is intended to be (to allow for shrinkage), and after having carefully smoothed and bevelled the edges, send it to the brass founder's to get a similar one cast in brass. When cast, the frame will require careful cleaning and trueing up with a file. Holes to take $\frac{3}{16}$in. diameter screws must then be drilled and tapped at *c c*. These serve to fasten the frame into its box. At B and B' rather larger holes must be bored, the former being carefully bushed with ivory or hard ebonite, the latter fitted with a metal screw, through both of which a hole is put, sufficiently large to serve as bearings for the end A and A' of the spindle (see Fig. 21, A A'). At *e* and *e*, precisely opposite one another, are drilled two $\frac{3}{16}$ holes, which serve as bearings for the driving wheel. At *g*, a small hole about $\frac{1}{2}$in. and $\frac{1}{4}$in. deep, is drilled and tapped, to receive a small screw. This is intended to receive the small contact spring R (Fig. 21).

§ 46. The next thing needed is a small brass driving wheel about 4in. in diameter and $\frac{1}{4}$in. thick, with a groove cut in the periphery, to take a gut band. The tiro need not make a pattern for this, for nearly every toy-engine shop keeps brass flywheels of about this size. If it have not a groove when bought, one can easily be put in it on the lathe. This wheel is shown at Fig. 22, G, mounted on an iron

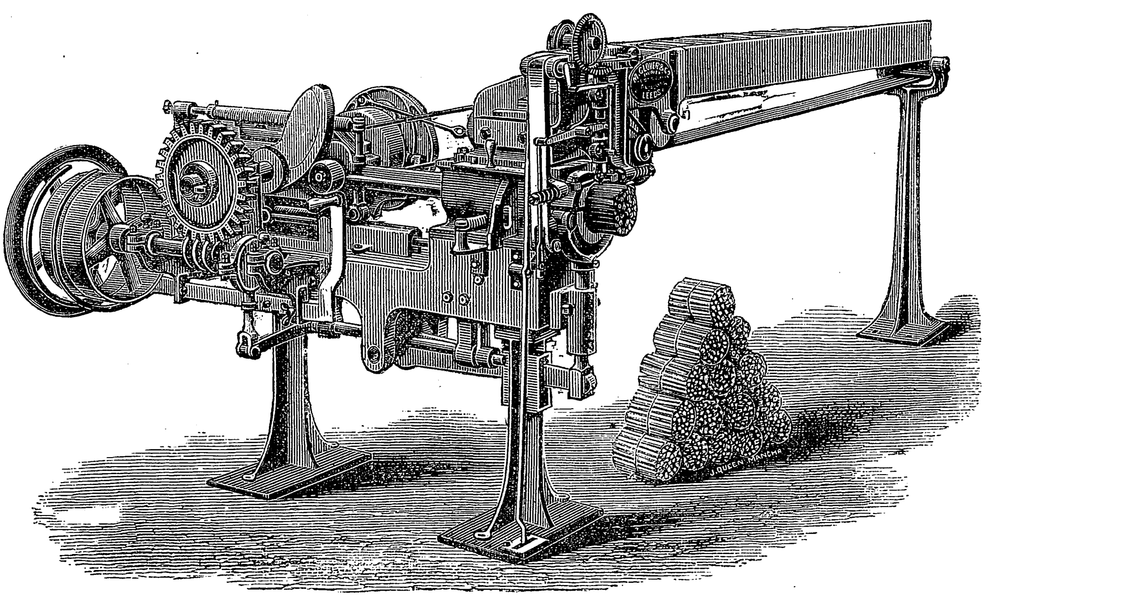


shaft 3in. long, H. This flywheel may be keyed or brazed to the shaft. Just beyond the flywheel at I the shaft is turned down so as just to enter freely into the holes at *e* and *e'*. At the extremity, G, a screw thread is put on the projecting end of the rod to take the female screw of the driving handle, shown at J. At the opposite extremity, H, the shaft is drilled and tapped to take a rather large-headed screw which serves to prevent the shaft from riding to and fro.

§ 47. The operator may now proceed to wind the bobbins. For this purpose he will need about 1lb. of No. 26 or 28 double silk-covered wire. Having ascertained by testing with a battery and galvanometer, that the wire is continuous, it will be well to soak the coil of wire for a few minutes in hot melted paraffin wax, allowing the paraffin afterwards to drain off, by suspending the coil for a few minutes in a rather warm place. The iron bobbins F F' are then wrapped round with one layer of brown paper, which is fastened down to the cores with good glue. Two semicircles, with hole cut in the interior to fit the iron cores, are also glued inside the flanges, so that the whole of the inside of the bobbins is entirely covered with brown paper. When the glue is *quite dry*, the bobbins may be warmed, and plunged for a few seconds in hot melted paraffin. Each bobbin is then to be wound, *in the same direction*, with the wire above specified, until the bobbin is filled to the top of the flange. To prevent unwinding the finishing ends may be tied down to the bobbin with a

† This article is introduced here at the express desire of many correspondents, although really intended to appear later on.

FIG. 1.



bit of silk, leaving, however, about 2in. of the wire *free* for attachment to the spindle. The commencing ends of the wire must also be allowed to protrude beyond the flange for 2in. or 3in. for connection. The two bobbins are then screwed firmly to the yoke, the yoke afterwards being put on the spindle. When this has been done, the four ends of the wires are joined, as shown at Q, Fig. 21; that is to say, the two lower ends (after their covering has been removed) are twisted together, soldered and rubbed over with Prout's elastic glue, to insure insulation; while the two top ends are screwed, each one down to the shaft, one at B and the other at B′, the covering having been previously removed from the wire at these points to insure perfect electric contact with the two halves of the shaft. In order that the machine may work, the relation between the winding and connections of the lower ends of the bobbin wires (as seen from the yoke end) must be like this— ∽. A thin ebonite washer is now placed over the yoke, and the little pulley P screwed tightly in its place. This must be screwed down very firmly, as upon this depends the stability of the armature. The armature is now *finished* as far as actual work goes, but the bobbins may be covered with any pretty-coloured silk velvet, if appearance be studied.

§ 48. The brass frame is now clamped by means of a stout brass cross-piece K (Fig. 22) to the magnet; and if necessary, a second cross-piece (also of brass) is screwed to the frame at L. The back end of the armature spindle (the end farthest from the pulley) is passed into the larger hole B′ of the frame A. This will allow the other end of the spindle being inserted into the opposite hole B, without strain. When the spindle is in its place, the hollow screw is placed in B′, and screwed home, until the armature spindle can just turn freely, without too much play, before the poles of the magnet. In like manner the driving-wheel I is put in its place by passing the long end of spindle through the holes *e* and *e*, and then fixing it in position by means of the larger headed screw already mentioned at the end of § 46.

The small spring R is then screwed down to the frame at *f*. It must *just rest* on the projecting corners of the triangle E′ during rotation, and *just clear* the flattened portions. On careful attention to this point a great deal of the efficiency of the machine depends. The shock is felt, not *while the current is continuous*, but at the instants of *breaking* and *making* contact. The instrument can now be placed in any suitable box, which must be sufficiently long to allow the armature to rotate without striking against the ends, and just a trifle—say, $\frac{1}{8}$in.—wider than the frame. The frame is attached to the box by means of screws which pass through the box into the holes *c* and *c′* of the frame. The screw at *c* should be hollow, so as to take a small pin, or screwed wood, which is intended to make connection with the metallic cords and handles, which are used for giving shocks. Another similar screw is put in the side of the box almost opposite the armature, and to this screw, in the inside of the box, is fastened a rather stiff brass spring about $\frac{1}{4}$in. wide, bent into the shape of L, the longer end of which must press firmly against the end of the armature spindle which projects through the bushed hole B (Fig. 22). This latter screw forms the other terminal of the machine, the other cord, &c., being affixed thereto. It is usual, though not essential, to place a soft iron keeper at the back of the magnets poles, which may be partially or wholly removed at will. This enables the operator to regulate somewhat the strength of the shocks by increasing the inductive effect of the magnet on the armature, consequent on the removal of keeper from near its poles. There must also be a hole in the box, to allow of the insertion of the driving-handle, J.

PATENT FIREWOOD CUTTING AND BUNDLING MACHINERY.

MESSRS. GLOVER AND CO., of Leeds, have patented machines, which we herewith illustrate, for the purpose of cutting-up waste timber and tying it in bundles ready for sale. These may be worked either separately or combined. The whole arrangements are so ingenious as to well merit the attention of all those who are interested.

The chopping portion consists of a knife, which is actuated in a manner similar to the chisel of a mortising machine. The timber to be chipped is cut into lengths of about 6in., and fed into the machine by rollers, the grain of the timber, of course, being vertical.

The blocks follow each other in close succession, and the cross head carrying the chisel being itself of some weight, the blocks are cleanly split, knots being readily cut through, which hand labour would probably have to throw on one side; and we notice that the splitting exactly resembles hand-work, the grain of the wood being followed, a spring side being fitted to the feed trough opposite the knife to allow the necessary small movement to take place in order to secure the above result.

A brake is applied to the wrist pin disc, which stops the machine when the strap is thrown off. Any required size of chips may be made by altering the rate of feed.

After leaving the knives the chips fall upon a set of revolving octagonal rollers, which thoroughly sift any dirt or dust out of them, and also carry them forward towards the bundling machine.

Here the chips fall into a box of a fixed size. In this box they are subjected first to a rapid agitation, which settles them into their least possible volume, their flat sides coming together, and they then are operated upon by four "formers," thus making the bundle round, after which they are firmly compressed. Previous to this, however, they are all set with their ends level by means of a plunger, which enters the back of the chamber, pushing the sticks up to a diaphragm, which then withdraws.

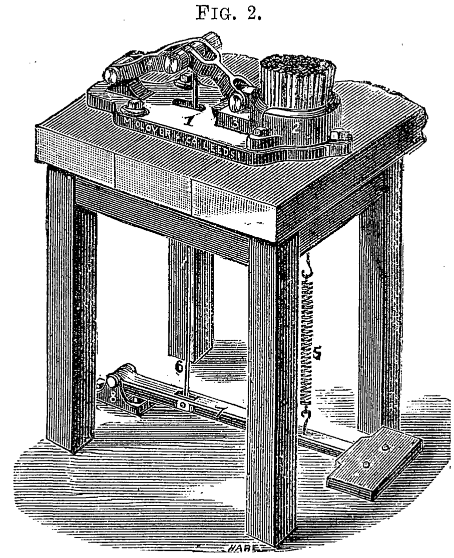
When compressed ready for bundling they are ejected from the chamber by the advance of a cam-driven plunger, and forced outwards through a slightly converging tube, having a movable spring top, into the position shown in the illustration Fig. 1.

In this position they are tightened up by means of an encircling belt of steel, which is drawn up by means of a powerful toggle-joint gear, and when thus held, a wire is passed round the bundle and held by means of a clip above, which can be released by a foot lever.

When the wire is fixed the clip is made to revolve by a peculiar engaging device, twisting the ends of the wire, and the bundle is then complete. The clip then releases the wire, and the operation goes on, the finished bundle being pushed out completely by the next comer.

Fig. 2 shows a bundling machine of a different

FIG. 2.



construction, for hand and foot work alone, being adapted to the smaller requirements of firewood dealers and public institutions. It is claimed that this very simple, yet extremely powerful and expeditious, machine effects a very great saving in time and wages, and turns out better work, though only requiring the most inexperienced hands. The illustration otherwise speaks for itself.

A THEORY OF VOLTAIC ACTION.*

THE experiments, as described below, lead to the conclusion that the difference of potential observed near two metals in contact is due to the chemical action of a film of condensed vapour or gas on their surfaces.

Such a pair of metals, with their liquid or quasi-liquid films are quite similar to a galvanic cell composed of the same metals, and a liquid similar to that of the films as electrolyte, said electrolyte being divided (in the ordinary static "contact" experiment) by the intervening diaphragm of air or other gas.

* Abstract of a paper by J. BROWN (Belfast), communicated to the Royal Society by Lord Rayleigh, Sec. R.S., Nov. 18th, 1886.

In making the experiments, a specially prepared quadrant electrometer was used, having opposite quadrants of the pairs of metals under examination. This instrument was gas-tight (in the ordinary sense), and means were provided for introducing any desired gas or vapour into it, so as to act on the metal quadrants while being tested electrically.

A copper-zinc Volta's condenser, having plates 8in. diameter, was also used. With both instruments the differences of potential near the metals were compared with that of a Daniell cell, represented by the symbol D in what follows.

A number of experiments were made to ascertain the rate of decrease of difference of potential of the films on copper and zinc in air, due to the gradual tarnishing of the metals, the object being to estimate the effect due to clean metals, and compare this with their heats of combustion with oxygen. Although with these metals the comparison holds fairly well, with some others it is only an approximation, which, however, is only what might be expected, seeing that so little is known of the nature of the film and the action taking place in it.

Similar measurements were made with copper and iron in an atmosphere containing hydrogen sulphide. The film on the copper becomes positive as soon as the gas is admitted, and in this particular experiment the difference of potential rose in 1h. 18m. afterwards to ·55D. It then fell gradually during eight days to zero, owing to the protecting action of the films of sulphide formed on the metals, the gas being still present. The following (quantitative) results were also obtained in this kind of experiment, where a change in the constituents of the atmosphere surrounding a pair of metals in contact reverses the difference of potential of their films, in correspondence with the reversal of electromotive force which takes place after a similar change in the corresponding liquid electolyte used with the same metals as a voltaic cell.

Such reversal takes place with pairs of copper-iron when hydrogen sulphide or ammonia gas is added to the air surrounding them; with silver-iron when hydrogen sulphide is added, or with copper-nickel when either ammonia or hydrochloric acid gas is added. The addition of neutral or inert gases has little or no effect, and no exceptional case has been found.

It was sought to annul all electrical effect by varnishing the condenser plates, as had been done by the earlier experimenters, or by filling the electrometer with naphtha till it covered the quadrants; but the difference of potential did not fall below ·29 D in the first case and ·23 D in the second.

Faraday's statement that electrolytic "decomposition, and the transference of a current, are so intimately connected that one cannot happen without the other" ("Experimental Researches," Vol. I. page 252), gives countenance to the idea that the film is of an electrolytic nature, and, therefore, probably, water condensed from the air. Two experiments were therefore made to test the effect of drying the air round the metals. With a pair of copper-zinc quadrants inclosed with phosphoric anhydride for 173 days the difference of potential gradually fell from ·659D. to ·5D. Then, on allowing the instrument to remain open for an hour, the value rose again to ·67D., a result quite as marked as might be hoped for with the unsuitable apparatus at command.

Touching more nearly on the nature of the film itself, it was found that when the copper and zinc quadrants were wet with distilled water, their difference was ·88D. (by calculation from thermo-chemical data it should be about ·9D.), and when the copper was wet with copper sulphate solution, and the zinc with zinc sulphate solution, thus forming a Daniell cell divided in its electrolytic circuit the value was almost exactly one Daniell.

The well-known experiment of Sir W. Thomson, where a water-drop was placed between the previously disconnected metal quadrants, is thus easily explained. The water-drop connection equalised sensibly the potentials of the films by altering those of the metals, which were previously at one potential.

This aspect of the Volta condenser as a copper-fluid zinc cell divided in its electrolyte, suggested the possibility of joining the films only on the two metals, without bringing the metals themselves into direct contact, and so producing a real galvanic current-producing cell from the apparently dry metals. After the expenditure of much time and care in bringing the copper and zinc plates to a true surface, cleaning and adjusting them, a current was observed which varied in different experiments from a few up to 130 divisions of the galvanometer used, but which immediately ceased when the plates were either drawn apart or placed in direct metallic contact.

It was found also that the "film cell" so produced could be polarised by connection with another battery.

In order to show that electrification is produced without any dissimilar contact of metals, an old experiment of Gassiot's was modified so as to avoid any such uncompensated contacts. The zinc plate of the condenser was joined to the zinc quadrant of the electrometer, and the copper of condenser to copper of electrometer. Now, on altering the capacity of the condenser, a very decided alteration of the difference of potential near the quadrants of the electrometer was observed. It is evident there were electrical charges present, although there was no actual metallic contact at which any electromotive force could (according to a commonly accepted theory) have existed to produce them.

The paper concludes with a series of diagrams representing the distribution of potential in a zinc-water-copper element, under different conditions, according to the theory adopted.

In an appendix, Mr. J. Larmor, Fellow of St. John's College, Cambridge, points out the difficulty of explaining the production of a variation of potential at the quadrants in the above modification of Gassiot's experiment by any hypotheses other than that of some kind of chemical action at the surface of the metals.

A METHOD OF FINDING OUT THE GENERAL CHARACTER OF THE COMPONENTS OF A CEMENTED COMBINATION.*

By EDWARD M. NELSON.

SOME microscopists take no special interest in their lenses beyond occasionally wiping the front, and with a camel's-hair pencil brushing the dust from the back when it gets too thick. Others unscrew the combinations to clean them, and like to know whether they are composed of two, three, or four sets of lenses. Some, again, know all about the components of each combination, and some wish they did. It is to this last class of inquirers that this paper is directed. Let me first say that there is only one way of finding out the exact composition of a lens, and that is by taking down every combination, uncementing every lens, measuring the exact curvature, and the refractive and dispersive power of the glass of which it is made. It will be admitted, however, that it is very useful to know whether a combination consists of two or three lenses, and if those are biconvex, plano-convex, meniscus, &c. To find such information without uncementing a combination is the scope of this paper. The method I employ is simply the consideration of the reflected images from the surfaces of the glass. Take the plane mirror of your microscope in your hand, and examine the reflection of a window. Notice that it is an erect image, and that when you move the mirror in a certain way the image appears to come towards you. Now look at the concave side, the image is inverted, and when the mirror is moved in the same direction as before the image goes away from you. A convex mirror behaves as a plain mirror, there being only this difference—that the greater the convexity the smaller is the image, which difference is also true of a concave mirror—viz., the greater the concavity the smaller the image. If you now examine a single biconvex lens, you will see a large erect image from the surface next the window, and a small inverted image from the surface on the other side. It acts precisely as if it were a convex and a concave mirror. In a single biconcave lens you have a large inverted and a small erect image. In a plano-convex, with the convex side towards the window, you will find a small erect image from the convex side, and a large inverted image from the plane side. With the plane side towards the window, you will have a large erect image from the plane side, and a small inverted one from the other side. With the concave side of a plano-concave towards the window, the concave side will give an inverted image, and the plane side an erect image; but with the plane side to the window, you will get two erect images. Converging and diverging menisci have for their convex sides two erect images, and for their concave sides two inverted. I find, however, that in a converging meniscus, if the concave surface is of very large radius, the reflection from it when viewed from the convex side will be inverted instead of erect; in other words, it will take the form of a plano-convex. I imagine that in a diverging meniscus, which closely approximates the form of a plano-concave, the same result would be found—viz., that the image from the flat side, when seen through the more concave side, would be erect instead of inverted, as one would expect; but of this I have no practical experience, not having a single lens of that form to experiment on. Now, if we take a cemented doublet, consisting of a biconvex and a plano-concave, we shall very easily see the two bright reflections from the two exterior surfaces—viz., the plane and the convex. The image from the cemented surfaces, however, will not be so readily apparent. With a little attention it will be discovered as a faint image, with most probably a bluish tinge, though occasionally it may have a reddish tinge. When once seen, it will be easily recognised again. A triple combination will have two faint images as well as two bright ones. I find the following the best method of procedure. First find out by the number of faint reflections if the lens is a doublet or a triplet. Next find out the nature of the external surfaces, and write them down—e.g., plano-convex doublet. This means that the combination is composed of two lenses, and that one of the external surfaces is convex and the other plane. Now write down the reflections as they come, beginning at the side next the window, underlining the reflection from the first surface, and putting the reflection from the cemented surface in (). In writing these down, I use the following abbreviations: *e* for erect, *i* for inverted, *s* for small, *l* for large, and L for very large. It is a good plan to draw the lens by representing, first, the external surfaces only, and then filling in the cemented surfaces, according to the reflections you obtain. It is absolutely necessary that the reflections from both sides of the combinations should be ascertained, as it is impossible to discover the construction of the combination from one set of reflections. When the images are large it is as well to look at the reflection of the bar across a window; the knob of the hasp showing if the image is erect or inverted. The images from small lenses require to be examined by a magnifying glass. One word of caution, and that is, until one is practised in picking up these faint images, the very large faint ones are apt to be overlooked. Until one is familiar with the manner of holding a lens, only a faint blue tinge will be seen over the glass; but after a little practice, a distinct image of the window bar will be obtained. The following are a few examples:—

A plano-convex doublet—

Convex side .... *se* (si) li.
Plane side .... *le* (se) si.

It therefore consists of a biconvex and a plano-concave. The next two form an interesting pair, as both have the same external form.

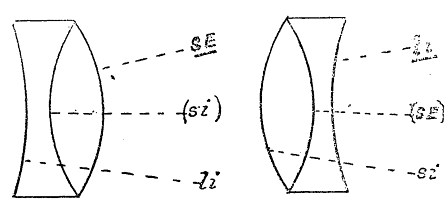


FIG. 1.

Converging meniscus doublet—

Convex side .... *se* (si) li.
Concave side .... *li* (se) si.

This consists of a biconvex and a biconcave. The other has—

Convex side .... *se* (se) li.
Concave side .... *li* (si) si.

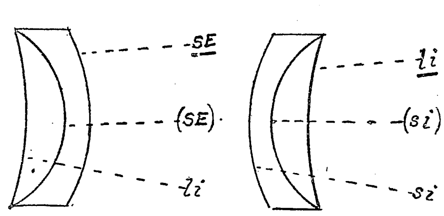


FIG. 2.

This consists of a converging and diverging meniscus. The difference between these two last combinations is at once shown by the different characters of the reflections from their cemented surfaces. The intelligent observer will note that the concave external surface, when seen through the convex surface, has its sign changed from *e* to *i*; of this I spoke above.

An unequal biconcave doublet—

Most concave side .... *li* (se) si.
Least concave side .... *Li* (si) se.

This is, therefore, a biconcave and a converging meniscus. The s i in the most concave side is not what one would have expected. The internal curves of the meniscus must have a short radius, so that it overpowers the external concave surface of the biconcave. The least concave side is very flat as shown by L. A biconvex triple will take the form of *e* (i) (e) i on both sides. In consists of a biconvex, biconcave, and a biconvex. A plano-convex triple consisting of a biconvex, biconcave, plano-convex will have the same form, only the plane side will give *Le* instead of *se*, and li instead

* Read before Quekett Microscopical Club, Nov. 26, 1886

of si. An unequal biconvex triple, as a properly constructed opera-glass objective, will give:—

Most convex side ...... *le* (si) (Li) li
Least convex side ...... *le* (Le) (se) si

The lenses therefore are biconvex, diverging, and converging menisci. A biconcave triple, as in a properly-constructed opera-glass eyepiece, gives:—

From the thickest lens side...... *li* (se) (le) se
From the thinnest lens side ... *li* (Le) (li) se

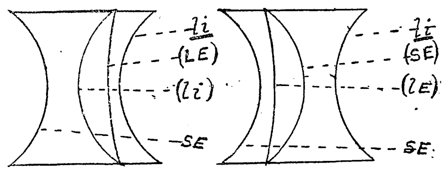


FIG. 3.

Its form is biconcave, converging meniscus and diverging meniscus. If the middle were a piece of plain glass, which is sometimes fraudulently put, its form would be—*i* (e) (e) e alike on both sides. But if it had a thin converging meniscus in the middle, it would read:—

From one side .... *li* (le) (le) se
From the other ...... *li* (Le) (Le) se

You will have probably noticed that the diverging meniscus turns the (i) into an (e), following a plano-concave, as I hinted above, only making the s into an L. These examples will be sufficient to make anyone acquainted with the method I employ. I have for long thought it was possible to find out the character of a combination by means of the reflections; but having only received negative replies to my repeated inquiries from those who ought to know, I have been deterred from investigating the matter for myself until this summer.

USEFUL AND SCIENTIFIC NOTES.

Orthochromatic Photo. Plates.—According to the *Photographische Mitarbeiter*, the following is the recipe for orthochromatic gelatine plates, as given by Dr. Mallmann and Ch. Scolik. The plates are first dusted with a soft camel's hair brush, and placed in a bath containing water, 200c.cm.; ammonia, 2c.cm.; in which they are allowed to remain for two minutes. They are then taken out, and after draining are immersed in the following solution:—Erythrosin solution (1 to 1,000), 25c.cm.; ammonia, 4c.cm.; water, 175c.cm.; for 1 to 1¼ minutes, the dish to be kept covered and in motion. Both baths can be used for a dozen plates, but after the seventh or eighth 1c.c.m. ammonia should be added to both solutions. The plates are then taken out, and allowed to dry in a perfectly dark room. This is accomplished in about three hours. Care should be taken against overheating. With these plates the alkaline pyrogallic developer should be used. If the oxalate of iron developer be employed, veiling is the result.

Detection of Leaks in Water Mains.—The microphone is now being used in Germany for the purpose of detecting loss of water through leakage in town mains. The apparatus consists of a steel rod, which is placed upon the cock in the neighbourhood of which the leak is suspected, and a microphone attached to the upper end of the rod. A dry battery and a telephone complete the equipment. No sound is heard in the telephone if the cocks are closed and no leak occurs; but a leak of even a few drops through a badly fitting cock causes sufficient vibration in the pipe to affect the microphone, and to give audible sounds in the telephone. At a recent meeting of gas and water engineers in Eisenach, it was stated that the apparatus is so simple to handle that, with a little practice, ordinary workmen are able to detect and localise any leak.

A CORRESPONDENT of the *American Machinist* gives the following as his method of straightening a shaft: "It was 16ft. long, 2$\frac{15}{16}$in. diameter, and had a 44in. pulley, 8in. face upon each end, one tight and one loose pulley, 8in. face upon the middle of shaft. Without taking it out of its bearings I took a piece of timber 8in. by 8in., 10ft. long, and hung it to the shaft by a ⅝in. chain, at each end of the timber, the timber being 24in. inches below the shaft, then chalked the shaft at the high point, then turned that point down, then set a jack screw upon the timber with top of jack at the chalked point, turned up the screw a little, took out jack, chalked again, and repeated the operation until I had the shaft straight. The whole operation did not take over one hour. This shaft was ½in. crooked, and I once straightened a 3in. shaft the same way that was bent 6in.

SCIENTIFIC NEWS.

IN the course of his anniversary address before the Royal Society, Prof. G. G. Stokes, the president, said that the balance-sheet showed a considerable excess of income over expenditure, and that what has been called the "Scientific Relief Fund," thanks to the munificence of Sir W. Armstrong and the subscriptions of Fellows and others, will shortly amount to £20,000. Referring to the late eclipse expedition, Prof. Stokes said that, although there has not been time to discuss the observations in full, two points appear to have come out clearly—that the brightness of the corona was much less than had been expected, and that it is doubtful whether it is possible to photograph the corona unless the sun is eclipsed. Speaking of the advance which has been made in celestial photography, Prof. Stokes said he had received an invitation to be present, with another delegate from the Royal Society, at the Conference which is to be held at Paris on April 16, and would take an early opportunity of consulting the new council about it. The Royal and other medals were awarded, as specified on p. 282, and Prof. Michael Foster was elected one of the treasurers, and Prof. D. Ferrier and A. Gamgee, M.D., members of the council.

The death is announced of Mr. Arthur Grote, on the 4th inst. He was born in 1814. He was a Fellow of the Royal Society and also of the Linnæan Society. Mr. Grote wrote a number of papers on subjects connected with botany and natural history, and contributed an introduction to Hewitson's "Description of New Indian Lepidopterous Insects in the Atkinson Collection."

Prof. Rücker, F.R.S., has been appointed to the post so ably filled by the late Prof. Guthrie, F.R.S. The professorship of Physics in the Normal School of Science at South Kensington is worth £800 a year.

In the *Journal* of the Liverpool Astronomical Society for December, Mr. T. G. Elger continues his article on "The Moon surveyed in Common Telescopes," Mr. Denning has some useful hints on "Telescopes and Telescopic Work," and there are a number of papers on interesting subjects connected with astronomy.

Messrs. Macmillan will publish almost immediately "The Chemistry of the Sun," by J. N. Lockyer, F.R.S., in which will be a full statement of the hypothesis put before the Royal Society by the author some years ago—viz., that the so-called elementary bodies are in reality compound.

In the course of one of the Rosebery lectures at the University of Edinburgh, Mr. G. J. Romanes said that the cell remains the unit, for protoplasm could not yet, so far as the microscope could show, be said to justify the name of structure. At the same time, the difference of cell pointed to difference of protoplasm, and it must be concluded there were as many kinds of protoplasm as there were species in the vegetable and animal world.

The Potato Tercentenary held at St. Stephen's Hall, Westminster, produced a splendid show of the famous esculent vegetable, and at the conference several papers were read. Mr. W. S. Mitchell said in his paper that he believed Drake introduced the potato to England in 1586. Mr. Clements Markham read a paper in which he stated that the original home of the potato was in the Cordilleras of the Andes, and that it had been cultivated from time immemorial over an extent of 3,000 miles. Mr. J. G. Baker of Kew, read a paper on the "Wild Germs of Tuberous Solanums," in which he stated that there are five thoroughly distinct species of tuber-bearing solanums, all natives of America. S. tuberosum (the common potato), in one form or another, extends down the western side of the American continent from the Rocky Mountains to the Chonos Archipelago, a range of 75 degrees of latitude, and within that area no fewer than sixteen forms are found, so different that even some botanical writers have regarded them as different species. Mr. Murray, of the British Museum, read a paper on the "Potato Disease," in which he said that microscopic investigation showed that the complete fungus could be produced in three hours—a fact which sufficiently accounts for the sudden and disastrous spread of the disease, too familiar to all potato growers. Dr. Maxwell Masters read a paper on the "Production of Varieties by Cultivation," and several well-known cultivators took part in the "conference," which will certainly result in the wider dissemination of more accurate knowledge concerning the history and character of the favourite vegetable.

According to Dr. C. W. C. Fuchs's twenty-first annual report, the number of earthquakes recorded during the year 1885 was 230, of which 40 occurred in January, 30 in February, 27 in March, 23 in April, 11 in May, 18 in June, 10 in July, 12 in August, 15 in September, 14 in October, 10 in November, and 20 in December. It appears that the volcanic eruptions during 1885 were few and insignificant. Vesuvius remained in its usual Stromboli-like condition, except in May, when a feeble eruption occurred. Etna was also generally quiet; but in March the instruments at the observatory indicated subterranean disturbances, and in August ashes were ejected.

At an inquest held last week in Clerkenwell relative to the death of a man aged 77, it was stated that the deceased "was inventing a valuable improvement in steam navigation," giving "four times the ordinary speed with a quarter the present consumption of fuel"—at least, so said a witness, who also stated that the deceased expected £40,000 from the Government; but was somewhat stubborn, as he wanted the cash before divulging his invention. The deceased probably had a sufficient reason for his reticence.

With reference to the submarine boat which has attracted some attention in the daily papers, it may be as well to point out that the idea is certainly more than 250 years old, for in the reign of James I. a Dutchman, named Drebbel, constructed a boat which travelled under the surface of the Thames. Since then many submarine vessels have been designed, but none of them have yet accomplished what has been done by Prof. Tuck's *Peacemaker* (see p. 82) in the Hudson River, New York. That vessel apparently dives with ease, and returns to the surface as desired. A very powerful submarine vessel is being built to the designs of Mr. Nordenfelt, with engines of 1,300 horse-power, and it will probably be ready for trial in Southampton Water in the spring.

The Paris Academy of Medicine, expressing an opinion on the adulteration of wine, declares that the addition of pure alcohol to wine to the extent of 2° may be permitted, because that quantity is necessary for the preservation of wines of low strength. Some of the wines sold in New York have been recently analysed by Dr. Cyrus Edson, who says that one firm of "extensive growers" manufacture wine from dried fruits and a solution of sugar, the liquid being preserved by the addition of salicylic acid. Dr. Edson has recently succeeded in getting an order for the destruction of upwards of 5,000 gallons of this stuff.

On Friday last a conversazione in connection with the King's College Engineering Society was held at the College, when all the departments in which there are evening classes were exhibited in full work. The advantages offered by these classes to those desirous of obtaining technical instruction are evidently appreciated, and the number of students is rapidly increasing.

We do not often draw attention to advertisements in this page, but we make an exception for once, for which not a few readers may thank us, with regard to the sale next Friday at Manchester of the scientific and mechanical instruments of the late William Hartley, the inventor of the geometric chuck. His machine for geometric turning included in this sale is the most perfect ever made for this purpose, and is absolutely correct in all its movements.

The general meeting of the Aëronautical Society of Great Britain will be held in the hall of the Society of Arts next Saturday, commencing at 3.30 p.m.

THE production of copper in the United States in 1885, including 5,086,841lb. made from imported pyrites, was 170,962,607lb., valued in New York at 18,292,999dols. at the average price of 10·7 cents. per pound. The increase in pounds over 1884 was 25,740,667; in value, 503,312dols.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of he* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE BINARY STAR η CASSIOPEIÆ.

[26566.]—I SHOULD be glad to know of any very recent measures of η Cassiopeiæ, Σ 60. Engelmann gives, for 1882·87, 165·70° : 5·155″ (six nights); Seabroke, for 1883·10, 166·2° : 5·11″ (five nights); Doberck's elements give, for 1883·0, 164·6° : 5·51″; L. Struve's, 168·1° : 5·40″. Evidently the semi-axis major obtained by both Doberck and Struve, though much smaller than Dunér's, is still too large. The "Star Guide" gives, for 1886·0, 175° : 4·9″. Probably a does not much exceed 8·5″. I have drawn attention to the remarkable similarity between the binaries 70 Ophiuchi and η Cassiopeiæ in the ENGLISH MECHANIC for July 10th, 1885 (letter 24441.) **H. Sadler.**

DOUBLE STARS—U CYGNI.

[26567.]—I HAVE noted Mr. S. M. B. Gemmill's query *re* U Cygni in letter 26492, page 260; but after a prolonged search I regret to say I can find no mention of it as a double star in any books I have consulted. This may perhaps be accounted for by the fact that it is almost too wide a pair to be considered a double star at all in the strict sense of the term, and is certainly not a case where any considerable orbital motion would be expected. I have placed the star on my working list, and have measured it on four nights, with the following result:—

P.A.	Dist.		
51·7°	62·72″	1886.90	4 nights

The definition on two occasions was rather unsteady, but the colours were noted in brilliant contrast, and with a low power the pair is unquestionably a very fine one of its class. I omitted to mention that a power of 180 was employed, and both methods of illumination used in making the measures. **Kenneth J. Tarrant.**

Letchford House, Pinner, Dec. 3.

SIRIUS.

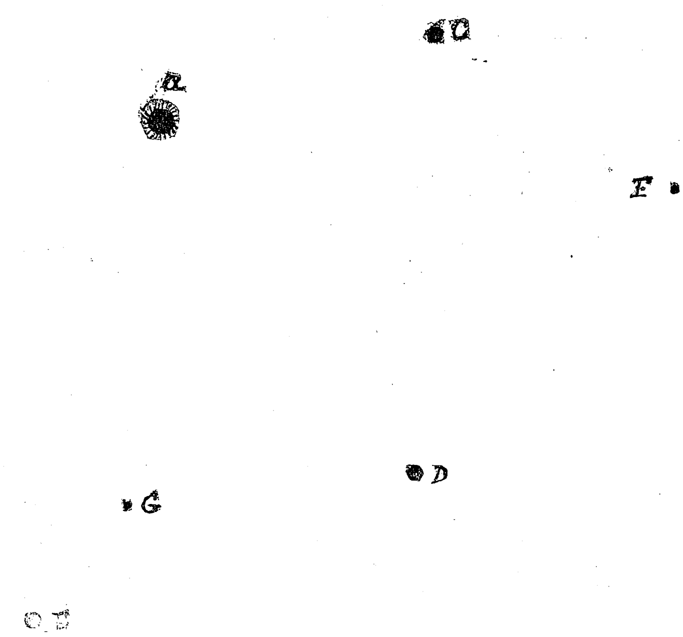
[26568.]—IF Mr. Sadler will read my paper in the *Journal* of the L.A.S., and compute by the formula there given the sum of the masses of the Sirius system, for a parallax of 0·150″, he will find, I think, that my figures are substantially correct. As the *cube* of the parallax enters the formula as a divisor, a small difference in the assumed parallax will make a considerable difference in the resulting mass. I fail to see, however, how Auwers arrived at so small a mass as $13\frac{3}{4}$ for Sirius and $6\frac{3}{4}$ for the companion, with his assumed parallax of 0·193″. This parallax would give, for a mean distance of 13 times the radius of the earth's orbit, semi-axis major a = 0·193″ × 13 = 2·509, and the semi-axis major of the Sirius system is certainly more than this. Colbert found a = 8·41″. There is a misprint in the formula given in my paper. On page 48, $\left(\frac{a}{p}\right)$ should, of course, read $\left(\frac{a}{p}\right)^3$. **J. E. Gore.**

ASTRONOMICAL—α ARIETIS—δ EQUULEI.

[26569.]—AS this star has come to the front of late in the "E. M.," I send you the result of two observations I have made lately. If the sketch inclosed is compared with the one given on p. 222, it will be seen that the stars have changed their places considerably since the time of Ad. Smyth. Their magnitude also has varied. I estimated—

α C P. = 108° dist. 260″
α F = 80°
α D = 50°
α G = 350°
α E = 340°

D is half a mag. smaller than G; F is, at least, two mags. fainter than D; G is very faint, and does not seem to have been observed before. It is, at present, the nearest *comes* to α visible; E is



given only as a point of reference to find G. I looked for the close *comes* S. of α. During my first observation I thought there was something like it at position 230°; but this was not verified during the next.

δ Equulei is now position 180° ±, and enters that portion of its orbit where it has never been observed. Double-star observers will doubtless watch its movements with the greatest interest, as this seems to be the most rapid movement known.

Nov. 25. **C. M. Gaudibert.**

THE VARIABLE STAR V CYGNI.

[26570.]—THE non-success of Mr. Gemmill in not seeing this variable on Oct. 31 (letter 26492, p. 260), probably arose from the aperture of his telescope being too small. However, if he is familiar with the place of the object, he should have glimpsed it with a $3\frac{1}{4}$in. o.g.; but if he is not certain of its identity, he will find a description of its position in letter 24964, page 199, for Nov. 6, 1885.

Mr. E. W. Maunder (letter 26546, p. 301) states that this star has not often been observed, and that its period has not been satisfactorily determined. I think it will probably be found to be an irregular variable with *two* unequal maxima.

I have not seen Mr. Baxendell's observations, to which he refers; but great weight will be attached to this accurate observer's data. The Rev. T. E. Espin stated that he has kept this variable on his list for regular observation, and possibly he could now add particulars. Some Continental astronomers noted in 1882 and 1883 several variations in the physical appearance of this beautiful star, as it presented sometimes a nebulous aspect with a sensible diameter.

The late Mr. J. Birmingham, its discoverer, gave the following estimates of its magnitudes:—1881, May 22, 9 mag.; June 9, 8 mag.; July 30, 9 mag.; Dec. 21, 12 mag. 1882: April 28, 8 mag.; May 6 and 16, 8·3 mag.

The following are the dates of my own observations, with the respective rough eye-estimates of magnitudes, which I hope may be of some service, in connection with others, to enable its light curve to be tabulated for future reference by observers of variable stars:—

	Mag.		Mag.
1881, May 31	$9\frac{3}{4}$	1885, Oct. 3 and 15	$10\frac{3}{4}$
1882, May 13	$9\frac{3}{4}$	" " 26	$10\frac{1}{2}$
" Sept. 3	9	" Nov. 12.........	$9\frac{3}{4}$
" Oct. 19	$9\frac{1}{2}$	" " 14.........	$9\frac{1}{2}$
" Nov. 7	$9\frac{1}{2}$	" " 16.........	$9\frac{1}{4}$
1883, May 5	$12\frac{1}{2}$	" " 18.........	9
" May 27	12	" " 21.........	8
" June 2	$11\frac{1}{2}$	" Dec. 2	$8\frac{1}{4}$
" July 26	$8\frac{1}{2}$	" " 5 and 7	8
" July 28	$8\frac{3}{4}$	" " 10.........	$8\frac{1}{4}$
1885, Sept. 19	$11\frac{1}{2}$	1886, Jan. 2	8
" " 26	11	" Oct. 31	12
" " 29	11	" Nov. 25.........	$11\frac{1}{2}$

Belfast, Dec. 6. **I. W. Ward.**

BARNARD'S COMET.

[26571.]—I FIRST saw this object on Nov. 11th in strong twilight. I noted it as a "pearly-white nebulosity, with strong central condensation as bright and larger than Messier 13 Herculis."

Cloudy weather prevented further observations until December 2nd, 17h. 40m. G.M.T., when I picked it up when sweeping. A great change has occurred. The comet, which before had no trace of a tail, has now *two* tails, the longest, which expands as it recedes from the nucleus, being 8° long; the short one, which tapers to a point, is about 1° in length. The tails inclose an angle of about 40°. The edges of the long tail, and that of the short tail which is farthest from the long tail, are perfectly straight and sharply defined; but the other edge of the short tail seems to shade off indefinitely except just near the nucleus, where it is sharp.

The head of the comet is about equal to a star of the third magnitude in brightness, and its position is, roughly, 15h. 10m. N. Dec. 16°, about 3° west of τ^1 Serpentis (Proctor), while the tail can be traced to 45 Boötis with an opera-glass, and about two-thirds this distance with the naked eye. **C. L. Tweedale.**

[It is impossible satisfactorily to reproduce the sketch sent with this.—ED.]

COMET f 1886.

[26572.]—SEEING from the letter of B. J. Hopkins (26545, page 301, Dec. 3rd, 1886) that this comet was developing into a rather interesting object, I persuaded myself to rise at the rather unusually early hour (for me) of 5 o'clock this morning, and, the sky being clear, I was amply rewarded for my trouble by a splendid view of the comet, both naked eye and telescopic; so with your permission I will just describe its appearance, and, taking the naked eye aspect first, I may say the head was as bright as a large third magnitude star, and was situated in the eastern sky about half a degree north of κ Herculis—in fact, exactly at the point of the elbow of Hercules' left arm as he is placed amongst the old constellation figures. The tail, though faint, I could see stretching upwards almost perpendicular above the head to a distance of about 9°, passing exactly over the star π Serpentis, and almost reaching ϵ Coronæ. Now, turning my 3in. achromatic on the comet, with a low power, I found it a beautiful object, with two tails, the long one and a short one at an angle of about 40° with the other, as mentioned by B. J. Hopkins; but he describes the short one as on the preceding side which I think must be a mistake on his part, as I found the short one on the following side, and I hardly think it likely they can have changed places. The nucleus was very bright, and situated about in the centre of the head as far as I could judge, and the long tail (here again I differ from B. J. Hopkins) widened out a little gradually as it receded from the head, the short tail, on the contrary, tapering almost to a point at its end, and being widest near the head—in fact, curving there towards the long tail, and, in my opinion, actually joining it, though at a short distance from the head the division was quite distinct, and this distinctness increased with distance from the head, though the inner edges of both tails were nowhere so clearly defined as their outer edges, which were comparatively sharp, especially the preceding edge of the long tail. The latter stretches over several small stars, which did not appear in the least dimmed by it; in fact, the tail as it crossed the field of the telescope resembled, as much as anything, a ray of sunlight shining through a chink in a shutter into a dark room, and seemed to make objects which it crossed more distinctly visible rather than less so. It was a very interesting sight altogether, and I shall certainly

not neglect any opportunity I may have of renewing my acquaintance with it, and I am sure it will repay anyone for any trouble he may be put to in getting up early to see it; but, by the by, if it continues straight forward in the apparent path it is now travelling across the sky, it will soon be visible in the evening, as it, in fact, does not pass below the western horizon now till after 6 o'clock in the evening, and each evening it is a little higher; so let us hope it will continue in that course, and then we can view it at our leisure, at reasonable hours, when weather permits.

Huddersfield, Dec. 6. **Excelsior.**

EGYPTOLOGY.

[26573.]—IT may be quite true, as "Memnon" says, page 283, that the Pentateuch nowhere promises or threatens anything in another world; but it constantly implies that blessings or curses on the posterity of those addressed are to affect themselves. Unlike the Sadducees, it takes for granted a "resurrection," being in fact pervaded, as well as the later books, by the Buddhist or Pythagorean idea of retribution in future lives here, in this same world. Eli was threatened in prophecy, before Samuel's time (probably before his birth) that the misery and short lives of his distant posterity should "consume his eyes and grieve his heart." On the contrary, Abraham and Isaac had been promised not only "to thy seed will I give this land," but to "thee and thy seed after thee," though in that life, under those names, they possessed none of it but a purchased burial plot. Each and his seed were yet to enjoy it together. Accordingly, Christ told the Sadducees that, at the time of His own birth, Abraham had been among them. "Your father Abraham longed to see my day, and he saw it and was glad." They were promised too, ages after David's time, that they should be gathered with David their king, "whom I will raise up to them." And Christ promised His apostles that they should sit on twelve thrones; which for aught we know they have. Such kings as our Alfred and St. Louis may have been of them.

Though it was predicted to Noah, "Whoso sheddeth man's blood, by man shall his blood be shed," the two most treacherous murderers in the very same book, Simeon and Leir, died peaceably, one at a greater age (Ex. vi. 16) than any Jew recorded since, or any Gentile, till old Parr and older Jenkins; as if to hammer into the brains of us European minority (for the Asiatic majority have always held it) that the threat need not be realised in the same life and death, for bloodshedders (and others) may have more than are dreamt of in our philosophy.

The people under Moses were so repeatedly reminded by him that they were fewer than any single nation of the seven they were to conquer, that the language of Canaan must have soon become the only one of all that were not grown up at the Exodus. Four centuries later, when Samuel wrote the Heptateuch, there was not a particle more reason for Israelites to retain Egyptian words than for the Moabites or Philistines to do so.

I said, and repeat, it is not written at the end of any other life than Abraham's, that "God had blessed him in all things." One more text compared with "Memnon's" speech of Eve will dispose of his accusation that translators ever used "the Lord" to disguise a difficulty. If Eve's speech be inconsistent with aught after it, why not with ch. iv. 26. "Then began men to call upon the name of JHVH"?

Why does he not object that if men only began to use this name after Seth was 205 years old (or in our corrupt dates 105), and Seth had not been born till Cain was grown up, and a murderer, Cain's mother could not have used it at his birth. Translators had but to leave "Jehovah" in one of these verses, no matter which; but by putting "the Lord" in both alike, they supply "Memnon" with a stiffer contradiction than he thinks he gets out of Exodus. The later neither says nor implies that the name *began* to be used only then. I said that anyone believing this (Moses, or any later), would still have applied it to God in translating the oldest documents. But there is no sign that this was ever believed by any. The Lord merely told Moses (Ex. vi. 3) that to three particular forefathers, He had not been known by this name; but the previous oracle (iii. 15) rather implies that to others He had been. "This is My name for ever, and this is My memorial to all generations," rather looks as if even antediluvians had known at least its meaning. All the Genesis names, we must note, by having meanings in Canaanite, show that they were translated into that from older tongues, not merely transliterated by sound, as they are into English. We might have had them Englished, as Hanahash, the liar who deceived Eve, and was doomed to become "the crawler," has been made for us a "serpent"; though a king of Ammon with the same name is not called so.

If there were fifty more Egypts on earth, all with histories going back before Menes, and all consistent, and every other Gentile legend not only ignored the Flood (which they all remember), but contradicted it, and pointed to monuments alleged older (as Lyell's invention of the cinder cones, that the "Speaker's Commentary" swallowed without inquiry), the facts of geology would outweigh all that as feathers. Even those certain 40 years ago sufficed. What are "great Egyptologists" to what is stamped physically on the globe? What "Memnon" can or can't "imagine" has even less to do with it. God's universe contains several more things than "Memnon" has imagined.

Joshua, according to the text, never spoke to either "the sun" or "the moon," but only to a "sun of Gibeon" and "moon of Ajalon Valley." And if "the sun stood still in the midst of heaven," no such thing had been predicted. Why could he not have said, Sun in heaven, stay; instead of "Sun of Gibeon, be silent"?

It is a small point, but "Ramases," "Dens," and "Memnon" all will have Samuel the "high priest"; I. Samuel i. shows he was of the tribe of Ephraim, and therefore could never be a priest; though as a prophet he had higher privileges. He could build altars and offer sacrifice anywhere; which no priest could do away from the sanctuary, and one who was neither a priest nor prophet, even if king, could do nowhere. Samuel's anti-royalist politics were nowise inconsistent with his editing the old prophecies about kingship. He believed himself ordered by God to accede to the popular clamour; and for aught that appears, he was the sole dissentient. I prefer Sir Isaac Newton (to whom I am indebted for all these views except Jacob Bryant's explanation of Joshua), who found no inconsistency here, to "Memnon" after all. **E. L. G.**

[26574.]—"MEMNON," in his reply (26526), says "'Dens' would find it hard to prove that Samuel wrote Deuteronomy." In that he is quite right; but as I never said so in my letter (26514), of course I do not need to prove it. If "Memnon" will refer back, he will see that I mentioned Samuel as the arranger of the Pentateuch, and that the whole possibility of his reformation depended upon its being in existence as the basis upon which he had to work. But as in this discussion the original information asked for has been overlooked—viz., as to who was the Pharaoh of the Exodus—the general opinion of authorities seems to be that it was Thotmes II. of Manetho's eighteenth dynasty, and Joseph's Pharaoh was Osirtasen I. of the Tanite (Zoan) dynasty, also styled the "Beloved of Set," "Set the Golden" being the Baal or sun-god of the Phœnician branch of the Shepherd kings; and when Aahmes, the king who knew not Joseph, drove out the Hyksos he captured Tanis or Anaris, their capital city, made it his principal residence, as did also his successors —hence the ease with which Moses and Aaron (living in Goschen) could have an interview with the king.

In the able letter of "E. L. G." (26527), he says of the hailstorm that it took place in the night. Well, it may be so; but if "E. L. G." will look at the 26th verse, he will find it says that Joshua hanged the kings upon trees *till the evening*, and in verse 27 it says, "And it came to pass at the time of the *going down of the sun* Joshua commanded and they took them down off the trees." As the hailstorm had done its work before this time, I don't see how it could have been in the night. **Dens.**

[26575.]—WITH regard to "E. L. G.'s" idea (26527) that no place now above sea-level has ever been submerged, and that the English and Irish Channels, much of the Mediterranean, &c., have become sea-beds, "not by sinking, but by the addition of so much water to our globe as to raise the ocean level about 100 fathoms," I would simply advise him to calculate the quantity of water necessary to raise the ocean level this height (even supposing it possible), and then ask himself where the water came from?

"E. L. G." also tells us that he now thinks "all our strata kept their form unmoved." There can be no doubt in any reasoning mind that the stratified rocks were deposited under water; if this is not sufficiently proved by their construction, it is by the existence of marine shells. The strata would therefore be horizontal when deposited, but now it is in many places folded into huge ridges and valleys, while marine fossils are carried in these upheavals and contortions to all habitable heights, and have been found in the Himalaya Mountains at 18,000ft. above sea-level. And in a lesser degree, if "E. L. G." would only take the trouble to notice cliffs and escarpments, or even railway cuttings, he could see that his statement of the strata being originally deposited in their present positions is erroneous.

If there are no traces of aqueous action in the "hills under the whole heaven" more than may be attributed to the "actual downpour" of the rain, I would ask "E. L. G." how the fossils of marine organisms came to be imbedded in the stratified rocks, or how the pebbles obtained their rounded form.

"E. L. G.'s" quotation from Darwin, which he says, "Poor Darwin, the most famed—Evolution Darwin—contrived so well to forget," does not in any way justify the sneer implied, for there is not a word in it that is anywhere in Darwin's works recanted. Darwin is not alone responsible for the statement to which "E. L. G." objects, for it is a well-understood geological fact that there have been in the long history of the world wide and repeated exterminations of its inhabitants. There is, however, a vast difference between wide and total extinctions, and the very widest extermination as yet suggested would not necessarily have any material effect upon the evolution of species. **Silex Seadrift.**

[26576.]—I AM really sorry for "E. L. G.'s" position about the Flood. His former position, from which he was routed by Prof. Challis, was at least an intelligible and consistent one. On the one side was the Bible with its clear assertion that the Flood covered the whole earth; on the other science, with its equally clear assertion that no such flood could have occurred by natural means, and that all the evidence available is dead against any such Flood having ever occurred. I can understand and sympathise to some extent with those who give up common sense and accept the miracle. I heard a remarkable sermon on the subject by Müller, the founder of the great orphanages at Bristol. He insisted on the absolutely literal interpretation of the words of Genesis, and threatened unbelievers with various pains. He was perfectly logical—the Bible said so—and, therefore, it was true.

But "E. L. G." now gives up both the Bible and common sense. The Bible, because I defy any candid person to read that chapter and infer from the words of the text that the author meant his readers to believe that the hills were not covered by the flood, but by torrents. If he did mean that, all I can say is he expresses himself so badly that I should hesitate to accept his account of any occurrence whatever. The world, anyway, for 3,000 years has taken the passage the other way.

But "E. L. G." gives up common sense and science as well, for I challenge him to find a single geologist of established position who will date the birth of Mount Ararat from the time of this flood.

I cannot see the good of these attempts to twist the words of the Bible and twist science till they fit in a wholly distorted state. In the long run I am quite sure they do more harm than good to the cause they are intended to advance, for they make men treat the more important parts of the Bible with the same carelessness. Why not accept the fact that these old legends are the ones which Moses (if "E. L. G." likes) found preserved amongst his people and accepted? We know that the story of Chedorlaomer in the 14th chapter is such an old legend. **F. G. S.**

[26577.]—"MEMNON" (26526) says:—"I have asked 'Ramases' for particulars often, and do not get them." This is unfair. "Memnon" asked for particulars of Gesenius's opinion, and he got them. In the connection now referred to regarding the two writers (so-called) of Genesis, I gave my authority, and where to be found. If the ENGLISH MECHANIC will print the particulars in full from the "Speaker's Commentary," I will send them.

"Memnon" ought to have known that the apparent motion of the moon, equally with the sun, is due to the rotation of the earth. So this point tells in favour of the Bible record; and as to its using the language of appearance, so also does the *Nautical Almanac*. Again, "Memnon" considers the miracle as "singularly improbable," since it had the extermination of the Canaanites in view. The very opposite is the case, because it is alleged that the same God, who is the Author of that law which in Nature exterminates the unfit, gave the command to exterminate these very unfit and corrupted nations. And had Israel been obedient, they would have been able to have completed the extermination, and the world to-day would have been better on that account.

Nov. 26th. **Ramases.**

[26578.]—I AM afraid "Ramases" and I can never agree either as to facts or theories. He insists (26528) on supposing all the great Egyptologists rely absolutely on Manetho, which is a perfect delusion on his part. Manetho's lists are useful, and must be considered by all Egyptologists, but are only to be absolutely relied on when corroborated as they have been largely by the monuments. Is it possible "Ramases" thinks that Mariette absolutely relies on Manetho? If he does, he can believe anything. Everyone knows that in Rameses II.'s time the name of Menes heads the lists of kings on a public monument. The Turin papyrus of the same age is a valuable historical document, and as a matter of fact all the

eminent Egyptologists believe in the great age of Egyptian civilisation. As this great age is considered to clash with Genesis, all proofs go for nothing to thousands of small people, who can see nothing when it interferes with their theories.

I do not rely on Menes or any particular king. I rely on the well-founded knowledge of the extreme antiquity and peculiar character of the civilisation of Egypt.

Certainly, the early king (probably Menes) who turned the course of the Nile at Memphis to protect his capital must have had many subjects and many enemies—so could not be Noah, or any of his immediate descendants. From the time of Moses (Maneptha) to the expulsion of the Shepherds can hardly be asserted even by "Ramases" to be less than 200 years (it probably was much more); to this add 500 for the time of the Shepherds, that leaves about 160 years for the fourteen previous dynasties reaching to Noah, during which many of the most wonderful works in Egypt were produced, many of them early in that time, yet, according to "Ramases," at the end of the 160 years we come upon Noah and Shem, Ham, and Japhet, with a boatful of animals.

"Ramases" may object to the 500 years, as he objects to everything not telling on his side, though all the best authorities accept it. Still, as clericals cut it down I suppose I may as well do so, just to show it will do "Ramases" really no good. So let us divide it in two, so as to make the period from Noah and his Ark to the arrival of the shepherds 410 years—about as much as the Jews are said to have spent in Egypt. Into this length of time, according to "Ramases" I suppose, we must crowd, the Great Pyramids, and about 70 others, the Tomb of Ti, the Great Sphinx, the Labyrinth, the Great Dyke at Memphis, Lake Moeris, the obelisk at On, the Proto-doric tombs at Beni Hassan, the marvellous statue of the School Master, the statue of Chephron, &c. The idea is so ludicrously absurd that none but a thick-and-thin theologian could imagine it.

At what rate could the population have increased in the first years of that time, and why should Egypt have at once such a peculiar style of art-religion and written language? I fully agree that art and science produced these masterpieces in rapid succession very generally, but must point out that we find such flowering always preceded by a long slow period of dull preparation. In Egypt this early period can hardly be seen, it is so far off, but all analogy requires us to admit it; indeed, the peculiar character of the art, as distinguished from Assyrian, Hindoo, Chinese, &c., necessarily obliges us to consider it took a long time to attain such a character. Your London readers can see a specimen of the early style in the far end of the large Egyptian room in the British Museum, where two complete fronts of tombs of the time of the Pyramids are on view. Our notion of evolution in anything requires long periods before marked outbursts, and all evolution theories require all notions of a flood 4,000 years ago to be discarded, so Darwin's views won't help "Ramases," and he certainly did not share "Ramases'" views. Neither will Champollion's date of 2200 B.C. for the oldest existing Egyptian monument prove useful to him, as that date only leaves 147 years to Noah and his Ark—a ridiculously short time—especially when we remember that no record exists of the making of such a big thing as the Sphinx—it was mended in the time of Chepron. Who made it, or when it was made, no one knows—it was certainly not later than the Pyramids. But since Champollion's time immense strides have been made in Egyptology, and all in the direction of lengthening the monarchy.

To show that all orthodox people don't share "Ramases'" views, let me refer to a lecture delivered by the late Sir Erasmus Wilson, vice-president of the Biblical Archæological Society, and president of the Egyptian Exploration Fund, to the Young Men's Christian Association at Margate in 1883, published by Kegan Paul and Trench, on "The Recent Discovery of Ancient Egyptian Mummies," in which he says: "Now, the first Pharaoh of Egypt, King Mena, lived nearly 6,000 years ago—4,000 years before the birth of our Lord Jesus Christ."

That the writer of Genesis was not aware of this, or of the history of ancient Egypt is clear, so that if Moses was learned in their learning, he could not have placed Noah and his Ark where it is placed in Genesis; therefore, I consider I have clearly established that point.

The question of language I think I have also made clear—namely, that the ancient Jews could not have written and spoken Egyptian for either 250 or 400 years without its leaving deeper marks on their language than exist. Also that the ignorance of immortality displayed is decidedly anti-Egyptian. Also that the book Genesis is largely written by one person, who said that at an early date—the time of Enos (Gen. iv. 26)—"then began men to call upon the name of Jehovah." While another part of the same book is written by another person, who also writes in Exodus, and states that the name Jehovah was not known till God told it to Moses. It is impossible to suppose we have perfectly reliable or contemporary documents or writings by any one man, though they appear to have been edited by Ezra, or somebody about his time. What they were originally we cannot know with certainty, so that the clash of dates and the flourishing of marvellous miracles in extreme antiquity go for very little. Indeed, the date 400 or 430 is probably a simple round number, adding an 0 to the favourite number of 40; or is a reminiscence of the 511 years of the Shepherds in Egypt, or of a part of it.

"Ramases" complains of my saying "I suppose," &c., about Deuteronomy; but really it is impossible for me to enter fully into every point raised, and I wish to use the mildest language possible. In such short letters as I can write I cannot attempt to prove everything. I only referred incidentally to its *very* late date. All I need prove is that it was not written by Moses, and that I think I did. Anyone who reads it without prejudice must see that it cannot have been written throughout by Moses, either as to the beginning or end, while its matter also proves it. It is quite clear that the passage as to the death of Moses was not written by one of Moses' scribes, as asserted by "Ramases," as a long period after his time is implied necessarily by the words, "And there rose not a prophet since in Israel like unto Moses." "Ramases" has met all my definite statements on this point by *unproved denials and assertions*, all of which are against the facts.

"E. L. G." is an astonishing writer, and I hope "Dens" will answer his oddities. He actually says of the Flood, "We have no warranty, I now think, for supposing any submergence of places now above sea-level." Does he not consider the remarkably plain words of Gen. vii. 19 warranty enough when it says: "And the waters prevailed exceedingly upon the earth, and *all* the *high hills* under the *whole* heavens were covered"? If this full and clear statement is not a warranty for the assertion, why should I, or any one else, rely on either or both of the conflicting dates of the time Israel was in Egypt or the date of the Flood, or any other particular?

That the present arrangement of continents, islands, and sea level was not made by the addition of water is shown by the fact that the dove could find no rest for her feet (Gen. viii.), though when she was sent out was long after the forty days rain, when Noah thought he could come out soon. Also in verse 11, where it is asserted that "the waters were abated from off the earth," clearly, they were supposed to have gone somewhere. Where did they go to? "E. L. G." says "Nowhere—they remained"; but this is flatly against the text, as is also his other extraordinary assertion that there was no time when "our hills were covered with standing water."

"E. L. G.'s" opinion on texts is so interesting that I am anxious to know why, if miraculous hail showers, &c., were so common, that they were not more efficacious? The curious reason given for Judah's failure has nothing to do with faith or morality, but is simply ascribed (Judges i. 19) to the fact that he "could not drive out the inhabitants of the valley because they had chariots of iron." The rest of the chapter shows many other failures. Why did not the hail affect the horses of the chariots, and the men also?

His arguments from Darwin are quite comic. Darwin, who knew all that was known, when in his prime, had not an atom of belief in a universal flood 4,000 years ago, and yet is now considered to be one of the very greatest men of the 19th century.

The disappearance of the horse from America required no universal flood, and is a fact well known to all palæontologists; but what about the presence of animals peculiar to America—such as the sloth, tapir, llama, pecari, jaguar, condor, &c.? These are not found elsewhere, so I suppose Noah sent them in a supplemental Ark to America, where also we find the fossils of their particular ancestors.

Prof. Agassiz says: "Ever since New Holland was discovered it has been known as the land of Zoological marvels—all its animals differ so completely from those of other parts of our globe that it may be said to constitute a world in itself, as isolated in that respect from the other Continents as it truly is in its physical relations.

In Australia fossil and living kangaroos occur, and various other sets of peculiar animals. Did Noah send an Ark there?

Prof. Owen says, in "British Fossil Mammalia," speaking of South America: "Most of the fossil mammalia from these formations are as distinct from the European-Asiatic forms as they are closely allied to the peculiarly South American existing genera of mammalia."

This would not be so if a universal flood occurred about 4,000 years ago; yet Genesis says, "All flesh died," which I respectfully deny, and maintain that the facts of history, geology, and palæontology all go to prove that no recommencement of human, animal, or vegetable life dates from that time. Can "E. L. G." find any eminent naturalist or scientist who denies what I say? Huxley, our most eminent naturalist, I know, thinks as I do.

I recommend "E. L. G." to admit it is possible that other things may be true besides those enshrined in his philosophy, which, though I must suppose he is old, has a very juvenile flavour. It seems to consist largely in arranging the facts or statements as he pleases, and vigorously asserting that expresses the true meaning of the text, while "Ramases," working with caution, asks his opponents to prove to his judgment every minute point, never thinks it has been done, and eagerly accepts everything apparently telling on his own side.

These gentlemen start with a false assumption; namely, that everything is really true in Genesis, Exodus, &c., so must make them square with what else is proved, or deny what contradicts them. For, at least, the present, I must bid them good-bye.

Memnon.

[This must end the discussion.—ED.]

IS VIOLET A PRIMARY COLOUR?

[26579.]—THE question raised in the first paragraph of Mr. Hardie's letter (26452) will bear only one interpretation. It clearly implies a belief that, if the violet of the spectrum is a secondary colour, it can be decomposed by the prism into its blue and red constituents. No one having a clear conception of Young's theory of colour-vision would have raised such a question; and not until I had carefully re-read the passage did I feel satisfied that I had not misunderstood it.

Mr. Hardie professes to doubt that continued exposure of the eye to any one colour tires the colour nerves, and so renders them temporarily less sensitive to that colour. There is no lack of evidence to support the belief. If a piece of stained glass be held for a minute or two before one eye, it will be noticed that the intensity of the colour gradually diminishes, and if the glass be then transferred to the other eye, there will be no further room for doubt that the eye before which the glass was first held has lost its power to perceive the full depth and richness of the colour. The proof obtained by placing a small square of black paper on a white or coloured ground, gazing at it for some time, and then removing it, is too well-known to require a detailed description.

Let the possibility of fatiguing the colour nerves be once securely established, then the changes of tint, observable in all secondary colours when the eye has been rendered partially insensitive to one or other of their components, follow, as a necessary consequence, from Young's theory, and furnish the best possible proofs of the truth of that theory. But if Mr. Hardie's explanation of the changes of tint is correct, then the two following conclusions are unavoidable:—First, that all colours, primaries or secondaries, can, with equal readiness, be altered in tint; secondly, that no colour can be modified in exactly the same way by exposing the eye to either of two such different colours as red and green, or blue and green. Neither of these conclusions can be established by an appeal to facts. No decided change of tint can be produced in the red or blue of the spectrum, though their intensity may be much reduced. The green appears slightly bluer when the eye has been exposed to red light, and a little more yellow after exposure of the eye to blue light, which is just what Young's theory would lead us to expect, since green is supposed to affect both the red and blue, or violet (?) nerves to a moderate extent, as well as its own special set of nerves. The modifications, however, which can be effected in the secondary colours of the spectrum are most striking. The boundary between blue and green, which ordinarily appears nearly coincident with the dark line F of the solar spectrum, will seem to have been shifted to a position midway between lines E and F—that is, much nearer the red end of the spectrum, after the eye has been fatigued by long gazing through green glass. When the eye has, by similar means, been rendered partially insensitive to blue, the opposite effect is produced, and green then appears on both sides of line F. Again, long exposure of the eye to light passing through red glass causes the green of the spectrum to extend quite up to the sodium line, and yellow is found on the red side of that line. I need not again describe the changes of tint produced in the violet of the spectrum by similar means.

The second conclusion which ought to follow from Mr. Hardie's explanation of these facts is refuted by the additional fact that exposure of the eye to red light produces exactly the same change in the blue-greens of the spectrum as that produced by exposing the eye to green light. This also is quite in accordance with Young's theory, according to which the red rays excite the red nerves powerfully, the green nerves moderately, and the third set only slightly. Therefore long gazing through ruby-stained glass, which transmits no green or yellow rays, and not much orange, will fatigue the green nerves to some extent as well as the red, but can have little or no effect on the blue nerves. In like manner, gazing through violet-blue glass,

which transmits no green rays, fatigues the green nerves sufficiently to cause the green yellow of the spectrum to look more yellow, and the yellow slightly more orange. Again, using a common prism, it will be observed that, after prolonged exposure of the eye to green light, the violet seen through the prism will appear bluer. This effect is doubtless due to fatigue of the red nerves of the eye; but since I was unable to find for this experiment a green glass which entirely cuts off the red rays, it would be too hasty to assume that the fatigue of the red nerves was principally due to the action of the green light. But, whatever the cause, there is no doubt about the effect, which is the direct reverse of that which Mr. Hardie's hypothesis requires. The complementary to green being rose-purple, the violet ought to have looked much redder.

In the face of these facts it would be useles to discuss at length Mr. Hardie's experiments; but a few brief remarks upon them will not be out of place. Granted the visibility of coloured ghosts on a black background, then they should be just as plainly visible with closed eyes, if daylight has nothing to do with the continuance of the impressions on the retina, as Mr. Hardie insists. Now, three or four seconds' gazing at small bits of bright-coloured paper suffices to render coloured impressions distinctly visible on a white ground; but a much longer interval is insufficient to form an impression which will remain visible after the eyes are closed. Likewise, if green glass be held before the eyes for half a minute or more, as soon as it is removed the light from the sky appears strongly tinged with a rose colour; but if the eyes be closed and covered by the hand, the rose colour is not seen.

Several of the effects described by Mr. Hardie must be in great measure, if not entirely, due to contrast. At all events, the bare possibility of such being the case suffices to render the experiments inconclusive. Whoever doubts the influence of contrast in such cases should place a small square of darkish grey paper on a coloured ground, and cover the whole with tissue paper. The bit of grey paper immediately appears strongly tinted with the colour which is complementary to that of the ground upon which it lies. The effect of contrast is also admirably illustrated by shadows falling upon a white ground which is illuminated by sunlight shining through stained glass; and another beautiful illustration is furnished by the purple patches often seen on a bright green sea. The purple patches are the shadows of small detached clouds, and owe their colour entirely to contrast with the surrounding green.

Before closing this letter I must refer to an experiment described in my last, having modified it in a manner which throws additional light upon the result. I pointed out that staring at a small piece of violet paper will cause a green ghost to be visible on a blue ground; a fact which, accepting the usual explanation, appears at first sight to countenance the hypothesis that blue is a secondary colour composed of green and violet. Believing this green ghost to be due to the reflection of white light from the surface of the blue ground, I screened off all direct daylight from the blue paper by placing it within the shadow of a piece of deep blue glass. This does not interfere with the blueness of the ground, but, on the contrary, greatly improves it. The ghost, however, seen upon this ground no longer appeared green, but became so as soon as the blue glass was removed. This result brings the experiment into harmony with the evidence obtained from the blue of the spectrum.

I certainly made no "unconscious slip" in my suggested explanation of the violet ghost seen on a blue ground after staring at green, and I have nothing to retract from that explanation. Since I attribute the violet ghost to the presence of white light and to fatigue of the colour nerves (both of which causes Mr. Hardie repudiates), what ground has he for saying that I explain the ghost in his way?

It is not my intention to continue this controversy; this letter will therefore be my last contribution on the subject.*

Nov. 10th. **F. W. Reynolds, B.A.**

[*And the last we can admit.—ED.]

HOW A BOY MAY RAISE A SOLID TON WEIGHT WITHOUT MACHINERY.

[26580.]—IT is surprising how this question can be made a subject of controversy and denial. It is a well-known fact that the native Hindoos raise heavy logs by numerous ropes hauled taut from the elastic branches of trees above them, the operation being repeated seriatim till the desired height is attained. I have on more than one occasion seen a stone raised off the ground by a spider, the stone weighing, perhaps, a hundred times more than the insect; this was accomplished without intention, as the tie from the lower framework of the web was first attached to the stone, and every night on repairing the web the spider added another strand to the tie, and hauled it taut, till at last the stone was lifted.

Some years ago one of our indiarubber companies (I forget which) advertised and sold what they termed "accumulators," consisting of an elastic cord, with a loop or eye at each end. By attaching a number of these to the body to be raised or otherwise moved, and hauling them in succession, and fixing them at the available stretch, any desired power may be obtained, according to the number used. On a smaller scale these appliances are sold by most ironmongers for door-springs. **F. H. Wenham.**

HEATING WATER RAPIDLY.

[26581.]—THERE exists an apparatus capable, as is asserted for it, of heating by gas 36 klgs. (83·61b.) of water, for bathing purposes, from 12·7 deg. C. to 35 deg. C. (55 deg. F. to 95 deg. F.) in *one minute*, or a full bath of 35 gallons of water in about five minutes. The consumption of gas is about 0·533 klgs. (1·167lb. or 26 cub. feet) for the 35 gal., or 160 klgs. of water, so heated.

The calorific effect is, therefore, 160 klgs. of water raised 22·3 deg. C. with 0·533 klgs. of gas. Assuming gas to develop about the same number of calories as coal, weight by weight, the *useful effect* is, in this case—

$160 \times 22{\cdot}3 \times 425 = 1{,}516{,}400$ kilogramme meter

and—

$0{\cdot}533 \times 7{,}000 \times 425 = 1{,}585{,}675$ „ „

or ·956 of the *theoretic heat value* of the gas.

Marienberg.

THE "STRONGEST MOTIVE" IN OBEDIENCE.

[26582.]—HAS your correspondent, Wm. John Grey, F.C.S. (29288, p. 86), ever asked himself what he means by the "strongest motive" in obedience to which he takes it as axiomatic that a man always acts? What test does he propose of strength? That the motive in question gets the better of the other motives which compete with it? But, surely, that only amounts to saying that the prevailing motive is that which prevails—a truism which "Garrison Gunner" will scarcely concern himself, I imagine, either to assert or deny.

I can conceive of no other test of the *strength* of a motive unless it be the extent to which it affects or disturbs the nervous system; but if the strongest motive equals the motive which most strongly affects our nerves and brain, we certainly do not always obey it—e.g., a man will stand fire, though he is trembling all over with fear. Here the desire to run away affects him most strongly, yet his habit of courage will prevail over it.

May I add that if "motive" means the desire of whatever kind which I adopt as my good for time being and principle of my action, then "motives" as such never compete? Desires *may* compete, but all competition is over and selection made before one in particular becomes the *motive*.

Lastly, I think Mr. Grey should class along with inherited constitution and training not merely the agent's environment at the instant of action, but the agent's *view* of that environment, the environment as focussed in his self-consciousness. Except so far as the agent takes into consideration some of his circumstances more than others, environment has little to do with his action. I think the problem of free will is more complicated than Mr. Grey suspects. **F. C. Conybeare.**

RANGE OF BAROMETER.

[26583.]—WILL some of the many scientific readers of the ENGLISH MECHANIC give me the ordinary rise and fall of the mercury column, or the sweep of the index-hand of an aneroid barometer? I am told that in England the column varies several inches during the course of an unsettled spell of weather.

Here, in California, I have never seen the hand of my own, or any other aneroid barometer fall lower than 29·65, or rise higher than 30·25, and these extremes would indicate very fine weather or an unusual storm.

This query may prove interesting to many, if your many subscribers in all parts of the world will give it their attention.

I should also like to ask some of your astronomical correspondents a question. I know "A Fellow of the Royal Astronomical Society" will help me out, for he is as a beacon light to the benighted amateur. If an observer at the earth's Equator in a perfectly clear atmosphere should look for a star to rise in the east, he would see the star by refraction before it was actually above the horizon, and when setting he could still observe the star after (theoretically) it had set, thereby he would be enabled to see the star over twelve hours.

Now, then, suppose another observer at the exact opposite point of the earth's surface were to be watching the same star, he would, in practice, see the same star at the same time; while, in theory, one should lose sight of it just as it rose to the other—in fact, each would be able to see it over twelve hours. I know this is a simple, and, perhaps, foolish question, but the answers may be interesting.

Again, any object—say, a building—at the North or South Pole would turn once upon its axis every twenty-four hours, while a building at the Equator would not. The first would have the motion of the hub of a wheel, while the other would have the motion of the spoke. Will someone tell me at just what latitude both buildings would have the same amount of axial motion, and what that motion would be?

M. C. B., San Francisco, Cal. U.S.A.

CUTTER-BAR.

[26584.]—I HAVE for twenty years had your magazine, and have received many a good wrinkle through its Query and Answer to Queries Columns. But I have one good thing I would like to communicate for the benefit of your readers and for the encouragement of "J. L."

In looking over the number for March 26th, 1880, I found a sketch of Haydon's cutter-bar, and further on there was a correspondence, one of those correspondents being "D. H. G.," this gentleman asserting that he had banished every solid tool from his bench for 10 years; he also very truly styled this bar his slave-of-all-work. At this time I was seeking some easier method of grinding turning tools, and lo! here to my hands, in a forgotten mine of turning lore, is the very thing. Being an adept at the anvil of 32 years' experience, I quickly forged a bar and sling out of shear steel, the shank of bar $\frac{11}{16}$ths square, the sling and screw of proportionate strength. I broke some old square files $\frac{3}{8}$in. thick into pieces $3\frac{1}{4}$in. long, and ground the faces to have 5° clearance, and the top face to 55° with the two front faces. I have also tried round cutters; but hexagon is the form that comes nearest to 120° front angle.

The result is a great surprise to me. I have cut out square corners right and left, cut V-threads right up to a deep shoulder; can do any surface work;—in fact, there is no outside piece of turning but for which a cutter is most readily fashioned at a trifling cost. I would suggest to you, Mr. Editor, the desirability of giving another sketch of "Haydon's Cutter-Bar" from the hands of our old friend.

I am purposing to buy Mushet's steel to make the cutters from, and would thank any fellow reader to record his experience of its cutting power.

Evod.

RHEA FIBRE.

[26585.]—I NOTICED in your issue of, I think, the 12th ult., a remark relative to the fibre of the Urtica nivea (Ramie or China grass). You appear to think that this fibre could not be compared to flax either for strength, durability, or cheapness. For the benefit of the readers of your journal, I would call your attention to the fact that for many years the Government of India have had before them statistics concerning the value of this fibre, and offered £5,000 for the best method of treatment on account of its wonderful properties, being the strongest, longest, and lightest fibre known. It will work up to compare with silk, and for coarser fabrics is of more value than flax, as, for instance, I had two lengths of hose constructed on the same principle and the same counts of threads; on testing, the Ramie hose stood a test of over 600lb. to the square inch, a pressure of about double that of the flax. A machine-belt of the Ramie fibre was tested to a strain of over 3,900lb. per square inch, against 2,100lb. for leather belting.

The fibre is used largely in France instead of silk, as it is capable of receiving a fine gloss which makes it almost impossible to tell it from silk. A company was formed some nine months since to work this fibre in England, and have erected works near Old Ford, where they are preparing the fibre for spinning.

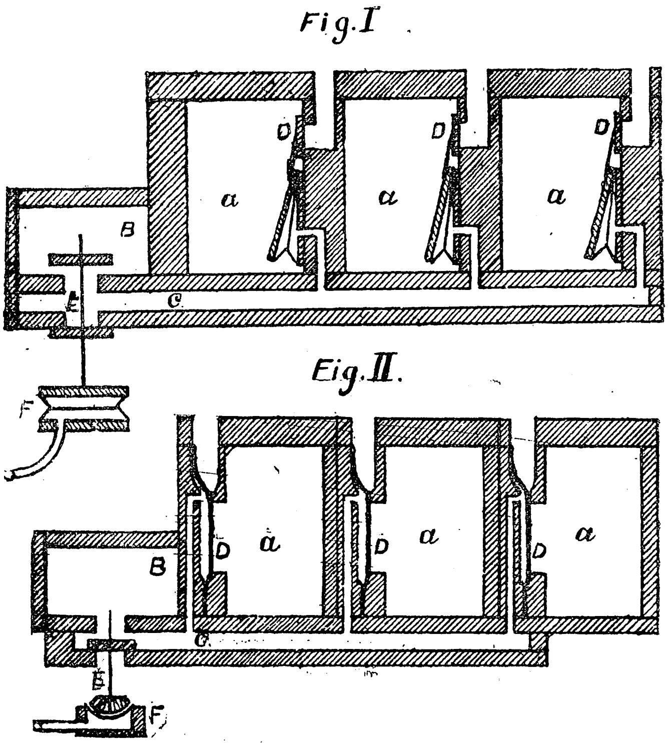
At the late Colonial and Indian Exhibition the Glenrock Company (Limited) were requested by the India Office to exhibit products from the fibre which is being cultivated to a large extent on their Indian estates, and the samples shown were greatly admired by all experts.

Dec. 4. **Urtica.**

ORGAN WINDCHESTS.

[26586.]—AS Mr. Audsley has been writing about Mr. Roosevelt's patent windchest, I beg to say that there is another pneumatic windchest, simpler than Mr. Roosevelt's, and, I think, in several parts better. I give the two sketches to show the difference.

No. 1 is Mr. Roosevelt's patent, and No. 2 is Mr. Drechsler's patent (Askew-crescent, Uxbridge-road, W.) Both have the same principle, only Mr. Drechsler has done away with those little bellows (wanted one to each pipe), and is using a piece of leather for the pipe valve. Mr. Roosevelt has the higher pressure of wind permanent in those little



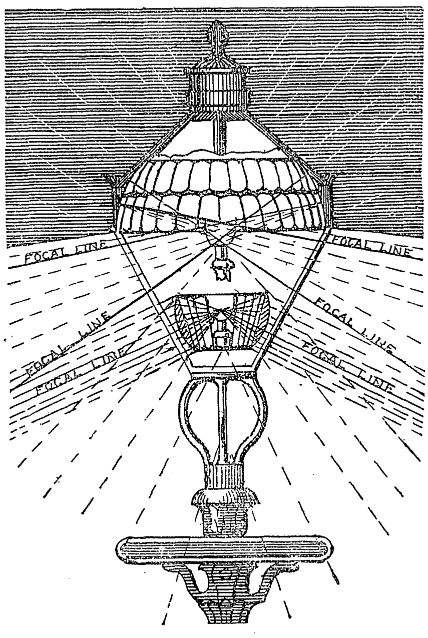
bellows F, Fig. 1, and in all tubes, running from the keys to the windchest, while in Mr. Drechsler's the wind is only required when touching the keys. This system prevents a good deal of leakage. Box B, Fig. 1, contains wind of a higher pressure than the pipes are wanting, and keeps through C the pneumatic bellows open, the pipe valves D closed. By exhausting the high pressure through C E by touching the key, the pipe wind in A presses the bellows together and opens the pallet D. In Fig. 2 the higher pressure in B keeps the leather valve against D, and when exhausting through C E the pipe wind in A forces the leather to the left and enters the pipe. This system seems to me very simple and good, is not liable to go out of order at all, and the use of action wind is not worth mentioning. I should advise "C. H. D." and "W. H. H.," before doing anything else, to see Mr. Drechsler's windchest and action. It is the quietest and quickest action I ever have seen in tubular pneumatics. **N. H.**

STREET LIGHTING.

[26587.]—To increase the lighting power of street lamps by means of refraction and reflection has more or less occupied our mind for some time past. We commenced our experiments with the "druggist's bottle"—placed six lights around a globe of glass filled with water, refracting the rays from the one light through that of the opposite one, which gave off right and left a powerful refractive light. Were the globe totally surrounded with jets of gas, we would have a ball giving off refraction light (at a certain angle below the horizontal axis of the ball) all round the horizon. We adjusted the ball by means of a cupped elongated nut, by this means placing the horizontal axis more or less below the white of the flame, thereby altering the rays deflected downwards. We consider, however, that the druggist's bottle, even although carried out with a ball of solid glass, must be rejected for street lamps.

Our next step consisted in placing two convex lenses closely together at the bottom, and inclining the convex surfaces downwards, one jet being placed before each convex surface; the rays were refracted through the convex surface, caught up by the other lens, and refracted down at a certain angle, or, in other words, the rays from the one light are refracted through that of the other light, or vice versâ. The lenses should be 6in. diameter and upwards, and for narrow streets they throw beams of soft light right and left along the pavement; the lamp must be perfectly air-tight, with wire gauze at the bottom and ventilator at the top, so as to burn the gas steadily in all weathers.

All-round refraction now claims our attention: this is effected by subdivision, as shown in the *Multum in Parvo* design for a street lamp, as per engraving, and which is delineated merely for the sake of illustration at the bottom of the lamps. It is obvious that the light of itself is not visible to the eye; but the focal centre of the lenses being brought close together, the refraction from the one is amalgamated with that of the other, giving off a powerful all-round increase of light from a single jet of gas. We will now draw the reader's attention to the reflective system of increasing the lighting power of street lamps. The most powerful reflectors are made of concave glass, silverised, or otherwise coated to form a concave mirror, and which are greatly used in lamps on our various railway systems. A number of those mirrors may be placed around a single light, deflecting the rays downwards, or when we take an odd number of reflectors and place them around a single light, leaving open spaces opposite each reflector, beams of light will be cast all round the horizon in rays according to the number of reflectors used.



To obtain an all-round light as nearly as practicable recourse must be had to subdivision, thus bringing the focal centres closely together, amalgamating the reflection from the one in that of the other.

We should not advise any experimentalist to try and subdivide a concave mirror, as they must be manufactured; but by placing paper gummed on to the part we wish to reject, we retain the focal portion to experiment with. The engraving shows two rings of subdivided concave reflectors, and unlike plain mirror glass, the two rings become flooded with reflection.

For an ordinary height of lamp-post we should only use one subdivided ring; but when a central lamp is preferred to light up a large area, such as a railway station, &c., the lamps should be placed at a greater elevation, and then two rings are preferable, the focal lines adjusted to meet the requirements. Of course we have no desire to place the refraction or reflection method in a lamp, but merely do so for sake of illustrating our subject.

Portobello, N.B. **John G. Winton.**

JOY'S VALVE GEAR—GREAT EASTERN LOCOMOTIVES.

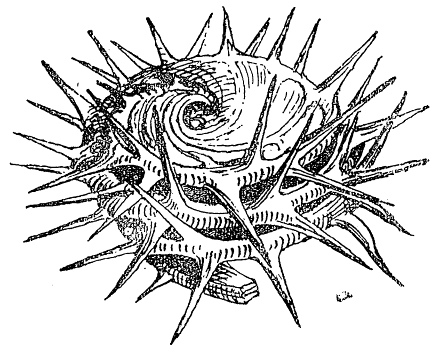
[26588.]—Joy's valve-gear, as used on the G. E. R., does not seem to have been an unqualified success. The goods engine (No. 696) fitted with it has been reported in the English Mechanic to be a failure, and recently it has been removed from one of Mr. Worsdell's four-coupled express engines (No. 562), its place being filled by the link-motion, with the valves between the cylinders instead of on the top as formerly, and a powerful spring is used to take the place of the ordinary balance weights. This engine, so altered, has been out since the middle of October, and is, I believe, considered an improvement. It would be interesting to know how the Joy valve-gear has fared on other lines.

A new type of express engine has recently come out on the G. E. R., the first of this class, No. 710 having been out about three weeks. This engine has 18in. cylinders and 7ft. four-coupled driving wheels, and was built at Stratford. The leading wheels, 4ft. diam., have outside bearings, and the valve-gear is similar to that of No. 562, except that the valves are beneath the cylinders. A noteworthy feature of this engine is the unusually large blast pipe, its diameter being 5¾in. I have not full dimensions at present. **East Anglian.**

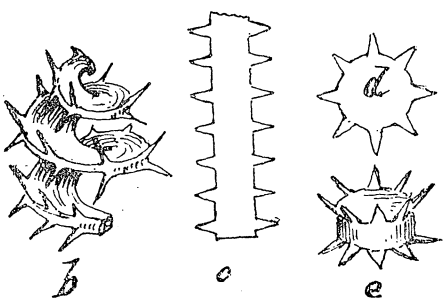
ERODIUM CYGNARUM.

[26589.]—Amongst the objects of interest imported with our fleeces of Australian wool is the seed vessel of the above plant.

It is about ¼in. in diameter, of a helicoid form, and consists of about three whorls. In the woollen manufacturing districts it is known as the "burr," and is greatly detested by all who have to deal in wool on account of the way in which it entangles the fibres of wool amongst its spines.



a.. Seed vessel. x .6.



Reference to Fig. *a* will show how troublesome a thing it can be.

Fig. *b*, drawn on a smaller scale than *a*, shows the screw-like form. On being steeped in warm water it separates into three parts—the top, bottom, and a narrow strip that forms the side.

Figs. *c*, *d*, and *e* show this; and also that each spine is composed of two halves, one attached to the top or bottom of the chamber, and the other coming away with the side-wall.

Description of model:—The plan of construction can be demonstrated by means of a paper model, thus: Cut a strip of paper about ⅛in. wide and 4in. long, with a few spine-like processes projecting from each side. Fasten the ends with strong gum, so forming a ring, and bend the spines at right angles; fasten the spines to a flat piece of paper, and cut away the surplus paper as shown at *d*. Do the same with the other side. This shows the mode of construction; but, of course, gives no idea of the beauty of the seed-vessel itself.

T. Prince.

DIATOMS—VEGETABLE OR NOT?

[26590.]—I am very much obliged for W. H. Shrubsole's kind answer (26562, p. 304) to my query. I was not surprised at the motion only of a navicula, but at its *backing out* of the "rock" and *going round*,

which seemed to display sense. I believe it is not yet definitely settled what is the source of motion of diatoms. Could Mr. Shrubsole tell me what he holds to be the best theory?

Londiniensis.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60700.]—**To Draughtsmen, &c.**—The method given on p. 306 for dividing a straight line into any number of parts is very simple; but it occurs to me that those divisions which are farthest away from E must be longer than those nearer to E. Is not this so? If so, do you know of another equally simple but more correct way of dividing? I should much like to have your method of division of circles, if you would kindly send it.—G. M. S.

[60766.]—**Wheel Tire Furnace.**—This querist should look in Vol. XXIV. pp. 275, 296, 320, 365, 414, and 437 for a great deal of information about heating and bending wheel-tires. He should also read the articles on Cart and Wheelmaking, especially one which appeared in XXXVI. p. 375. —NUN. DOR.

[60768.]—**Glass Taps.**—Small taps are made out of glass rod; but "G. W. A." can purchase them cheaply ready to attach to any tube he wants. If he must make, he must thicken up the tube at the spot wanted, and when a hole is made, grind the tap in that with the finest emery and oil, finishing with rottenstone.—SAML. RAY.

[60782.]—**The Mustel Organ.**—The querist can obtain the drawings and specifications to which he refers from MM. Mustel et Fils, Rue de Malte, 42, Paris; probably also from Messrs. Metzler, Great Marlborough-street, London, W.—ORGANON.

[60788.]—**Botany and Geology.**—Surely any one who has obtained an advanced certificate from the S. and A. Dept. in these subjects ought to know what books to study for honours. Geikie's "Geology" and Lindley's works on "Botany" ought to give all information; but, for honours, some amount of field practice is necessary.—JURASSIC.

[60795.]—**Studio.**—One should really see the place before offering an opinion; but it is safe to have glass wherever light can be obtained, and to fit every part which has any effect in lighting the sitter with blinds in working order.—COL.-CLO.

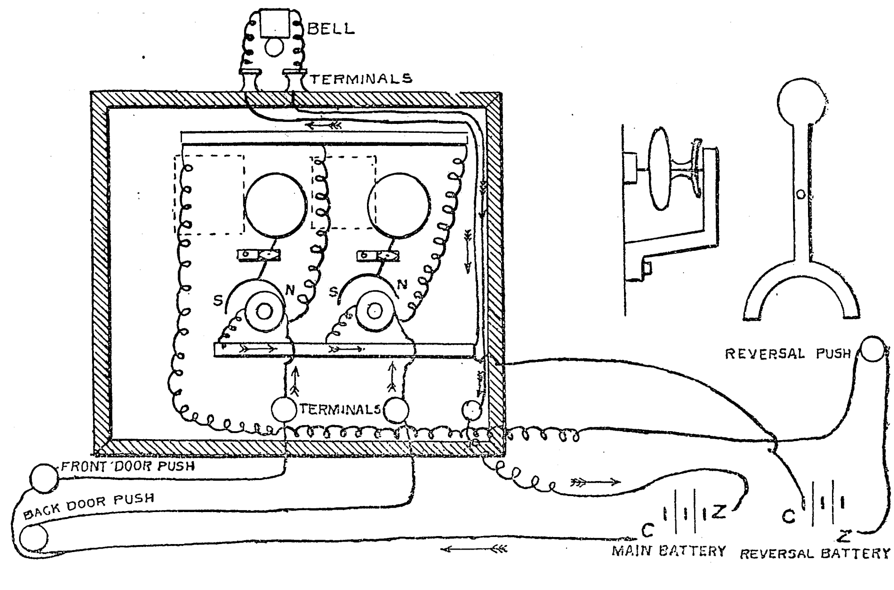
[60800.]—**Ratepayers' Association.** — The only way is to call a meeting, and if there are public grievances, no doubt a sufficient number of ratepayers will attend, and perhaps a sufficient number will subscribe to the requisite fund. The association will have no "power" at all; but it may be able to influence the whole body of ratepayers to such an extent that the local board, or the guardians, or the vestry will pay some attention to the resolutions and amendments duly passed by the association. It is "votes" only that the members of these bodies care about. A change of men is desirable, and an association can often effect that when good reason is shown.—THE BEADLE.

[60807.]—**Mersey and Severn Tunnels.**—The top of the Severn tunnel is about 145ft. under the level of high-water spring-tide, and about 50ft. under the bed of the river at the deepest point. I have not any figures of the Mersey tunnel; but they might be found in any of the engineering papers, or the *Building News*, for instance.—NUN. DOR.

[60808.]—**Small Gas-Engine.** — Read the letters on the gas-engine which appeared in Vol. XXXIX., and procure a set of castings.—T. P. M.

[60812.]—**Paper Making.**—The chloride of zinc is clearly stated to be added to the pulp; but as to the quantity, probably those who use it do not know yet what are the best proportions. It is a matter for experiment.—SELIM.

[60839.]—**Mounting Plates of Wimshurst Machine.**—I beg to thank the correspondents who have so kindly answered my question. With respect to Mr. Wimshurst's suggestion of employing a bobbin of hard fibre, it so happened that I hit on a similar device in the interval between putting my query and obtaining the replies. My method differs slightly from that recommended. I turn the end of the boss quite flat, leaving only the end of the brass tube projecting; then turn a disc of either hard fibre or wood the same size as the boss, with a suitable projection to fit the 1in. hole in the plate. This is fixed in its place with tricycle-tire cement, and a hard fibre washer cemented to the inner side of the plate in the ordinary way. A central hole is then made in the



bobbin thus formed to receive the projecting end of the brass bushing tube. This method affords a solid centre, and the plate can safely be attached to the boss with screws and, if necessary, be taken off again without difficulty. If also the boss is out of truth, the error can be corrected by inserting thicknesses of paper or other thin material between the bobbin and the boss. With reference to the method of mounting described by "A., Liverpool," I venture to think he ascribes undue importance to the alleged weakening of the plates by making a central hole. It may be true if the centres are broken out; but I always bore mine with a copper tube and emery powder. There is no difficulty in doing this after a little practice. I have only had one instance in which plates thus pierced have come to grief after being mounted. This was last winter, when having left a 16in. machine in a wooden outbuilding used as a workshop one frosty night, both the plates were found badly cracked from the centres next morning. In reply to "G. M. S.," I always turn the bosses on a steel rod the same diameter as the spindle. This practically embodies his idea, and requires no keying. I think he will also see that the advantage to be gained by employing boxwood washers is included in the bobbin method described above.—SODIUM.

[60862.]—**Parallel Motion.**—Find the exact length of stroke, and cut two pieces of timber of such a length that when stood on cylinder cover and steam gently turned on, the main links will come down on them to exactly half-stroke. If not quite correct at first trial, you can see what is wanted and alter accordingly. Now see that the bearings are all in line and horizontal, and radius rod of correct length. Level top of cover first. Of course it should be perfectly level, and if not, the line of bearings of motion must be same amount out of level.—T. C., Bristol.

[60911.]—**Steam-Engine.**—In reference to my question on page 248 to "T. C., Bristol," and others, the ports are 1$\frac{3}{4}$in., travel of valve 5in., with $\frac{3}{8}$ clearance top and bottom of valve-chest. It is a D slide. To bring eccentric forward and put lap on steam edge of valve, would not the other port open before the crank got to the centre, and so cause a reaction on the piston?—SLIDES.

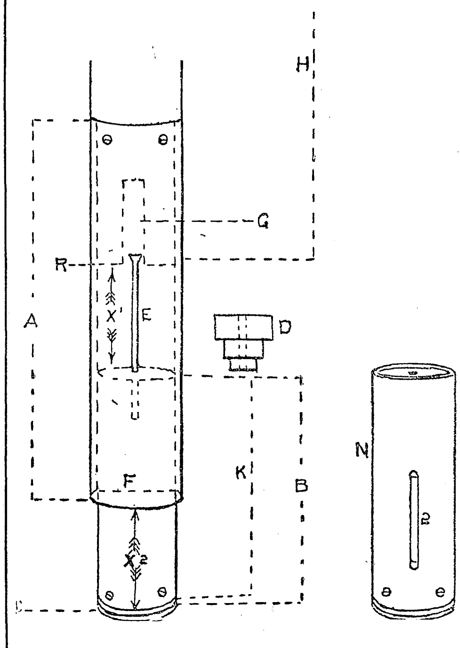
[60936.]—**Oxygen.**—Mr. Allen is quite right, I believe (p. 302), as to chlorate being practically the only source of oxygen for theatres and other exhibitions, during at least these last 20 years; but he should know, and all querists should, that it is always to be mixed with either black oxide of manganese or red-lead, or some other oxide. When heated alone, it is liable either to explode or to send off nearly all its oxygen in one violent rush. Great care is necessary that the matters you mix with it contain nothing combustible, as carbon, starch, &c.—E. L. G.

[60948.]—**Electric Indicator.**—The diagram herewith represents one of the best and simplest forms I know of. It is for two rooms; but the connections are the same for any number. I have had to put in some of the parts of the indicator to make the drawing intelligible. Two batteries are required; but only one electro-magnet for each hole, and the reversal battery may be a very small one; probably one cell would do. The flat bands are strips of thin metal, the arches, pieces of steel or hard cast-iron, as sections of a split gas-pipe. Remember that for successful working of electric reversal indicators, thoroughly soft iron for magnet cores is requisite. The dotted squares represent the holes in the face of the indicator; the principle of the whole is the reversal of polarity of an electro-magnet in conjunction with the magnetic law that, like magnetisms repel, and vice versâ, and Ampère's rule for winding to produce N. or S. poles. The arches should be so adjusted as to touch at the outer ends of the coils (with left to right winding), and are permanently magnetic with poles arranged as shown, which you can test by the working before fixing, or by a compass.—E. CONRY.

[60953.]—**New Electric Machine.**—In reply to "L. H. R.," it may possibly be of some benefit to himself as well as of others of "ours" to state that until quite recently I held the opinion inculcated in my youthful days—that electricity was an entity present always and everywhere. But the unexpected outcome of my experiments not agreeing with such a doctrine, forced me to look for a better, because I found that electricity is not always in a state of existence any more than is the sound of my violin, or the light of my box of matches, or the heat of the coals I am at present toasting my shins at. I know that if I bend a spring that every particle of material included in that bend must shift its relative position to its neighbouring particles, and that this may be repeated indefinitely, but I do not know how to explain these phenomena. Likewise, then, if we bring suitable bodies into certain relations with each other, these similar vibrations are set up and constitute what is termed electricity. And as regards this molecular theory, one cannot do better than to master its doctrines as enunciated in Mr. Sprague's work. It appears to me that as a rule, 'tis the "try, try, and try again" men who make most of the new discoveries, leaving it to those more mathematically inclined to do the theorising. I belong to the former, and only deal in actual experiment. Thus, I made a rubber, say, 2ft. square. On rubbing this upon a sheet of glass, if it be removed there is a certain amount of electricity upon the opposite side of said glass. Now, if, whilst rubbing, or just after, a finger be applied and removed, upon removing the rubber it will be found that there is a considerable increase in the quantity, but a lowering of the tension; if a section of foil of same area as the rubber is laid upon the glass the action is much improved, as it gathers the electricity of the whole surface at once, and if the aforesaid rubber be raised straight at one end from the glass and the operator puts himself in the circuit from said foil to the rubber, he will experience a shock more enlightening than pleasant (Memo., try it upon something a good deal smaller than 2ft. square). Another lesson to be learned from these experiments is that the glass will not part as freely with the electricity so long as a rubber is in contact with it, as is the case if it is removed; so will it be found that the circuit of the current when electricity is carried away from its place opposite to the rubber, is back again to that position equally as it is to the opposite face of the glass. Now as to your questions anent the arrangement of the machine. I have tried four rubbers upon it, and find that it does not produce the desired quantity, nor even reasonably increase the quantity produced by one only, and the only reason for using two rubbers is to balance the strain upon the glass, as a better effect may be obtained with one only, from the above-mentioned reasons, and a rubber can be employed as large as one half of the area of said disc, the foil on face being divided into two sectors, the result being what we term shocks instead of sparks, if the little brush marked A be removed, as the effect of this upon either this machine or a Wimshurst is to convert tensional into what is termed normal electricity, or in other words, to cause it to expand

into quantity at the expense of its energy. It does not improve the machine to add the second brush, as in a Wimshurst machine. But it would do so, if the rubber were so arranged as to lift off the glass whilst the charge is being delivered; but if the object be to collect a quantity under tension, (or would it be better to term it compression?) as when in a Leyden jar, for instance; on the rubber coming into contact with the glass again, the electricity so stored would leak back in large quantity to it: this may be well observed by arranging a Wimshurst machine of, say, 19in. plates, with a large number of sectors, only divided from each other by, say, ⅛th of an inch of glass, in a dark room. The electricity may be seen flowing back in a regular torrent in the direction of the brushes, whence it has been carried by the revolution of the discs. In "all" these machines, increasing the number and area of the sectors means quantity with proportionate loss of tension. The question thus resolves itself into, "What is it you want to do, Mr. Wimshurst?" I opine he is actuated by the same motive impelling myself—viz., an improved method to the clumsy dynamo for producing electricity. Mechanically speaking, a dynamo is a rude contrivance, and must sooner or later give up the palm to something much lighter and far more efficient. To the engineering mind, heavy weights, requiring extreme accuracy and running at tremendous velocities, are evils to be ameliorated, if not entirely got rid of. The best arrangement for producing a light with a Wimshurst machine is to take a piece of glass tube, say, ⅜in. bore, place a cork, say, 2in. from one end in the tube, which may be 12in. long; fill up the inside to, say, 2in. of top with shreds of tinfoil waste, and push in a section of cork to keep same in place. The bottom cork is provided with a wire with an eye on it, so as to connect with earth; the other end is in contact with the inside foil. Similarly, there is a short piece inserted in the before-mentioned section—one end in connection with the inside foil; next, we must put another cork in this end, having also a wire through same, capable of adjustment by sliding to within any distance, say, a quarter of the inner wire, and a hook to hang it upon the conductor on the other end. Now, then, if we coat the outside with corresponding foil an inverted Leyden jar is the result, and a constant flow of shocks can be obtained with very little jumping, and the objectionable noise is "corked up." If a fine wire be fastened to the end, instead of hanging it to conductor, we may hold it in the hand directly to one of the discs without feeling any inconveniences; so also can same be worked by bringing it into contact with the outside of an insulated Leyden jar, which is in process of charge and discharge. One important advantage of my arrangement is, that although it does not give the quantity a Wimshurst does, it will give it at a greater tension, and is capable of doing so in states of the atmosphere in which a Wimshurst will not work at all. By the way, I have one of these with no shellac upon it, and by leaving 1in. of the circumference of the disc free of the sectors it can be started in almost any weather in a cold room by the application of a rubber, gently. This does away with the permanent application which I have described heretofore. I cannot suggest any gain in altering the connections from that shown in the diagram. Lining paper is a strong paper possessing the same property as drawing paper, that of shrinking as it dries, after being damped, and is used by paperhangers for cracked ceilings and walls, and costs from 9d. the piece. I have not as yet arranged any conductor to this machine, and for the afore-mentioned reasons cannot state size of spark, being engaged in the interesting problem of "how to thicken the same." I may at a future period give some details of the machine I am at present experimenting with, which is a disc of 3ft. diameter, inclosed in a case 4ft. square, one side of which is of glass. —A., Liverpool.

[60958.]—**Crutch Slipping.**—The following appliance screwed on to the end of "Magnet's" crutches will probably give satisfaction:—A, piece of strong brass tubing, outside diameter same as crutch stick, end of stick being pared round for about 3in. to fit on to it that amount a good tight fit, secured with three screws countersunk; B, turned boxwood plug, with hole for screw carefully drilled in centre, with a piece of brass tubing (K) fitted tightly on to it, secured with three screws countersunk, the tube K to move in A easily, when oiled, but without any shake; C, leather to prevent slipping (soak leather for half an hour in water, hammer it on flesh side on smooth iron or stone, to get moisture out, leave for half-hour, and then hammer again a little, and then whilst it is damp nail it on B with smallest wrought-iron boot rivets); E, iron screw, its threads being entirely buried in B, leaving smooth part of screw only above it; smooth edge of head with fine file; F, pin to keep B in position, made of a long thin screw, cut in half where the thread joins the smooth part, the smooth part only being used, and a fine thread screwed on it for ½in. to screw into a hole drilled and screwed for it on one side of A, the other side being drilled and countersunk to take the head of screw (after all is done, and amount of spring arranged to satisfaction, this threaded end of pin should be slightly riveted to prevent any chance of its working loose); G, hole drilled in centre of crutch stick to allow free motion of screw head; H, crutch-stick; D, three indiarubber rings of varying diameters, as shown, the holes through centre of each being about half again as large as screw E, so that the holes, when the rings are compressed by becoming smaller, will not bind on screw, and also for a similar reason the outside diameter of largest ring should be less than inside diameter of A. The thickness of three



rings will of course be according to amount of spring that "Magnet" would like the plug to have, and in the same proportion of course, the distance between the points of arrows X 1 and X 2 will be respectively, X 2 being in all cases ¼in. longer than X 1. But I advise, to make tubes, &c., to have more spring than might be at first thought advisable, and then if spring be found too much, a wooden ring could be put in place of an indiarubber one. Of course the rings D are only shown detached for clearness of sketch, their proper place is slipped on to screw E. (A steel spiral spring could be used instead of indiarubber if "Magnet" so prefers.) N, side view of plug, showing slot W to allow plug to move up and down on pin F; the amount of spring must be so arranged as to cause the top of W to slightly press against pin F, when crutch is off the ground, by means of the indiarubber and wooden rings, as before stated, and length of slot W downwards must be such that when the maximum pressure is put on crutch, then there will be still a space of ¼in. between pin and bottom of slot, because the pin is not intended to take any pressure, and would break; the cushion of rubber must take it all. You will perceive that the slot in tube K is rather longer than slot in boxwood plug, this is so that K will not touch pin F, and thus tend to wear it through; oil K and slot W occasionally, but do not get oil on indiarubber rings, as it might soften them.—G. M. S.

[60975.]—**Paraffin Oil or Coal-Gas.**—Thanks to "B.Sc., Plymouth," for his reply. I have a pamphlet by the patentee or manufacturer of the apparatus, but that does not give the information asked for in my query. Can any of "ours" give further information, and oblige?—JIMBO.

[60982.]—**Chronic Inflammation of Nostrils.**—Probably due to inspiration of cold air while body warm. To avoid the effects of this, place small plugs of cotton wool in each nostril. Discontinue iodine and Ol. eucalyptus, as both are irritating or stimulating. Use instead nasal douche of sodæ bicarb. sol. (½ per cent.) night and morning. Nothing will cure if cold baths are used.—A DUNLOP STEWART, M.B.

[60983.]—**Chloride Battery.**—Thanks to the friends who have so kindly given their opinions of this form of cell. Would they now please go a step further and suggest a battery having some of the qualities of the Leclanché, but about three times its strength per cell, and much oblige?—M.M.I.SC.S.

[60976.]—**Arithmetical Question.**—Although this question is correctly answered by Mr. S. M. Cox in issue of 26th inst., I offer a few notes for the further information of "Puzzled" which I hope may not be thought superfluous. If "Puzzled" is to perform the whole calculation himself without reference to Inwood's tables (which only deal in whole numbers in percentage), it may not be amiss to jot down the formula, which is—

$$x = \frac{P}{\dfrac{R^n - 1}{R^n (R - 1)}}$$

In which x = required annuity,
P = the principal,
R = £1, plus its interest for one year (the interest in this case, after deducting tax, is 4·375 per cent.),
n = number of years.

So the formula becomes—

$$x = \frac{1000}{\dfrac{1{\cdot}04875^{10} - 1}{1{\cdot}04875^{10}\,(1{\cdot}04875 - 1)}}$$
$$= 128{\cdot}7.$$

If he has Inwood's tables he can find by one reference, without any computation or division, in the fifth table (p. 118, ed. 1884), the annuity that £1 will purchase at 5 per cent. for ten years, and by moving the decimal point three places, the annuity that £1,000 will purchase for the same time—viz., £129·5. The income-tax can be then taken off the gross interest of £295, leaving £287 nett, and a correspondent annuity of £128·7. If, however, the mortgage is only to bear simple interest, and at the same time to be paid off in instalments, the calculation is not so readily performed.

Let r = the rate, or the interest on £1 per annum.
n = the number of years.
p = present value of the annuity.
x = the annuity.

Then it is evident that the present value of the first annual payment is $\frac{x}{1+r}$, and of the second $\frac{x}{1+2r}$, and so on to $\frac{x}{1+nr}$. Therefore the statement is—

$$P = x\left(\frac{1}{1+r} + \frac{1}{1+2r} \dots\dots\dots + \frac{1}{1+nr}\right)$$

and in the case in question—

$$100 = x\left(\frac{1}{1{\cdot}04875} + \frac{1}{1{\cdot}09750} \dots\dots\dots \frac{1}{1{\cdot}4875}\right)$$

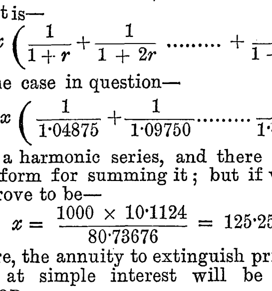
This is a harmonic series, and there is no convenient form for summing it; but if worked out it will prove to be—

$$x = \frac{1000 \times 10{\cdot}1124}{80{\cdot}73676} = 125{\cdot}25.$$

Therefore, the annuity to extinguish principal and interest at simple interest will be £125 5s.—SURVIVOR.

[60984.]—**Boat Propulsion.**—If Mr. Harrison will communicate with the inventor of a "Velocipede Boat" (patented 1884), he can have a boat made to order which can be propelled either by hand or feet, which will exactly answer his purpose.—Address: A. BIVER, Norfolk Villa, Norfolk-road, N.W., London.

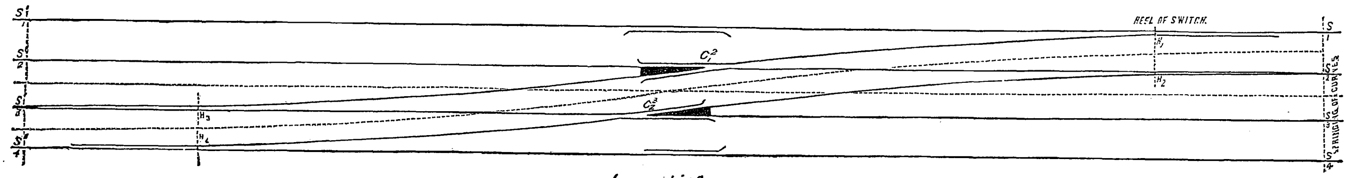
[60989.]—**To Mr. Wimshurst and Others.**—As this query is not addressed to Mr. Wimshurst exclusively, permit me to point out that if you had strictly adhered to the instructions referred to, you would have used tricycle-tire cement and not the disastrous "diamond" variety. If your machine has not less than 14 sectors on each plate, it ought to be freely self-exciting and not require the somewhat novel application of a dry duster. Did you clean the plates well before applying the shellac varnish? It has often occurred to me that many of the machines reported in these columns as faulty are defective through inattention to this



point. I always clean my plates first with turpentine to remove any traces of grease, then with methylated spirit. If this is done properly, the leaves of the charged gold leaf electroscope will not collapse when the glass plate and the knob of the electroscope are brought into contact—an experiment which at once demonstrates the electrical quality and cleanliness of the glass. I find small plates, say, from 12in. to 16in., can be mounted with very considerable accuracy, by using

the following expedient:—Out of a piece of hard wood turn a disc of about 4in. diameter, with a projecting pin or spindle about 4in. long. (See sectional sketch.) This pin must be of such a thickness as accurately to fit the spindle-hole of the boss. If now the plate be placed on the disc with the pin projecting through its central hole, and the boss, with its cement heated to the proper degree of liquidity, be passed down the pin and gently pressed into position, it must evidently be held truly perpendicular to the plate while the cement sets. It is better to turn this bit of apparatus out of brass or iron, as the wooden pin is apt to warp. Don't destroy your cracked plates. They can be repaired with "coaguline," as Mr. Wimshurst has pointed out. One of mine has been thus repaired, and works excellently. I will not undertake to say where the electricity comes from. Theories differ.—SODIUM.

[60993.]—**Permanent Way.**—In answer to your question in ENGLISH MECHANIC, the book I have quoted from in the following rules is Donaldson's "Switches and Crossings," which is, with the exception of these simple rules, purely theoretical, and would not be any use to anyone who had not a fair knowledge of mathematics. It is published by Messrs. Spon, Strand, London, at 10s. 6d. I inclose tracing of a cross-over road for example, one in eight, hoping it will be clear enough for you. I must explain, the lines on the plan represent the centre of the rails, so the point of crossing would not therefore be at the position marked, but some little distance in front; a string, or straight-edge, placed along the centre of rails would give you the required point, or a line run along the inner side of rails would give two points B B, so that you could line on the centre point A. Also the rules only apply in the case of when the clearance at the heels of the switch is 2in. and the thickness of rail $2\frac{1}{2}$in., and the gauge is 4ft. $8\frac{1}{2}$in. Any other information that I can give you are welcome to. Rule I.—When the main line is straight the radius of branch line in feet is equal to ten times the square of the lead:



LEAD OF 1 IN 8

1 in 7 radius of branch line =
$10 \times 7^2 = 10 \times 49 = 490$ft.
1 in 8 radius of branch line =
$10 \times 8^2 = 10 \times 64 = 640$ft.
1 in 9 radius of branch line =
$10 \times 9^2 = 10 \times 81 = 810$ft.
1 in 10 radius of branch line =
$10 \times 10^2 = 10 \times 100 = 1{,}000$ft.

Rule II.—The lead of one crossing is equal to that of the other, and to the interval between the heels of the switches expressed in feet, divided by fifteen and a half:—H_1H_3 and H_2H_4.

Interval $108\frac{1}{2}$ft. lead of crossing =
$$\frac{108\frac{1}{2}}{15\frac{1}{2}} = 108{\cdot}5 \div 15{\cdot}5 = 7$$
Interval 124ft. lead of crossing =
$$\frac{124}{15\frac{1}{2}} = 124 \div 15{\cdot}5 = 8$$
Interval $138\frac{1}{2}$ft. lead of crossing =
$$\frac{138\frac{1}{2}}{15\frac{1}{2}} = 138{\cdot}5 \div 15{\cdot}5 = 9$$
Interval 155ft. lead of crossing =
$$\frac{155}{15\frac{1}{2}} = 155 \div 15{\cdot}5 = 10$$

Reverse the above rule, you have the interval between the heels of the switches is equal to fifteen and one half times the lead. Rule III.—The distance in feet of either crossing from heel of the switch on the same rail as the crossing is equal to seven and one quarter times the lead of the crossing, and the interval between the points of the crossings is equal to the lead of either crossing: $H_2C_1{}^2$ and $H_3O_2{}^3$. Distance of either crossing from the heel nearest switch lead of—

1 in $7 = 7 \times 7\frac{1}{4} = 50$ft. 9in.
1 in $8 = 8 \times 7\frac{1}{4} = 58$ft.
1 in $9 = 9 \times 7\frac{1}{4} = 65$ft. 3in.
1 in $10 = 10 \times 7\frac{1}{4} = 72$ft. 6in.

Interval between the points of crossings measured parallel to main line =
1 in 7 = 7ft. 1 in 8 = 8ft. 1 in 9 = 9ft. 1 in 10 = 10ft.
—T. ATKINS.

[60995.]—**Brighton Engines.**—1st. The engines coupled in front run very smoothly, owing to a special arrangement of the valve gear, by which, at high speeds, the temperature of the cylinder is maintained, and as much steam is locked up in the cylinders as raises the pressure at the end of the stroke to near that in the steam-chest. 2nd. The front-coupled engines, when running at high speeds, only have a slight rolling motion due to the irregularities of the road, and are not subject to the violent lateral oscillations peculiar to engines with a low centre of gravity. 3rd. The advantages claimed for front coupling are that a shorter coupling rod can be used for fast-running engines, and a larger boiler and fire-box obtained than when the coupled wheels are at the back, and it also allows the use of small lightly-weighted trailing wheels. The above statements are taken from a paper read by Mr. Stroudley before the Institution of Civil Engineers, on March 3rd, 1885.—A. W. B.

[60996.]—**Points and Crossings.**—For an ordinary crossing, narrow gauge, the length from point to crossing should be 75ft., the angle of crossing 1 in 10, the total length from point to point 165ft., and the radius of curves 9 chains. Almost any elementary engineering work will give instructions respecting the laying down of points and crossings.—HENRY W. WEBB.

[61001.]—**Landscape Painting in Oil-Colours.**—In my reply to this query will "Welsh Hog Hair" read, "along with a badger hair softener No. 8 or 9," as there is an error which makes the information foolish.—DENS.

[61001.]—**Landscape &c., Painting in Oil Colours.**—The following colours will be sufficient to commence with:—White, yellow ochre, vermilion, crimson lake, brown-red, burnt sienna, bitumen, cobalt blue, and black. A few hog-hair and sable brushes. Medium-strong drying oil and turpentine, equal quantities. The shadows may be thinly painted with brown-red and black mixed to a bistre tint, and, when dry, wet the shadows again with the same tint, and commence painting. Strong colour is not in the high light or in the deep shadow, but will unite both, greying down when required; the shadows to be a little cooler than the lights. Practice is the only way to find out your own style of colouring. Some prefer warm and others cool pictures. For my own part, I like the old-fashioned way of glazing and scumbling with all the warmth that can be got.—J. C., Southport.

[61002.]—**Dynamo and Storage Battery.**—TO E. CONRY.—Thanks for your reply and offer. I shall be greatly obliged for full details of above, as I can bring in play gas or water, and probably steam by the time I shall be ready for it. I thought, perhaps, I might have driven with lathe, as I can drive 3in. emery wheel 4,000 revs. per minute; but will lay it aside now.—LUMSIE.

[61004.]—**The Italian Language.**—In reply to "A Student," the letter *s* in Italian is *impure* before a consonant, as in scena (scene), strumento (instrument). The present and past participles are formed from the infinitive of the three conjugations as follows:—

Infinitive.	Present.	Past. Sin. m.	f.	Plu. m.	f.
1st Am-are	ante	ato	ata	ati	ate
2nd Cred-ere	ente	uto	uta	uti	ute
3rd Sent-ire	ente	ito	ita	iti	ita

There is no rule for the placing of the adjectives in Italian; the correct placing of them can only be learned by practice. The placing of certain adjectives before or after the noun greatly alter its signification, as—*un uomo buono*, a good man; *un buon uomo*, a simple fellow. The personal pronouns are usually omitted before the verbs; *coloro* and *eglino* are both the proper words to use for the third person plural. In translating "I go to the friends of the lawyer," "to the" must be expressed by *dagli*, and not *agli*, as the preposition *da* corresponds to the *chez* of the French, signifying *in the house of*: *da* also signifies *from.* It would be too long to give a list of the best books to read; but I should not omit De Amicis as one of the best modern writers.—NELIGEL.

[61008.] — **Belting.** — CORRECTION.—I added 2c. instead of cos. ϕ of 2c.; the length would consequently be $19{\cdot}9 + 22 = 41{\cdot}9$ft., not 44ft. as given by me.—T. C., Bristol.

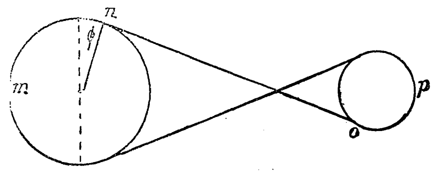
[61012.]—**Annealed Zinc.**—Zinc cannot be annealed. When cast, it is just as hard or soft as it is, and remains so; if heated, it will be brittle while hot, and if then cooled, it is just as before. Lead and tin are the same.—DENS.

[61015.] — **Magnets.** — To "MECHANIC."—I think I have slightly misread your query. My reply refers to the inherent capacities of the magnets rather than to what I see you desired to know.—EDWARD CONRY.

[61008.]—**Length of Belting.**—In this question the given quantities being $D = 6{\cdot}7$, $d = 3{\cdot}5$, and $c = 12{\cdot}1$, the third formula becomes—

$$\text{Sin. } \phi = \frac{D + d}{2c} = \frac{10{\cdot}2}{24{\cdot}2} = {\cdot}4214876.$$

Now, in the table of natural sines, the nearest



lower value to this number is ${\cdot}4212996$ = sin. 24° 55'. Correcting for the difference, we have ${\cdot}4214876$ = sin. 24° 55·71'; hence $\phi° = 24{\cdot}928°$.

Multiplying this by ·0175, which is the sine of 1°, we have the circular measure of—

$$\phi = 24{\cdot}928 \times {\cdot}0175$$
$$= {\cdot}43624$$
$$\therefore \left(\frac{\pi}{2} + \phi\right) = \frac{3{\cdot}1416}{2} + {\cdot}43624$$
$$= 2{\cdot}00704.$$

Hence—
$$\left(\frac{\pi}{2} + \phi\right)(D + d) = 2{\cdot}00704 \times 10{\cdot}2$$
$$2\,(m\,n + o\,p) = 20{\cdot}4718.$$

Again, from the table of natural sines we find—
Cos. ϕ or Cos. 24° 55·71 = ·9068325.

Hence— $2\,c$ cos. $\phi = 24{\cdot}2 \times {\cdot}9068325$
$\therefore 2\,n\,o = 21{\cdot}9453465.$

But, from formula (1), the length of the belt—
$$L = 2\,(m\,n + o\,p + n\,o)$$
$$= 20{\cdot}4718 + 21{\cdot}9453465$$
$$= 22{\cdot}4171465.$$

It will be observed that this does not take into account the thickness of the belt or band, unless the diameters of the drums or pulleys D and d are each supposed to include the thickness of the belt.—MILVERTON.

[61046.]—**Logarithms.**—Napier used e as the base of his system of logarithms, where—

$$e = 1 + \frac{1}{1} + \frac{1}{1\cdot 2} + \frac{1}{1\cdot 2\cdot 3} + \frac{1}{1\cdot 2\cdot 3} + \ldots\text{ad.inf.}$$

Calculation of a few terms of this series shows $e = 2{\cdot}71828\ldots$ From the expansion of a^x in terms of x—

$$\log._e a = a - 1 - \tfrac{1}{2}(a-1)^2 + \tfrac{1}{3}(a-1)^3 - \tfrac{1}{4}(a-1)^4 + \tfrac{1}{5}(a-1)^5 - \ldots\ldots\ldots$$

For a write $1 + z$, then—
$$\log._e (1 + z) = z - \frac{z^2}{2} + \frac{z^3}{3} - \frac{z^4}{4} + \frac{z^5}{5} - \ldots\ldots\ldots$$
also—
$$\log._e (1 - z) = -z - \frac{z^2}{2} - \frac{z^3}{3} - \frac{z^4}{4} - \frac{z^5}{5} - \ldots\ldots\ldots$$
By subtraction—
$$\log._e\left(\frac{1+z}{1-z}\right) = 2\left\{z + \frac{z^3}{3} + \frac{z^5}{5} + \ldots\ldots\ldots\right\}$$
Multiplying both sides by $\frac{1}{\log._e 10}$ (= M)
$$\log._e\left(\frac{1+z}{1-z}\right) = 2\,M\left\{z + \frac{z^3}{3} + \frac{z^5}{5} + \ldots\ldots\ldots\right\}$$

Putting in the value of z from the query, and applying (1)—
$$2\log.(n-1) - 2\log.(n+1) + \log.(n+2) - \log.(n-2)$$
$$= 2\,M\left\{\frac{2}{n^3-3n} + \tfrac{1}{3}\left(\frac{2}{n^3-3n}\right)^3 + \tfrac{1}{5}\left(\frac{2}{n^3-3n}\right)^5 + \right\}$$
—F. T. B.

[61046.] — **Logarithms.** — When Napier, or Neper, published his table of logarithms, it does not appear that he gave any account of his methods of computation; but it is probable that these, as also other methods of his time, had their origin in the quadrature of the hyperbola—hence the name given to them of hyperbolic logarithms. The

early methods of computing logarithms were very operose, and have been long abandoned for the more expeditious methods of converging series. One of the best and most rapid series that have been invented for this purpose is the one under the present number, for which an explanation is required; it was first given by Borda, it is known as *Borda's Formula*, it was used by him in the computation of his table; it is as here—

$$2 \log. (n-1) + \log. (n+2) - 2 \log. (n+1) - \log. (n-2) = 2M \left\{ \frac{2}{n^3-3n} + \tfrac{1}{3}\left(\frac{2}{n^3-3n}\right)^3 + \tfrac{1}{5}\left(\frac{2}{n^3-3n}\right)^5 \times \&c. \right\} \quad\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

It is obtained from the well-known formula—

$$\text{Log.} \frac{1+z}{1-z} + 2M\left\{ z + \tfrac{1}{3}z^3 + \tfrac{1}{5}z^5 + \&c. \right\} \quad (2)$$

by an artifice, for if we make—

$$z = \frac{2}{n^3-3n}$$

we have evidently—

$$\frac{1+z}{1-z} = \frac{1 + \frac{2}{n^3-3n}}{1 - \frac{2}{n^3-3n}} = \frac{n^3-3n+2}{n^3-3n-2}$$

$$= \frac{n^3 - 2n^2 + n + 2(n^2 - 2n + 1)}{n^3 + 2n^2 + n - 2(n^2 + 2n + 1)}$$

$$= \frac{(n-1)^2(n+2)}{(n+1)^2(n-2)}$$

∴ Taking the logarithms we have—

$\text{Log.} \frac{1+z}{1-z} = 2 \log. (n-1) + \log. (n+2) - 2 \log. (n+1) - \log. (n-2)$. Substituting these values of z and $\log. \frac{1+z}{1-z}$ in equation (2) we have equation (1) as required.—MILVERTON.

[61046.]—**Logarithms.**—It would take up too much space fully to discuss the question of logarithms; but if "Equivolt" wishes thoroughly to understand them, he should read the chapter on Logarithms in Todhunter's larger Algebra or Trigonometry. He will there see that logarithms to the base 2·71828, &c., or e, as it is generally called, are those which occur naturally in theoretical investigations. As to the last part of the question—

$$\log._{10} \frac{(n-1)^2(n+2)}{(n+1)^2(n-2)} = 2\log._{10}(n-1) - 2\log._{10}(n+1) + \log._{10}(n+2) - \log._{10}(n-2)$$

Let M be the modulus for transforming from base 10 to base e. We have also—

$$\log._{10} \frac{(n-1)^2(n+2)}{(n+1)^2(n-2)} = \log._{10} \frac{n^3-3n+2}{n^3-3n-2}$$

$$= \log._{10}(n^3-3n+2) - \log._{10}(n^3-3n-2)$$

$$= \log._{10}(n^3-3n)\left(1 + \frac{2}{n^3-3n}\right) - \log._{10}(n^3-3n\left(1 - \frac{2}{n^3-3n}\right)$$

$$= \log._{10}(n^3-3n) + \log._{10}\left(1 + \frac{2}{n^3-3n}\right) - \log._{10} - (n^3-3n) - \log._{10}\left(1 - \frac{2}{n^3-3n}\right)$$

$$= \log._{10}\left(1 + \frac{2}{n^3-3n}\right) - \log._{10}\left(1 - \frac{2}{n^3-3n}\right)$$

$$= M\left\{ \log._e\left(1 + \frac{2}{n^3-3n}\right) - \log._e\left(1 - \frac{2}{n^3-3n}\right) \right\}$$

$$= M\left\{ \frac{2}{n^3-3n} - \tfrac{1}{2}\left(\frac{2}{n^3-3n}\right)^2 + \tfrac{1}{3}\left(\frac{2}{n^3-3n}\right)^3 - \tfrac{1}{4}\left(\frac{2}{n^3-3n}\right)^4 + \tfrac{1}{5}\left(\frac{2}{n^3-3n}\right)^5 + \&c. \right\}$$

$$- M\left\{ -\frac{2}{n^3-3n} - \tfrac{1}{2}\left(\frac{2}{n^3-3n}\right)^2 - \tfrac{1}{3}\left(\frac{2}{n^3-3n}\right)^3 - \tfrac{1}{4}\left(\frac{2}{n^3-3n}\right)^4 - \tfrac{1}{5}\left(\frac{2}{n^3-3n}\right)^5 + \&c. \right\}$$

$$= 2M\left\{ \frac{2}{n^3-3n} + \tfrac{1}{3}\left(\frac{2}{n^3-3n}\right)^3 + \tfrac{1}{5}\left(\frac{2}{n^3-3n}\right)^5 + \&c. \right\}$$

Hence $2\log._{10}(n-1) - 2\log._{10}(n+1) + \log._{10}(n+2) - \log._{10}(n-2) = 2M\left\{ \frac{2}{n^3-3n} + \tfrac{1}{3}\left(\frac{2}{n^3-3n}\right)^3 + \tfrac{1}{5}\left(\frac{2}{n^3-3n}\right)^5 + \&c. \right\}$

The proof of the expansions is too long to give here; but will be found in the works mentioned above.—IGNOTUS.

[61047.]—**Multiplex Copying Ink.**—Make the following into a warm solution, pour into your dish, and when set it is ready for use:—Water 4oz., sulphate of barium 2½oz., sugar 1oz., gelatine 1oz., glycerine 6oz. A very good ink is made by triturating aniline violet (which can be procured at most chemists) with glycerine quant. suf. The writing should be done with a quill pen. As I have tried the above, I can answer for its efficiency.—W. C. HALL, Newport, Mon.

[61050.]—**Pigs.**—The first thing to be considered is whether there is any by-law affecting the keeping of pigs within a certain distance of a public road or dwellinghouse. If not, I do not think your neighbour has any remedy against you unless they are kept in such a state or manner as to be a nuisance to him, in which case he can take proceedings for the removal of such nuisance.—W. C. HALL, Newport, Mon.

[61052.]—**Accumulators.**—I do not think there is any such rule, though there ought to be one elaborated by somebody, considering the amount of time and money that has been spent on accumulators. I know that even in the works of one of the largest accumulator-making establishments in the United Kingdom, the formation is simply done by "rule of thumb," derived from experience—i.e., that size x takes about so long at so many ampères to form; size y so long, &c.; and there is often an immense and unaccounted for variation even in these quantities. In regard to the latter part of your query, the following results, deduced from my own experience, may perhaps be of some little guidance. They are for accumulators formed from the plain lead, but are very rough, and depend greatly, if not altogether, upon the treatment during formation, a matter upon which the electrical literature is almost absolutely silent, and upon which, even in actual practice, there is no rule, each electrician doing what is right in his own eyes. These figures assume the cells to be well constructed and properly cared for, so as to avoid any internal short-circuiting or external leakage. The dimensions may to some seem large for the given storage capacity, but any reduction of the size would only risk disappointment:—To give about—

25	ampère hours.	520	sq.	ins.	of	peroxide	plate
35	"	"	700	"	"	"	
75	"	"	1,560	"	"	"	
150	"	"	2,856	"	"	"	
250	"	"	7,514	"	"	"	

General percentage of efficiency, about 65 per cent. —i.e., about 100 amp. hours would have to be put in to get 65 out. If the cells were well placed, well made, and well handled, perhaps as high as 75 per cent. might be got, and this percentage for accumulators would be, in actual practice, very fair. You will observe the storage capacity does not increase in absolutely direct ratio with the size—i.e., a cell double the size does not mean quite double the power.—EDWARD CONRY.

[61054.]—**Magnets and the North Pole.**—The least unsatisfactory explanation is that thermo-electric currents are caused in the earth by the sun "travelling round" from east to west, causing the currents to circulate in the same direction, and thus magnetising the earth (or at least the iron in the earth). Currents from east to west would make the North (properly the South) Pole of the earth in the north.—LONDINIENSIS.

[61054.]—**Magnets and the North Pole.**—I presume you mean "why does the 'so-called' north pole of a magnet turn towards the north, &c.?" The earth itself is a great magnet whose poles coincide nearly, but not quite, with the geographical north and south poles, and therefore it causes a freely-suspended magnet to turn into a north and south direction. But it should be remembered (having regard to one of the first laws of magnetism), viz., "like poles repel, unlike attract." That is the south pole of a magnet that points to the north (although called the north pole) and *vice versâ*.—W. C. HALL, Newport, Mon.

[61054.]—**Magnets and the N. Pole**—It is one of the natural laws of magnetism that permanent magnets tend to place themselves due N. and S., the "north-seeking" pole, or, as it is generally, though perhaps erroneously, termed the N. Pole, turning northwards. Various conflicting reasons have been assigned for this, one being that a strong current of electricity is continually flowing round the centre of the earth, about the equator, with other currents in other parts flowing parallel to the parallels of latitude at right angles, to which currents the needle tends to set itself, according to a well-known electrical law.—EDWARD CONRY.

[61054.]—**Magnets and the North Pole.**—Magnets do not always turn to the north in preference to any other point. When free to move, they place themselves in the magnetic meridian, i.e., the south-seeking end pointing to the S. pole, and the north-seeking end pointing to the N. pole. The reason of this tendency is because there are electric currents circulating round the earth from east to west, while there are also currents circulating round the magnets at right-angles to their poles. Since currents travelling in the same direction attract, while those travelling in opposite directions repel one another, it follows that the currents in the earth and in the magnets will tend to move these bodies until the currents are parallel in direction.—S. BOTTONE.

[61055.]—**Varnish for the Bright Parts of Bicycles.**—See information under "Answers to Correspondents," in last week's number, p. 313.—EDWARD CONRY.

[61055.]—**Varnish for the Bright Parts of Bicycles.**—As a practical cyclist, I can say that I have found a thin coat of vaseline smeared over the bright or plated parts of a cycle with a rag, quite as efficient and much more easily removed than any of the so-called invisible enamels in the market. Of course, this is assuming that you are putting the machine by for the off-season. If you wish to ride the machine you would have to wipe the vaseline off the handle bar and brake, or it would spoil your clothes. If you still decide on using a varnish, you must be careful to choose one that will not affect the nickel (if any).—SEVERN TUNNEL.

[61058.]—**Glass Embossing.**—I would advise "Perseverance" to slightly warm his glass plate, and apply Brunswick black, which I always use for the purpose, and find little difficulty from the lifting he mentions, and which I think is owing to the glass not being perfectly dry. Don't breathe on it.—ALBO CARBON.

[61058.]—**Glass Embossing.**—Let "Perseverance" try a varnish of bees'-wax dissolved in turps. When cold it is solid. Heat it, and apply with a brush a thin coating; the glass being warmed slightly all the better. Then, when cool, remove the wax, taking care to press the pointer on to the glass, and remove all the wax where he wants the hydrofluoric to bite—i.e., eat the glass. I have never seen the wax lifted bodily off the glass. As to the cause of "lifting" of any varnish, it would probably be the want of making the glass clean.—R. S. T.

[61060.]—**Gut v. Leather Bands.**—As it is for a slow motion, decidedly the two ⅜in. gut bands will transmit more power than the 1in. flat one. I think the best kind of fastening for leather belts as regards facility in joining up is "Greene's patent," which can be obtained of most engineer's furnishers.—F. R. DAVIS.

[61060.]—**Gut v. Leather Bands.**—I have had lathes with both gut and band, and much prefer gut. It does not slip nearly so much as 1in. belting. A single gut not over $\frac{5}{16}$ is better than the belt in my experience. The plan I adopt for fastening of 1in. belt is to remove the pin from a hinge and rivet one half of the hinge to each end of belt, and then have a pin to slip in rather loosely. I do not find it have any tendency to work out. In practice I do not buy hinges, but fold two pieces of sheet brass and cut them to form a hinge and rivet them on with three rivets in each, the rivets being the brass nails used for escutcheons on doors.—T. C., Bristol.

[61061.]—**Engine and Boiler.**—Boiler will safely work at 35lb., but you should test at 60lb. Connect your small boiler to the other when steam is down, so that the pressure will gradually rise to 60lb., when you can disconnect it. Your engine is only about half large enough all ways to do what you want, unless you are willing to stand and freeze at the job this weather.—T. C., Bristol.

[61061.]—**Engine and Boiler.**—Steam is not a suitable thing to test a boiler with, and rather a funny thing to turn on gently; something like the old joke about letting a gun off gently! It should of course be done with cold water, and the boiler you speak of might then stand 50lb., but do not get more than 25lb. of steam into it. It will not supply the engine you describe, and you do not say if you intend it to. Do not exceed a 20in. saw for so small an engine.—F. R. DAVIS.

[61061.]—**Engine and Boiler.**—Most locomotives carry a pressure of 140lb. to the square inch, and your wrought-iron boiler, if only ⅛in. thick, will only carry the following pressure. If single-riveted, lap-jointed, the cylindrical part will only stand safely a pressure of about 80lb. to the square inch; if doubly riveted it will safely stand about 100lb. to the square inch. These figures are from a factor of safety of six. Supposing the ends to be well flanged in or well riveted to the shell, there will be almost as great a tensive stress on the stay as the absolute tensive strength of the material, so that you see the cylindrical part of your boiler is much too weak and the ends are worse off still. Even supposing your ends were strong enough (say, ¼in. with one 1in. stay), the cylindrical part should be at least $\frac{3}{32}$nd (if single riveted) or about $\frac{7}{16}$ths (if double riveted). On the whole, I should not feel safe near your boiler if the pressure exceeded 30lb. to the square inch. As regards the second part of your query, it is obvious that the diameter of your saw would have to be about 15 or 16in. in order that the spindle might clear; but even supposing your cylinder ends stopped on, if you proposed to use the boiler at the locomotive pressure, I don't suppose you would be able to run a 15in. saw through beech.—SEVERN TUNNEL.

[61062.]—**Cheap Dynamo.**—TO MR. BOTTONE.—I cannot advise you better than tell you to double the dimensions of the dynamo described in my book, using a laminated armature and wire of double the diameter. You may charge accumulators, if you prefer it, from this same dynamo; but, of course, you will lose about one-third the power. —S. BOTTONE.

[61064.]—**Vertical Engine.**—You are radically wrong somewhere; you should have 40lb. in the cylinder at the commencement of stroke. The top diagram is of good form; but the vacuum is decidedly low; and as it seems good by gauge—viz., 12lb., and only about 7lb. in diagrams, I should think, perhaps, your indicator was out of order—the shape of diagrams generally being good. What are the size of ports? They should be, say, 9in. by $1\frac{1}{2}$in.—T. C., Bristol.

[61066.]—**Electric Lighting.**—Use a stranded lead composed of seven strands of No. 20, for the main. For the branch circuits use No. 16. You will use the same wires whether you are lighting 10's or 20's. It is well to take the mains to a central point, and then divide into branch circuit of nearly the same length. By this means the lights are fairly equal.—S. BOTTONE.

[61067.]—**Casting Name Plates.**—Brass name plates are moulded like other work, the face being rammed and turned over. The mould is faced with charcoal and with flour or meal, the castings washed in water with a scratchbrush, and dipped for a few minutes in dilute nitric acid.—J. H.

[61070.]—**Lathe.**—Reversing gear to alter the direction of the travel of the slide-rest is merely an arrangement of a simple train of three wheels, which we will call A, B, and C. One of these (A) is geared into B, and its axis forms the stud on which the "mandrel" wheel of the screw-cutting train is placed. The other two wheels B and C, geared together, rotate freely on studs fixed in a plate that is centred on the axis of A. A slight angular motion to the plate sets either of the two wheels B and C in gear with the actual mandrel wheel. When the mandrel drives the wheel A through one intermediate wheel B, the rotations are in the same direction; but when it drives through two intermediate wheels, B and C, the rotations are in different directions. Give particulars of how the left-hand end of your mandrel headstock is constructed, and I will sketch reversing gear to suit.—GOOLWA.

[61071.]—**Lathe.**— The reversing motion is effected on the same principle as that for self-acting lathes, and is essentially as follows:—There are in addition to the change-wheel train, sundry idle wheels whose function is the changing of the direction of motion without affecting the velocity ratios. In a lathe of this class the first driver is on a stud attached to the back of the headstock; and, of course, the other succeeding wheels are on the stud or studs on the quadrant plate, and on the end of the leading-screw. The wheel on the headstock mandrel, which we will call A, remains of constant size. On the stud which carries the first driver is another idle wheel which we will call D. Between A and D the reversal is effected. Two equal wheels, B and C, run loose on studs on a rocking plate, like that which reverses the motion of the back shaft in any common self-acting lathe. The radii of these wheels, B and C, are such that while B always remains in gear with D, C is always clear of D. When the rocking plate is in one position B has its centre in line with the mandrel wheel A and the stud wheel D, and gearing with *both* becomes the direct medium through which the former drives the latter. By turning the rocking plate through an arc of a circle, wheel B is thrown out of gear with the mandrel wheel A, remaining, however, engaged with the stud wheel D, and also with its fellow C on the rocking plate. But the latter having its centre placed slightly farther out than that of its fellow, enters now into gear with the mandrel wheel A to one side of the line of centres of A and D. Hence the gear is driven in the second case *through both wheels* B and C in the rocking plate: thus A, C, B, D, C, being in gear with A and B, and B as always being engaged with D, and the introduction of the extra wheel C reverses the motion. The advantage of this mode of reversal is that the quadrant plate does not need to be moved in order to bring another wheel into the train, as is the case with common lathes, when cutting left-handed screws. Set the tool-box over at an angle of 10° or 15° from the perpendicular, leaning the upper portion away from the work, and the tool will not hitch.—J. H.

[61071.]—**Planing-Machine Tools.**—By reference to the illustration on page 273, where the tool-box of a planing machine is shown, the querist may see a curved slot just above the tool-box. This slot allows the tool-box to be set out of upright, and is for the purpose of allowing the swing of the tool to be altered so as to relieve the tools used on side cuts during the back stroke. The text explaining the construction of the planing machine refers to the subject of this query: see last five lines page 273. Further information if wanted; but probably the above will suffice.—GOOLWA.

[61073.]—**Electric Boat.**—I am very glad you called my attention to the observation in question, as by a piece of ill-fortune I had omitted to read the No. of Oct. 8th, and had not seen it. I have not the least idea what the correspondent meant, and he has never offered any explanation. He promised at the same time to give a description of a motor after his own plan, but, so far as I can find, has not yet done so. I can only say I have nothing to alter in the dimensions, &c., I then gave. They were specially designed to meet the requirements of amateurs, who, according to my experience, almost always more or less short-circuit their field-magnets, and sometimes their armature too, in winding. Amateurs, especially in hand-winding, never keep the steady tension of the professional winder; they (perhaps unconsciously) lay a strand and then pull on it, thus bruising and disturbing the insulation. Out of eight small motors and dynamos that I once tested, there was only one that was not more or less short-circuited in the F.Ms. I advised a little extra length of coils on the F.Ms. in view of this, and if you care to refer to Urquhart on "Electromotors," p. 105, and "E.M." Vol. XLII. pp. 128, 227, 348, and 386, to say nothing of others I could give, and compare quantities and resistances with those I gave on Oct. 1st, you will be able to form an opinion for yourself of how little warrant there is for the remark you have referred to. I have made several motors exactly of the pattern of my description Oct. 1st, and all are now working, and with every satisfaction. Connect the F.Ms. in parallel, and you will thus be able to run with fewer cells in series. I wound the motor with an eye to its use in parallel, which I prefer myself, as current is easier got than E.M.F., though a little more costly. I know the motor and its performance sufficiently well to enable me to promise you that if you make it exactly according to directions, I will take it off your hands at a fair price if I do not show you that it will do what I claimed for it.—EDWARD CONRY.

[61075.]—**Magneto-Electric Machine.**—TO MR. BOTTONE.—If an "Amateur" will kindly turn to p. 20 of my book, "The Dynamo: How Made and How Used" (see "Sixpenny Sale Column"), he will find a full description of what he requires; or, if he will wait till the next article but one on "Electrical Instrument-Making for Amateurs," he will be able to make a commutator on the principle therein described.—S. BOTTONE.

[61078.]—**Red Rust from Sheet Tin.**—"Sheet tin," as you call it, is neither more nor less than iron tinned over to prevent its oxidation. When this coating wears off the iron rusts, and it is this rust that troubles you. It can be removed by immersion in sulphuric acid and subsequent polishing with bran or sawdust; but as it is always liable to reappear, it is better to discard the sheet, or have it re-tinned.—W. C. HALL, Newport, Mon.

[61079.]—**Lathe.**—Evidently either slackness in lathe somewhere, or tool or work springs. Perhaps tool is rather too high, and also rather light. —T. C., Bristol.

[61079.]—**Lathe.**—There are various causes for the fault that you name—viz., the tool being below the centre, insufficient rake on tool, having the tool-rest too slack, or not having the tool sharp enough.—WALLACE NEWLAND.

[61084.]—**Fireclay.**—I give two good kinds of fireclay for brick:—98·0 per cent. silica, 0·72 per cent. alumina, 0·22 per cent. lime, 0·18 per cent. iron oxide, 0·14 per cent. potash, 0·40 per cent. water. This would do for reverberatory furnaces, and stand very high temperature, but not when in connection with lime or acid matters. The other is—

Silica	50·0	per cent.
Alumina	32·6	"
Ferric oxide	3·5	"
Potash	2·3	"
Lime	0·4	"
Magnesia	0·4	"
Water	9·7	"
	100·0	

—H. B.

[61085.] — **Flameless Combustion.** — Your correspondent is probably aware that flameless combustion in some form is as familiar as combustion itself, and has been known for ages. My object in taking this matter up was not to discover an old thing, but to study the question from a practical point of view. It has been thought by many that the presence of a large flame was an indication of great heating power, until my experiments showed conclusively that, with a given fuel consumption, the larger the flame the lower its temperature, and the smaller the efficient duty obtained. With any specified heating surface and fuel consumption, perfect combustion being insured, I found that as the flame was reduced in size the available fuel duty increased until a point was reached when the flame disappeared entirely, the disappearance of the flame being accompanied by a sudden and great rise in the duty obtained. Perfect combustion without flame can only be obtained under certain peculiar conditions which are not always available, and its application is therefore limited. It is practically applied in the well-known injector furnace in a small gas forge, and also in a furnace for making Siemens-Martin steel; but the most important part of the experiments is the conclusive proof of the fact that not only is flame not necessary for combustion, but that the reduction in the size of a flame is, other things being equal, always accompanied by an increased duty and a higher temperature in the furnace. My experiments, although called flameless combustion, were really a series of researches into the internal conditions and the general properties of flames. In the original paper on this subject the internal temperatures of various flames were given, and the inefficiency of some large volumes of flame was conclusively proved on the lecture table by putting my hand inside them, and by placing in them with my hand balls of gun-cotton and parcels of gunpowder, which remained unburnt for any length of time. The more recent experiments on the action of flame on cold surfaces are a continuation of the same series of experiments, and the fact that it is quite impossible to force any flame, however powerful, into contact with a cold surface, is as unexpected as it is important from a commercial point of view. Flames are curious things, and the more they are studied the more unsatisfactory and disappointing they are; the less we have of them the better the results: they are simply signs of incomplete and imperfect combustion, and this being the case, it is better, as far as possible, to do without them altogether. If your correspondent will bear in mind the fact that I have not attempted to discover a new thing, but have simply been studying an old one from a new standpoint, he may possibly find my results of some practical use.—THOS. FLETCHER, F.C.S., Warrington.

[61086.]—**Wimshurst Machine.**—The following is from King, Mendham, and Co.'s catalogue:—"For taking the current oneself, medicinally or otherwise, the Leyden jars should be placed on the table without the tinfoil between them, and their knobs connected one to each conductor of the machine. A handle or sponge holder should then be connected to the outside of each jar and held in each hand. By altering the distance between the discharging knobs of the machine the current can be regulated to a nicety."—LONDINIENSIS.

[61086.]—**Wimshurst Electric Machine.**—In my former reply it did not seem to me to be necessary to state how shocks could be obtained, for I thought that in the common order of things "Electric" would have tasted more shocks than he cared for, and also have made fifty other experiments before he read my reply. However, he can "obtain shocks similar to the shocking coil" by connecting the top of one Leyden jar to one collecting comb, and the top of a second Leyden jar to the other collecting comb; then let him place the terminal balls a little way open, say, $1\frac{1}{2}$in., and place himself in the circuit by holding the outer coating of the jars, one in each hand; all that has then to be done is to get someone to turn the machine. "Electric" will be quite satisfied that the shocks are strong enough; they may be made stronger by using larger jars, and be made lighter by leaving less space between the terminal balls.—J. W.

[61087.]—**Metallic Fire Alarms.**—I believe iron and zinc strips are generally used for the most sensitive forms. Have had no personal experience. —S. BOTTONE.

[61089.]—**Coils.**—The second would probably be the strongest.—S. BOTTONE.

[61090.]—**Electric Scarf Pin.**—TO MR. BOTTONE AND OTHERS.—No, it is simply because polarisation takes place. Give the battery ten minutes or a quarter of an hour's rest, and you will find it work again all right.—S. BOTTONE.

[61091.]—**Curious Phosphorescent Insect.** —This is a centipede.—S. BOTTONE.

[61093.] — **Hexagonal Nuts.**—You can see them "from 3in. to 6in." in Calvert's *Almanac* for 1885, p. 54, and for particulars for smaller sizes, see Calvert's *Almanac* for 1884, p. 48.—WALLACE NEWLAND.

[61093.]—**Hexagonal Nuts.** — As engineers generally work by Molesworth's book, I give the list from that work, diameter first, and size over flats next—$\frac{1}{4}$ and $\frac{3}{8}$, $\frac{5}{16}$ and $\frac{9}{16}$, $\frac{3}{8}$ and $\frac{9}{16}$, $\frac{7}{16}$ and $\frac{3}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$, $\frac{9}{16}$ and $\frac{7}{8}$, $\frac{5}{8}$ and 1in., $\frac{3}{4}$ and $1\frac{3}{16}$, $\frac{7}{8}$ and $1\frac{5}{16}$, 1 and $1\frac{1}{2}$. The list runs up to 3in. bolts.—T. C., Bristol

[61093.] — **Hexagonal Nuts.** — "Ben Bolt" will find an absolutely correct list of Whitworth's standard sizes for the above in a table in "Molesworth's Pocket-Book," p. 418 (21st edition). This

table ranges from a $\frac{1}{4}$in. bolt to a 3in. bolt, and gives to four decimal places the width across flats, thickness of nuts, thickness of bolt-heads, and diameter of bolt at bottom of thread. I believe these are also given in Templeton's "Workshop Companion," but am not sure.—SUDBROOK.

[61093.]—**Hexagonal Nuts.**—This being my first attempt at answering any questions in the ENGLISH MECHANIC, I hope it will be of some value to "Ben Bolt." This is a full table of the sizes of the Whitworth standard of hexagonal nuts.

Diameter across flats.			Dia. across angles.	
Dia. in inches.	(*d*) in decimals.	nearest $\frac{1}{32}$in.	(*c*) in decimals.	nearest $\frac{1}{32}$in.
$\frac{1}{2}$	·9191	$\frac{29}{32}$	1·0612	$1\frac{1}{16}$
$\frac{5}{8}$	1·101	$1\frac{3}{32}$	1·2713	$1\frac{5}{32}$
$\frac{3}{4}$	1·3012	$1\frac{5}{16}$	1·5024	$1\frac{1}{2}$
$\frac{7}{8}$	1·4788	$1\frac{1}{2}$	1·7075	$1\frac{23}{32}$
1	1·6707	$1\frac{11}{16}$	1·9291	$1\frac{15}{16}$
$1\frac{1}{8}$	1·8605	$1\frac{7}{8}$	2·1483	$2\frac{5}{32}$
$1\frac{1}{4}$	2·0483	$2\frac{1}{16}$	2·3651	$2\frac{3}{8}$
$1\frac{1}{2}$	2·4134	$2\frac{13}{32}$	2·7867	$2\frac{25}{32}$
$1\frac{3}{4}$	2·7578	$2\frac{3}{4}$	3·1844	$3\frac{3}{16}$
2	3·1491	$3\frac{5}{32}$	3·6362	$3\frac{5}{8}$
$2\frac{1}{4}$	3·546	$3\frac{17}{32}$	4·0945	$4\frac{3}{32}$
$2\frac{1}{2}$	3·894	$3\frac{29}{32}$	4·4964	$4\frac{1}{2}$
$2\frac{3}{4}$	4·181	$4\frac{3}{16}$	4·8278	$4\frac{13}{16}$
3	4·531	$4\frac{17}{32}$	5·2319	$5\frac{7}{32}$

I hope this will suit. This is the standard given in the advanced science series of "Machine Construction and Drawing."—JOHN G. BELL, W. Nook.

[61095.]—**Incandescent Light.**—If you employed 5c.p. lamps, then for each set of three such lamps you would require 15 cells of a chloride of zinc battery. Hence, 30 cells would be ample for your purpose. To make the battery: Place rod of zinc in porous cell; surround the porous cell with broken carbon and one or more carbon plates connected together. Charge the zinc cell with solution of chloride of zinc (2oz. to the pint), the outer cell with chromic acid, 1 part; water, 1 part; hydrochloric acid, 1 part.—S. BOTTONE.

[61097.]—**Coil.**—The addition of condenser will not improve matters. Add another 4oz. of wire on the secondary.—S. BOTTONE.

[61097.]—**Coil.**—With two cells in series the shock should be irresistible enough, if the coil is well made, and does not leak anywhere. A condenser will certainly make a great difference; but it should be remembered that coils with condensers are never used to give shocks, unless we wish to half-kill someone. Try an extra cell first; but of course if there is a leak, this will not mend matters. I presume there is a soft iron core.—BOBADIL.

[61098.]—**Invalid Carriages.**—There are two methods by which the cycles now in the market for those who have not the use of their legs are steered. As a general rule, these are rear-steerers, because of the ease of mounting. The first is to steer by means of a back-rest connected to the rudder-wheel; this seems to me to be clumsy (though mechanically simple), and dangerous on a declivity. The second is as follows: The right-hand lever has a rotating handle, actuating an internal rack and pulling a rod, which is connected by a bell-crank to the steering-rod. This is apt to get loose and shaky; still, it must be a much more natural method of steering than moving your back from side to side.—SUDBROOK.

[61099.]—**A Rule of Grammar.**—"Doctor Med." should reflect on German idiom, "Es ist mich (not "Es ist ich"), meaning "It is me." On the other hand, "It is I" has authority of auth. vers. of Bible. "Me" is not necessarily accusative, or any objective case at all, though narrow-minded scholars may fancy so. Possibly "It is I" is merely the product of an erroneous grammatical conscience springing up in the English people. French personal pronouns have a special form or case distinct from the nominative form (or that used as the subject of the verb), which is at once the independent ungoverned form, the form after "to be," and the form to be used with prepositions Moi je le sais; C'est moi; C'est pour moi; Moi, toi, lui, elle, eux, elles, &c.—WEALD.

[61099.]—**A Rule of Grammar.**—Having been engaged in the tuition of languages both here and abroad for nearly 40 years, I venture to state a few reasons why the verb *to be* in all languages can only take one case. It must be quite evident that any one who *is* cannot *be* some one else. Hence, if I am he, it is very evident that he is I. Now, *him* is not the nominative to any verb in English, so as you cannot say him is I, therefore you cannot say I am *him*, or it is *me*. The French say *C'est moi;* but *moi* is another form of the nominative case, witness *moi qui vous parle*, &c. (I who speak to you, &c.) There is no *reason* like the above why we should continue the use of case endings rather than case prefixes; it is only a matter of convenience, and does not jar against common reason.—S. BOTTONE.

[61099.]—**A Rule for Grammar.**—"Doctor Medicinæ" certainly requires to appeal to the philological readers of the ENGLISH MECHANIC, for he appears not to have thoroughly grasped one of the first rules of syntax—i.e., "The verb 'to be' through all its variations takes the same case after it as that which next precedes it," as a glance at a modern grammar will show. Such expressions as "It is me," or "that is him," are well calculated to shock the sensitiveness of "strict grammarians." "Custom" may certainly "favour the expressions" among the ignorant or unenlightened; but "Malus usus abolendus est," and to the educated such "rules of grammar" are painfully irritating. "Doctor Medicinæ" appears to be better versed in the grammar of our "Anglo-Saxon forefathers" and "the latter part of the 18th century" than that of modern times, and the opinion (as asked for) of at least one of the readers of the "E. M." is that school is the best place for such persons.—W. C. HALL, Newport, Mon.

[61101.]—**Stars Visible from Bottom of Well.**—The only star likely to be visible in the daytime in the latitude of London is γ Draconis. Troughton, the celebrated instrument maker, said that he often saw this star by looking up the chimney of his workshop in Fleet-street. "Our latitudes" may include anything between the Lizard and Dunnet Head—a difference of more than $8\frac{1}{2}$°, so that other stars will be visible according to locality. It is not necessary that the observer should be actually at the bottom of a well, as the stars may be seen from the surface reflected in the water.—R. E. F.

[61101.]—**Stars Visible from Bottom of Well.**—Does "Faciebat" mean what magnitude stars would be visible during an eclipse of the sun? If so, I should say none under 2nd mag. Chambers says ("Handbook," p. 183, 3rd edition), "In the case of the eclipse of 1842, it was remarked by Piola at Lodi, and by O. Struve at Lipesk, that although the obscurity was such that stars of the 2nd and 3rd mags. ought to have been visible, yet only those of the 1st mag. were actually seen." The author goes on to say that this can be explained physiologically by the eye not having sufficient time to recover from the bright sunlight, and consequently not being able to take advantage of the obscurity which actually prevails. If what "Faciebat" wishes to know is the actual stars that would be visible, this, of course, almost entirely depends on the season that the eclipse takes place. I do not know what mag. stars can be seen from the bottom of a well.—A. R. B.

[61102.]—**Bending Beech.**—Hold the strips of beech in steam for a few minutes, or lay them in a copper of boiling water; then bend round a circular block to size required, fastening with a hand-screw or French nail until cold.—C. A. W.

[61105.]—**Exhaust Pipe.**—Start the engine very slowly, and open both cylinder taps that the water may have time to get out without being forced up exhaust pipe, and that is the only remedy. There would not be draught enough if exhaust were removed from chimney.—F. R. DAVIS.

[61105.]—**Exhaust Pipe.**—The water is evidently in the cylinder; fit a drain-cock to each end of cylinder and also to exhaust if possible. Can you not lead chimney into some brick flue belonging to house, if chimney on boiler is not tall enough of itself to give sufficient draught if you have to remove exhaust from chimney? But, probably, drain-cocks will meet the case if not already fitted. —T. C., Bristol.

[61106.]—**Cheap Disinfectant.**—When a solution of a soluble chloride, such as common salt (chloride of sodium), is added to one of nitrate of lead, a precipitate of chloride of lead, rather soluble in boiling water, but less so in cold, is formed. Having regard to the deliquescent nature of common salt by reason of its contamination with chloride of magnesium, I should not advise "Sanitary" to keep the powders mixed unless in a dry, warm place, or he will find his mixture of a rather pasty consistency. Never having heard of its disinfecting properties, I can venture no opinion. —W. C. HALL, Newport, Mon.

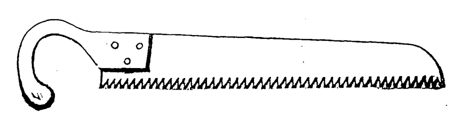
[61108.]—**Oil for Cycles.**—A mixture of common flask oil and paraffin (half-and-half) I think you will find answer very well, unless you object to its not very agreeable aroma.—W. C. HALL, Newport, Mon.

[61108.]—**Oil for Cycles.**—I am afraid "Lubricator" will not be able to find a more suitable lubricant than sperm oil. I use sperm oil, but I find the 10 per cent. of paraffin I put in helps to do away somewhat with the smell of the sperm. Every other oil I have tried—lard oil, olive, &c.—clogs up the bearings, and does not run freely. Has "Lubricator" tried plumbago and glycerine? I have tried it, but it is more expensive and not so satisfactory as sperm and paraffin. Many of the oils sold by the cycle agents do not smell badly; so I suppose they have something to neutralise the disgusting smell you speak of.—SUDBROOK.

[61109.]—**Defective Brickwork.**—Perhaps a little size incorporated with the whitewash would avail.—W. C. HALL, Newport, Mon.

[61110.]—**Dynamo.**—The calculations to find with a shunt-wound dynamo (which I presume yours is) the amount of resistance that would bring the E.M.F. down to a given figure are a little involved, but if you desire to go into them for future information, I should suggest your referring to Thompson's "Dynamo-Electric Machinery," and also availing yourself of the following formula from Munro and Jamieson. "The multiplying power of a shunt is the ratio of the current C which would flow through the galvanometer if not shunted to the current C_1, which flows through it when shunted. Thus $\frac{c}{c_1} = \frac{G + s}{s} = \frac{G}{s} + 1$, where G = resistance of galvanometer and s_1 resistance of shunt." This appears to give what you want; but I cannot say for certain, as I have not got the exact data for the purpose. S. Thompson's work would give it you better. When the E.M.F. of a machine has to be altered to such a large extent as you require, a much more useful and economical way is to slow down the engine, which reduces the E.M.F. at once, or, if driving off shafting, to put smaller pulleys on to the dynamo and shafting, so as to reduce the speed I have seen two pulleys on the shafting one half the size of the other, and two on the spindle of the dynamo, and two straps on the shaft, one running the dynamo at high speed for a certain purpose, and the other hitched up ready for use when a lower speed was requisite. If this be impracticable, insert a resistance in the shunt constituting the field-magnet circuit. I think you would get at the required resistance easier by actual experiment than by calculation, as by putting into the shunt circuit by a temporary attachment, say, the whole length of your iron wire, and then trying a lamp on the dynamo terminals for a moment. If the E.M.F. is reduced too much, cut out part of the coil by a temporary attachment at half length or otherwise, and so on until you get the resistance that will just allow of the lamp burning properly on the dynamo terminals. You can then reckon what extra E.M.F. to allow, so as to get through the 335 yards of wire the same light of the lamp as at the dynamo terminals (which extra E.M.F. will be 0·266 volt for each ampère of current you have to transmit), and allow enough E.M.F. to cover this loss. If you have no voltmeter, then you will have to fall back on trying the lamp at the ends of the No. 5 wires, until you reduce the resistance to the correct amount.—EDWARD CONRY.

[61111.]—**Hand Saw.**—I inclose sketch of a saw I have frequently seen used in Northern India and Afghanistan, in which the teeth being



exactly the reverse of European saws, the work is done by a pull in place of a thrust, and that more expeditiously than the uninitiated might suppose. If I remember rightly, a newspaper critic pointed out this matter of saw teeth when Holman Hunt's picture was first exhibited, censuring the artist, thereby ventilating his own ignorance.—OMPAX.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

60514. Silvertown Firing Battery, p. 118.
60517. L.B. and S.C. Engines, 118.
60521. To Mr. Lancaster, 118.
60526. Cable Winch, 118.
60530. Lens Grinding. To Mr. Lancaster, 118.
60532. To Mr. Lancaster, 118.
60541. G.W. Trains, 118.
60543. Steam Diggers, 118.
60558. Forging Engine Work, 118.
60559. Liquid Compass, 118.

60763. Clarionet, p. 203.
60764. Pyrophorus, 203.
60769. Capell Fan, 203.
60777. G.N.R. Locos, 203.
60792. Achro. Objective, 204.

QUERIES.

[61114.]—**Dynamo.**—To MR. BOTTONE.—Many thanks for answering my letter of 27th ult. Would you kindly say whether it makes very much difference in the power of the machine if the F. magnets are narrower, say 3in. wide and ½in. thick, for the dynamo in your book? Also if the laminæ for armature must touch each other on the spindle, or be a short distance apart?—ARTHUR J. KEMP.

[61115.]—**Gas-Engine.**—Could any reader kindly enlighten a novice on how the supply and exhaust valves of gas-engines are worked? Any information on the subject will greatly oblige—A. J. KEMP.

[61116.]—**Iron Boot—Used in Junod's Vacuum Treatment (Hæmospasia).**—Can any of "ours" kindly give me any information regarding this form of treatment—where the boot could be procured, or instructions for making it? Also name of any practical book on this mode of treatment? Any information will be most highly appreciated by—J. H. M.

[61117.]—**Horse's Action.**—Can any of "ours" kindly tell me how the Americans train their horses to lift their fore feet when trotting in the fine high showy manner they do? I have heard that it is done by fixing lead weights under their shoes. Any information will be most heartily welcomed. I am also desirous of procuring a really practical and useful book on the general management and care of the horse. Will someone kindly recommend such a work? Also, is there any work published treating on training horses to perform tricks, as circus horses do?—J. H. M.

[61118.]—**Electro-Magnet.**—Would Mr. Bottone tell me what size wire I should require for an electro-magnet to pull a 1oz. weight a distance of ½in. from core, and battery power I should want?—VOLT.

[61119.]—**100-Candle Dynamo.**—Please give me dimensions for 100-candle dynamo. I want to make my own patterns as per instructions in your book, but do not know size. I should like to have patterns same as Edison's, only a Gramme armature, and will you give me quantity of wire on F.M.'s and number of sections in armature?—VOLT.

[61120.]—**Ferrous Oxalate Developer.**—When this developer is restored, as given in replies to 60967, is the result a one solution developer, or has the iron solution to be added as before?—M.

[61121.]—**Wax or Paraffin Stains.**—Candles called "wax" or "paraffin" have replaced the old tallow dip. The melted wax is a very thin liquid, and falls over clothes and furniture. What will dissolve and remove it?—M.

[61122.]—**Magic-Lantern Slides for Boy's Lantern.**—I have made some very successful slides by smoking glass till opaque, then drawing motto or design with pencil or a needle point, and afterwards flowing varnish over to preserve. Of course, I can't see through glass so as to trace over a drawing. What can I use? Ink I find does not do. Will a pen do, or must a brush be used? I have heard of gelatine for slides. Can it be drawn on with a pen? Is it used alone, or must it be mounted on a strip of glass? If so, how?—M.

[61123.]—**Analysis of Kainit.**—Would any of our readers kindly give simple directions for testing the above substance, or say how I am to interpret the following results: H_2O 2·74 per cent. (@ 212° F.); H_2SO_4 23·76 per cent.; Cl 32·12 per cent.?—F. S.

[61124.]—**Analysis of Lime.**—In Dr. Lunge's "Pocket Book" we are directed to titrate with normal oxalic acid, using litmus or phenolphthalein as indicator. The colour is said to change when all free lime has been saturated, and before $CaCO_3$ is attacked. In adopting this method, I find that after the colour has once vanished it returns almost momentarily. How is this?—F. S.

[61125.]—**Cobalt.**—Will anyone kindly inform me where I can find a book, or article, giving an account, and plans, &c., of a cobalt-extracting works, and the best methods in use? I would pay for plans, if necessary.—EDGAR HALL, Queenboro'.

[61126.]—**L. and N.W. Engines.**—Can Mr. Stretton, or any reader of your paper, give me details of engine No. 955, Charles Dickens, Precedent class, as I see she has been to Crewe for repairs? I believe she has done good work. Also, why have they taken this engine off the 4 o'clock express?—OLIVER TWIST.

[61127.]—**Force Pump.**—Will any reader describe the simplest and best way to make a hand apparatus to force a large quantity of air or gas into a small cylinder?—SUBSCRIBER.

[61128.]—**Paper Valve.**—Can there be any objection to paper passing over reeds in organette (suction principle)? If so, what are they, and how remedied?—PAPYRUS.

[61129.]—**"Loeb" Battery for Electric Light.**—(As used at Burrows and Watt's, Soho-square.) This battery is stated to last 70 hours constant with a good light. I never heard of any such performance from a battery. Can any one give full description of cells and solution. No smell from them.—THOS. PLUNKETT.

[61130.]—**Spill-Making Machine.**—I am about to make a spill machine, both for wood and paper spills. Can any of your kind readers describe the best way for making the same? A sketch would greatly oblige—A YOUNG FITTER.

[61131.]—**Electric Cautery.**—To MR. E. CONRY.—What is the most economical and most satisfactory arrangement for obtaining the heating of a cautery the resistance of which is ·06 ohm? What is it that is here required? Is it current? How could the current flowing be scientifically—I mean accurately, not roughly—measured?—A. DUNLOP STEWART, M.B., &c.

[61132.]—**Glazing Red and Black Ware.**—Will some potter friend be kind enough to give the formula for glazing the common red and black ware, and if the ware is usually slipped before leading, and what part does the slipping play in the quality of glaze, and also where to get the lead ore, either ground or in the lump, with price?—POOR POTTER.

[61133.]—**Adiabatic Curve.**—Would any of "ours" please inform me how to describe the above curve, as I cannot find it in any geometrical work?—A. J. W.

[61134.]—**Small Electro-Motor.**—To MR. BOTTONE OR G. BOWRON.—To obtain the best results from a small motor, should the resistance of the fields be exactly balanced by resistance of armature?—ALCHEMIST.

[61135.]—**To Mr. Bottone.**—I made a dynamo according to your dimensions, and I cannot get it to work. When I coupled it up with another dynamo it worked as a motor. The connections are all right. When I short-circuit it at the binding screws, small sparks appear at the brushes, and it gives a small spark when the contact at binding screws is broken. There is 10lb. No. 22 on the field magnets, and 4lb. No. 18 d.c.c. wire on the armature.—ELECTRICITY.

[61136.]—**Screw-cutting.**—Many thanks to my brother readers answering my query on the above. I find by marking the face-plate and the leading screw wheel will answer; but what I want to know is the distance the saddle must travel in inches before it will gear right for taking the second cut. I will say 11 threads per inch. I have tried "J. H.'s" plan, but find it not to answer with my lathe, four threads per inch leading screw, but it will with two threads per inch leading screw.—ONE IN A FIX.

[61137.]—**Regulating Current.**—I have a 20c.p. dynamo. Sometimes I only require one 16c.p. lamp on, other times a 10c.p. lamp, sometimes a 5c.p. How can I regulate the current for the various lamps?—AMATEUR.

[61138.]—**Yacht Steering.**—Can "Vulcan," or any-one else, tell me if there is any known way of taking part of the pressure of the weather helm off the tiller of a sailing yacht? I do not mean by altering the centre of effort of the sails by increasing foresail; but some method of balancing the rudder, so as to ease, but not destroy, the weather helm—in short, to admit the use of a short handy tiller in place of a long one.—G. H. V.

[61139.]—**Chromic Acid and Bichromate Batteries.**—Will any of your readers kindly give their experience of chromic acid in batteries? For some time past I have been using seven large cells with porous pots for zinc. The solution I have used in carbon cell was: water, 18lb.; bich. potash, 2¼lb. at 6d. per pound, equal 1s. 1½d.; sulphuric acid, 8lb. at 1½d., 1s.; total, 2s. 1½d. This makes about two pints per cell. This charge will last for about 90 days, using one 10-volt 10-candle-power lamp about 15 minutes per day. This is about altogether 22 hours of work. I know that if I had used the batteries, say, two hours per day the solution would have given better results, say 30 hours for 2s. 1½d. Chromic acid is a better depolariser, but it is dearer. I believe the proportions for use are: chromic acid, 1lb. at 8d., equal 8d.; water, 2 pints; sulphuric acid, ½lb. at 1½lb., ¾d. 8¾d. for 2 pints solution, or for 7 cells, 14 pints, costing 5s. 1¼d. Would this give me 65 hours of work. By advertisements it should do much more than this (same in proportion as bichromate of potash), or 15 times 65 hours. Any facts will be useful.—W. W. N.

[61140.]—**Grey Stains on Black Marble.**—We shall feel grateful if someone will inform us how to remove the grey or whitish marks which make their appearance on polished black marble after being exposed to the action of the atmosphere of a shop. In the Nov. 19th issue, we were referred to p. 456, No. 1088; but we find this article only describes the method of polishing, not removing stains or marks. We find many housewives and shop-keepers thus troubled with their mantel pieces and marble clocks, and think a cure will be well esteemed.—AJAX.

[61141.]—**Screw-cutting.**—Will any reader of the "E. M." be kind enough to give a few methods for calculating screw-cutting by four wheels, or double train, with a few examples of, say, 13, 15, and 19 threads to the inch, the leading screw having two threads to the inch?—CHASER.

[61142.]—**The Wimshurst Machine.**—Would Mr. Wimshurst explain why, at each discharge given by one of his 17in. machines, brilliant sparks rise upwards from what appears to be the edge of outer coating of each Leyden jar? Is it a loss of electricity, arising from some fault in construction? I can only obtain a 2½in. spark between terminals, and only given at long intervals. I, however, manage to coax a somewhat long spark by holding a glass rod to larger ball. The discharge is loud and brilliant; but not the length I expected. Should be glad of any suggestions for improvement.—SHORT SPARK.

[61143.]—**Launch Engine.**—Will one of our practical readers help me as follows? I have engine, say 3in. by 5in., running at 300 per min., cutting off at two-thirds stroke; pressure, 60lb. I wish to get a little more power. I do not want to enlarge bore of cylinder, because I do not want to use any more steam or increase pressure. Suppose I increase stroke to 6in. and cut-off as before, what would be the result? Is power gained equal, whether bore or stroke is increased. My idea was that increase of stroke was more economical.—CANTAB.

[61144.]—**To "O. J. L.," "J. H.," and Others.**—With a screw-cutting treadle lathe, 6in. centres, would you consider 34 cuts to the inch, and a cross feed of 1-16th, reducing a bar of 1½in. soft steel to 1in., fast enough for a roughing cut, and would you recommend to take it off at one cut, or would you prefer to do it at twice?—EVOD.

[61145.]—**Does it Boil?**—What is the scientific account of a cup of hot water which steams though certainly not anywhere near the boiling temp.? How reconcile this fact with doctrine that there is a certain *sine quâ non* temp. at which water begins to leave the liquid form and take the gaseous form, or is such a doctrine a mis-statement on my part? Answerers requested not to urge that visible steam is not "gaseous" water; surely it is water that has been gaseous? Is it that the parent water-gas was a solution in warm air over surface of fluid, which, on rising up, cools and forms mist?—WEALD.

[61146.]—**Battery.**—Would Mr. Bottone kindly say how many cells (as described by him on page 561, last vol.) it would take to light one of Messrs. Shippey Bros. 5c.p. lamps? What size wire should I require from battery to lamp? Also the proportions of chromic and sulphuric acid? Would the light last longer if the glass cells where larger in diameter and contained more solution? Should the zincs be amalgamated?—MEPHISTOPHELES.

[61147.]—**Red Steam.**—In holding steaming cup of coffee between self and globe of paraffin lamp, not quite in the direct line, I have noticed decided red hue in steam rising; suspicion of other spectrum colours, but red hue predominant, and very like tinge of angry sunset sky preceding rain. What is the cause of colouration, and why red? I have no colour-blindness.—WEALD.

[61148.]—**Screw-cutting.**—I have two screws to cut—one that will traverse a nut the 20th part of 3in. at the 5th of a revolution, the other that will traverse a nut the 20th part of 3in. at the 4th of a revolution. What is the pitch and wheels required and the easiest method of arriving at the same?—PERPLEXED.

[61149.]—**Dynamo.**—Will some one possessing practical experience tell me how to cut out of circuit a heated coil in a dynamo? I have had experience with the Crompton, Pilsen, Joule, Siemens, and other dynamos, and to be able to stop the machine, cut out the heated coil, and let the dynamo go on with its work again is what I desire; and any practical rule by which a dynamo guilty of this transgression can be effectively dealt with will greatly oblige—A. B. C. DYNAMO.

[61150.]—**Hydraulic, or other Press.**—I shall be glad of the assistance of any brother mechanic who can advise as to the best press for pressing crushed ore into blocks, say, similar to the ordinary filter blocks made of charcoal. Have succeeded fairly well with a hand press; but I require from four to six tons pressure, which cannot be obtained with any arrangement I have. What would be a good form of mould for my purpose?—A VERY OLD SUBSCRIBER.

[61151.]—**Liquid Fuel.**—Having a cheap supply of coal tar creasote, and being desirous of utilising it for steam-raising purposes, I shall be glad of any hints from experienced readers. The small boiler set apart for the experiment measures 15ft. by 4½ft., with a 2ft. 6in. flue. The steam is required at 70lb. pressure. The best method, I understand, is to break up or pulverise the creasote with a jet of steam, so that it shall enter the fireplace in the form of very fine spray. I desire to learn what size of pipes for conveying the creasote and steam will be required for a boiler of the dimensions given, the best kind of spray producer, and whether the fireplace ought to be protected with firebricks? At present engine slack is being used for firing, and I should like to arrange matters so that either creasote or slack can be burned at will.—K. N. S.

[61152.]—**Spanish.**—I am studying Spanish with "Ollendorff's Spanish Grammar for the use of Italians," and I find it a good system for studying by one's self. Is the method mentioned by "W. J. R." (60802) superior? I should be glad to know, as I want to learn the language quickly, and I have no means of getting a teacher.—NELIGEL.

[61153.]—**Blowing Fan.**—Can any of your readers kindly give me an approximate rule to find the number of cubic feet of air delivered by a blowing fan per minute? Also any particulars relative to the use of forced draught, which I see is rather coming into use in the Navy?—G. STOCK.

[61154.]—**Lens Measurement.**—Will a subscriber kindly give an arithmetical example showing how to divide the diam. of a stop into the focal length of a lens, supposing the measurement to be ⅝in. into 6½in. of a lens?—PHOTO.

[61155.]—**The Pantanemone.**—In Vol. XXXIX., page 391, 1884, this machine is described, and in subsequent numbers it is very well spoken of. After more than two years, can any reader give any account of its working? Has anyone got one in use, and what is its power? I am proposing a windmill pump, and should feel inclined to give this machine a trial, if its power is equal to lifting 30 gals. an hour 25ft. high.—SURVEYOR.

[61156.]—**Battery for Lamps.**—I have a battery of eight double-fluid cells, two zincs and carbons in each, size of plates, immersed, 8in. by 6in., which is used for lighting ten Edison Swan 6c.p. 10-volt lamps in parallel. It is only used once a week for about 1½h., and as it is considerable trouble filling and emptying the cells, besides moving all the plates, I should esteem it a favour if Mr. Bottone, or some other reader, would kindly inform me whether it would answer to alter the battery into a single-fluid with a lifting arrangement, or if I could use a double fluid which would not deteriorate if left standing in the cells, of course with the plates out. How long would such solutions last? The one I am using at present is reckoned to last 16 hours. Also, is it any real advantage to amalgamate zincs when the plates are only immersed during the time the current is required?—ALBO-CARBON.

[61157.]—**Condensing or Non-condensing.**—We have a non-condensing steam engine; cylinder, 20in. diam.; pressure of steam, 50lb. The exhaust is connected to pipes containing steam at 10lb. pressure. We use a large quantity of steam for heating purposes, and pass steam at 50lb. through a valve to reduce it to 10lb., and we use this and the exhaust together; we blow none away. Should we gain anything by making it a condensing engine, and make up for the loss of the exhaust by taking more steam through the reducing valve?—R. R. R.

[61158.]—**White Enamel or Paint.**—Can any subscriber inform me if there is a white paint or enamel which will stand heat? If so, give price and where to be obtained. I want it to put on the back of kitchen range to give the brick and ironwork a lighter and cleaner appearance than the usual black.—JIMBO.

[61159.]—**Electrical.**—Will some reader be so kind as to tell me where I can find an explanation of Bennet's "Doubler," or will he give me a short explanation?—ELEM.

[61160.]—**Herbs.**—Could any kind reader give names and proportions of herbs to make what the French call "Tisane aux quatre herbes"?—URANOS.

[61161.]—**Converging Lenses.**—Would any of your readers discuss the relative qualities and advantages of plano-convex compared to double-convex lenses, my particular object being to obtain interference rings by means of polarised light, and could they recommend any book on practical optics or physics which might prove an aid in the construction of such apparatus?—NEW SUBSCRIBER.

[61162.]—**Sewing Machine (Wheeler and Wilson's).**—I have one of these machines which, when doing any stiff or rather thick work, leaves loops at the

back ½in. long, or more. I cannot find out the cause. I have polished up the bobbin, and the loop passes easily over it, and is held by the brush till the next stitch is caught, when the chamfered part of the hook releases it promptly. After that the loop goes up very tardily, and does not draw up tight. It is not held by the bobbin and spool ring at all to retard it, nor does it hang between the finger and the hook, as there is plenty of room. As the work did not travel straight when left to itself, but quickly travelled out to the edge of the material, I soldered a small piece of steel to the feed-bar where it was worn away, so that it should not be lower on one side, and the work now travels better, but is still inclined to go on towards the edge unless guided. I supposed that the feed-bar, by not pushing the work straight, had forced the loop hard against the back of the slotted hole in the plate, and so caused too much friction on it. I found a nick worn at the back of the needle hole, which served to corroborate this view. I chiselled away the sharp corner which this nick made at the entrance of the slot, and drew a strip of fine emery cloth in and out to smooth it, and the needle hole is now like a one-sided pear in shape. I observe that the eccentric which lifts the feed-bar is rather worn at the edges. I see it lifts the feed-bar before impelling it forward and at the same time as the loop is drawing in? Is this lifting intended to lessen the abrasion on the loop? If so, perhaps the worn eccentric is the cause, by its not lifting sufficiently. I see the loop after having caught the hook slightly, rubs against the hollowed part of the finger as the hook revolves. Should this be so? The loops are no better for what I have done at present. Could any reader suggest the cause of them?—PESTERED MAN.

[61163.]—**Faulty Dynamo.**—TO MR. BOTTONE.—Many thanks to you for information regarding dynamo in "Ours" of Nov. 26th. I tried the suggestions. I had not connected terminals. As soon as terminals were connected I had a spark on commutator; but I could not get any light in lamp. It is a Swan incandescent lamp. I reversed the motion of armature, and got as much current one way as the other. I cannot get any current on commutator, unless I join the lateral ends of F.M. coils; then it goes through a second time. It shows on the brushes if I run it at a medium speed. I find I can get more current through it than when run too fast. The size of machine is: armature, which is Siemens H pattern, 6in. by 2in.; about ¾lb. of No. 18 d.c.c. wire. The F.M. has poles 4in. by 3in., 1¾lb. No. 18 d.c.c. wire on each; pole pieces, 5½in. by 2½in. by 1in. thick in the core. The F.M. and armature are cast iron. It is built in a vertical form on brass plate screwed on wood base, brass bearings and brass brushes, ebonite insulated commutator. It is well insulated throughout.—ANXIOUS.

[61164.] — **Tackle for Moving Observatory Roof.**—In the directions for building a Berthon observatory, given in the "E. M." of Oct. 13, 1871, mention is made of a "gun-tackle purchase" for moving the roof. As I am at a loss regarding this arrangement, may I ask for information on the subject? Full details, with hints as to the means of obtaining what is necessary, will greatly oblige. Should any kind reader be disposed to describe any other practically useful and simple arrangement for the purpose, I shall be thankful if he will kindly do so.—OBSERVER.

[61165.]—**Spectral Colours and Diffraction.**—If I hold a piece of paper with a straight margin between my eye and the window on a day with a white cloudy sky, in such a manner as to leave only a narrow line of white light, the paper is fringed with red and orange, the edge of the window with violet and blue. Why is this? It is no doubt some result of diffraction; but why is the nearest edge fringed with red and yellow and the furthest with blue and violet?—F. BENNETT.

[61166.]—**Engine for Boat.** — Will "Glatton," or some other reader, assist me out of a difficulty—viz., what size of engine (compound) will it take to drive a 36ft. boat (6ft. beam) 12 miles an hour, and at what steam pressure? What would be probable cost of steel boiler for same, boat to weigh about 1 ton?—NOVICE.

[61167.]—**Water Tanks.**—I have to construct some water tanks, and receive no other instructions but the number of gallons they are to contain. Will some of your kind readers inform me of a short rule to find the dimensions (the three)? The tanks are parallelopiped and the frustum of a cone in shape.—B. M. AND J. S. B.

[61168.]—**Enamelling on Coins.** — Will anyone kindly tell me how the above is done in all colours, leaving the raised parts of the print perfectly clear, as one often sees in jellewers' shop windows?—J. BRIGGS.

[61169.]—**Safety Couplings.**—Can anyone give a description and drawing of the Gedge safety coupling recently adopted by the M.R., L. and N.W.R., L. and S.W.R., and other railways, and say when it will come into use?—R. E. F.

[61170.]—**Leather-covered Glazers.** —What is the best kind of leather to cover small glazers about 5in. diameter?—F. STELFOX.

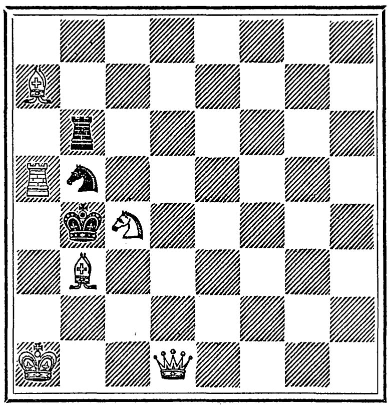
Carbon Lamp Filaments.—If steam be raised to a high temperature (to what is called a white heat) it is decomposed into the elements of which it is composed. Very high temperatures tend to break up chemical compounds. Place any kind of a wire, platinum, iron, carbon, &c., in a vessel containing a hydrocarbon gas (coal gas or gasoline vapour) and rise the wire to a white heat by a current of electricity. Those particles of the gas which are next to the hot wire are decomposed or broken up into carbon and hydrogen gas; the carbon is solid, and is deposited on the hot wire. In a short time a considerable layer of carbon will be deposited. Any portions of the wire thinner than the rest are heated by the current to a higher temperature, and consequently more carbon is deposited on that part until the wire is of the same size throughout its length. In the manufacture of incandescent lamps the carbon filment (or wire) is made uniform by this process.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXI.—BY T. H. BILLINGTON (Wolverhampton).

Black.



White. [6 + 3

White to play and mate in two moves.

SOLUTION TO 1,019.

White.	*Black.*
1. Q-Q Kt 6.	1. R-K sq (*a*).
2. Q-Q 4.	2. Anything.
3. Q or R mates.	
	(*a*) 1. R-K B sq (*b*).
2. P takes R, &c.	
	(*b*) 1. B-Kt 3 (*c*).
2. Q-K Kt sq, &c.	
	(*c*) 1. R-Q B sq.
2. Q-Q 8, &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,019, by F. Krasser and Link; to 1,018, by Link (very interesting); to 1,020, by Black Pawn and A. Bolus.

HANDSAW.—Name entered for Tourney B.

J. MACKENZIE.—Your attempt at 1,018 is incorrect.

A. DEAN.—If in 1,019 1. $\frac{\text{Q takes P}}{\text{B-Kt 3}}$ 2. $\frac{\text{Q-Q 4}}{\text{B checks}}$.

A. BOLUS.—There is something wrong about your solution of 1,019. You have 1. $\frac{\text{Q-Kt 7}}{\text{R-K sq}}$ 2. $\frac{\text{Q-K 4}}{\text{Anything}}$ 3. Q-K R 8, mate. This move is impossible; nor is there any mate.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 8, and unacknowledged elsewhere:—

D. W. ARMSTRONG.—E. P. Alexander.—C. S. Stock.—T. F. S. T.—J. B. Medland.—Blakey Emmott and Co.—Wool.—Green Lad.—B. A., Handsworth.—W. M.—J. C.—A. E. Richardson.—Amateur.—J. Seal.—Irish Contractor.—S. M. S.—Engineering, Manchester.—Country Solicitor.—A. W. Stokes.—J. Beardsall.—Les Dents.—A Fellow of the Royal Astronomical Society.—H. S. H.—A Belated Foreman.—J. H.—C. N. P.—Ignorant.—A. Treyer Evans.

A NEW READER, Londonderry. (On p. 562, No. 1117, there is a recipe for removing stains from marble. Two parts of soda, one of chalk, and one of pumice, are to be powdered, intimately mixed by sifting, and made into a paste with water. Rub that on well, and wash off with soft soap, polishing with a soft cloth. Something depends on the nature of the stains, but you will find many suggestions in back numbers.)—J. HUNT. (Pitch and rosin are both too brittle. A common cement is made by melting equal parts of pitch and guttapercha together. Perhaps a better is made by melting together 1lb. of guttapercha, 4oz. of indiarubber, 2oz. of pitch, 1oz. of shellac, and 2oz. of linseed-oil.)—F. BENNETT. (Good lime will be purchased by keymakers for organ, piano-keys, &c., and by carvers; beech by plane-makers and turners generally If by Portugal laurel you mean Cerasus lusitanica, it is used by cabinet-makers, stick-makers, pipe-makers, &c.)—SEGRO. (Many cigarettes are made by machinery, but others are made by hand. See Hints No. 4.)—ALBERT J. SELLS. (You can terminate the tenancy with the expiration of the agreement. If there is nothing said in the agreement about continuing the tenancy, it is a matter for another agreement.)—VIOLIN. (It is usual to stain and French polish. You can probably remove the present varnish with warm spirit. If not, rub off with fine glass-paper.)—RALPH LOUDON. (See the indices of back volumes, and the textbooks of astronomy.)—PERSEUS. (Your first question has been answered many times, even in recent numbers—last week, for instance, on p. 310. 1. How can anyone tell without examining them?) — DECORATOR. (What is the cement for? If you consult the indices, you will no doubt find references to one or more preparations, which may suit your purpose.)—CLIMAX. (You do not say what you wish to electro-plate; so the short answer must be Yes, and for further information consult the back volumes.)—OCTO. (Not that we know of. Red noses are natural enough in cold weather.)—R. S. P. (If you have used potash, no wonder that you cannot get it to set hard. See No. 1004, p. 355, or apply to the Greenbank Alkali Co., St. Helen's, Lancashire, for one of their circulars, in which they describe a process of soap-making without boiling.)—CONWAY. (How can anyone say without more particulars? Perhaps the insulation is not good; perhaps you do not turn fast enough; perhaps the machine is not so large as you require.)—TUNING KEY. (Tuning a piano has been frequently described. Nothing special about it, for it is purely a series of mechanical operations performed by a man who possesses an ear that can distinguish beats, and say at once whether any interval is rough or smooth. See No. 830, p. 571, and the indices of back volumes.)—ELECTRA. (How to make a phonograph was given in No. 683. See also the indices of back volumes, and if you will kindly look in any number you will see the rules relating to advertising for addresses, "Hints," &c., No. 4 above.) — AN ANGLO-ITALIAN. (Ville's "Artificial Manures," which we reviewed in No. 746, is published by Longmans, price 21s. It is of more use to the agriculturist than to the manure maker. We are afraid there is no satisfactory method of dealing with the matter referred to, if transport is prevented; but from a sanitary point of view the dry earth system would answer.)—W. H. J. (If you refer to the query, you wil see that it is for a pocket-coil. It would do for electric lighting if you have enough cells. See indices and recent back numbers.)—MUSICAL. (There is no charge for "copyright." That applies by law to any original work; but for the sake of having indubitable evidence of ownership, it is usual to register at Stationers' Hall, the charge for which is five shillings. A copy of the work to be registered must be presented at the time. In the case of a "play," a copy of the bill announcing its performance.)—J. E. W. (What has "auricular confession" to do with "ventriloism"?)—F. G. (Answered many times. A simple way is to make the iron red-hot and rub over with yellow prussiate of potash; but that only casehardens skin deep. The best method is to place the articles in an iron box and surround them with leather cuttings, filling up with sifted animal charcoal or bone-black. Lute on the lid and raise to a red heat in a furnace. Keep in that state for two hours at least, and then empty the contents of the box into water. 2. A pale gold lacquer is made by dissolving 10oz. of bruised seed ac and ½oz. of red sanders in a gallon of methylated alcohol. Strain. The brass must be thoroughly cleaned by dipping in acid and polishing, and then after being made quite warm, the lacquer is put on with a camel-hair brush, taking care not to go over the same part twice.)—O. G. A. (Gasoline is the best if you can procure it. Several apparatus of the kind are advertised; but if you look in the indices of recent back volumes you will see much about the subject. Try the "gas-maker lamp," sold by Mr. Wood, Blindley Heath, and Fletcher's gasoline furnace.)—C. KEMP. (Write on cream-laid paper with the ink made as described, and when dry place face down on the jelly, passing the hand lightly over the back of the paper. After a minute or so remove carefully, and a large proportion of the ink will be found to have been transferred to the surface of the jelly. Place a piece of dry paper on it, pass the hand lightly over, and remove, when a copy of the writing should be found transferred to the paper. When a sufficient number of copies have been taken, remove the remainder of the ink with water and a sponge. When the jelly is worn so as to be uneven, or is too much charged with ink, remelt and add fresh ingredients, pouring out into shallow trays, and removing bubbles by drawing a piece of card or stiff paper over the surface.)—TELEGRAPH POLE. (No; but such poles are always stayed.)—S. H. J. (See the indices of recent back volumes, wherein you will find references to descriptions of dynamos of somewhat similar dimensions.) — NICK. (Methods of nickel plating have been frequently described; but a full account of the art will be found in Nos. 993, 994, and 995. It can be done with a battery, but it is better to use a dynamo. Cost of battery apparatus, &c., can be obtained from Elmore and Co., Charlotte-street, Blackfriars, London, S.E.)—ELECTRIC. (With a saw, or with a piece of hoop-iron, some sharp sand, and water.)—B. R. (The question is, can you raise a *ton* weight in the manner described on p. 195? That is what requires demonstrating.)—J. M. (Flints are now considered to be, as a rule, the silicified bodies of sponges, sea-urchins mollusca, &c., which caused the silica to deposit around them; but occasional amorphous concretions may have failed to entomb the at one time living organism which caused the deposition of the silica.)—J. D. M. (Apparently a specimen of double dovetailing—a joiner's puzzle, in fact. Most people would prefer to see the model before guessing "how it's done"; but if you can take it apart you will perhaps find that the part between the dovetails or tenons is wedge-shaped in section, and has a much thinner edge on the inside than it shows outside. An article in No. 513, and some diagrams in No. 520, may help you. See also pp. 17, 125, 175, Vol. XXI. No drawing such as that you send can give any clue.)—TUBUS. (No remedy. Rubber tube should be kept under water if it is desired to preserve it.)—MAGNETO. (Draw a magnet over the pieces, or encircle them with a coil of wire through which a current is passing. The process is described in all the textbooks, and many

times in back numbers.)—CHING. (Is it necessary to ask such a question? To delicate people a cold bath might be an injury, but not to the healthy.)—F. W. G. (Good pieces are in demand for cutting prisms; it is also used for preparing the compounds of fluorine and as a flux in metallurgical operations.)—CONTRIVER. (Carpmael's "Patent Laws of the World," Clowes and Son; Johnson's "Patentee's Manual," Longmans. You will find all the information you can want in those.)—O. K. (Yes, no doubt.)—C. A. W. (The construction seems right. What battery did you use?)—T. D. COOK. (A full description of how to make a medical coil appeared on p. 52 of this volume.)—TOURIST. (The Canary Islands are so well known, especially Teneriffe, that you will find abundance of information in the cyclopædias and gazetteers. The subject is scarcely of sufficient interest to our readers.)—J. F. C. (What do you mean? They are moulded up in the usual way on the potter's wheel from clay, which remains porous when burnt. 2. Iron can be used, but will not last so long.)—NEMO. (Perhaps it has not been sufficiently purified. It is in crystal until ground to powder, and in that state is slightly affected by damp. For tests for adulterants see "Argol" in Slater's "Manual of Dye Wares," or Allen's "Commercial Organic Analysis," Vol. I. There is no rough and ready test.)—B. M. AND J. S. B. (There are several almanacs of the kind; but we presume you mean that devised by the late Rev. J. Pearson, which appeared in No. 933.)—TINPOT. (See the Ferguslie balling machine, exhibited at the "Inventions" by Mr. Brooks, of West Gorton, Manchester. In Brunel's original balling machine the ball is made on a rotating spindle, the thread being laid on by a rapidly revolving flyer, the axis of which is oblique with that of the spindle.)—S. (A sketch of the place would be necessary to give a definite answer. What you suggest might be done; but valves would have to be fitted to divert the current of hot gases—otherwise they would take the most direct course.)—EBONITE MAKER. (Indiarubber means pure rubber as sold in commerce. Sulphur means brimstone sold in rolls. Try 3 to 5 per cent. of sulphur. Plaster of Paris makes good moulds. Read the articles on the "Indiarubber and Guttapercha Industries," in Vols. XXXI. and XXXII., or procure the book from the Society of Arts, John-street, Adelphi. There are articles on the subject in most of the cyclopædias, and much special information in our back volumes.)—SPARK COIL. (You will find full directions in many back numbers; but why not look at a coil and make a copy of the contact breaker?)—A. B. (Writing done with a weak solution of sulphuric acid and a quill pen becomes visible when heated; but the best ink of the kind is the solution of chloride of cobalt, which becomes visible when heated and vanishes as it cools.)—J. B. (Set it spinning, and keep it spinning in various positions between the poles of an excited electro-magnet, or between the field magnets of a dynamo. See No. 762. 2. Certainly it would do, and any available motor could be used. The machine is not designed for the purpose; but as it generates current you can use that current for any purpose. Hand-power could not be depended upon.)—AQUA. (Sketches and descriptions of so-called self-acting fountains in Nos. 459, 582, 801, 967, 973, 974.)—YOUNG MU. (Rules have been given over and over again in back numbers, with many tables as well. There is a "universal" table in No. 1115. See p. 543, No. 1092, and the indices.)—PLOFED. (The camphor would dissolve in the wine, but not the sulphur. There must be some error, or perhaps it is meant that it is present in the form of a sulphide. An excellent wash is made of 8 fluid ounces of Eau de Cologne, 1 fluid ounce of tincture of cantharides, and half a drachm each of oil of rosemary and lavender.)—A SOCIALIST. (We have closed the discussion, and cannot reopen it.)—GULLIVER (We could not possibly spare the space the delineation of the gradients would take, and we must limit the room occupied by railway details, many of which are of interest to very few readers indeed.)—X. Y. Z. (In type.)

To Tell the Age of Eggs.—We recommend the following process (which has been known for some time, but has been forgotten) for finding out the age of eggs and distinguishing those that are fresh from those that are not. This method is based upon the decrease in the density of eggs as they grow old. Dissolve two ounces of kitchen salt in a pint of water. When a fresh laid egg is placed in this solution it will descend to the bottom of the vessel, while one that has been laid on the day previous will not quite reach the bottom. If the egg be three days old it will swim in the liquid, and if it is more than three days old it will float on the surface, and project above the latter more and more in proportion as it is older.—*La Nature.*

Detecting Barytes in White Lead.—The most common adulterant of white lead is permanent white, or sulphate of baryta. This admixture may be recognised by boiling a small quantity of the pigment in a glass test tube or flask, with nitric acid diluted with an equal measure of water. The white lead dissolves, but any sulphate of baryta remains as a white residue. To prevent any chance of error, the residue should be allowed to settle, the clear liquid poured off, the deposit again treated with nitric acid, and then boiled with water.

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OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, **Photo Apparatus**, wet or dry, cameras, sundries, &c., in exchange for Microscopic or Magic Lantern Slides.—Apply, PIGGOTT, Chemist, Huddersfield.

Wanted, **Launch Boiler**, Engine, Propeller, &c., for 16 by 5ft. boat. Can offer lot new Hammers, Axes, Planes, Ironmongery, Cutlery, &c.—HARRISON, Devoran, Cornwall.

Gas-Engine (Bisschop), 1 man power, cost £25; Water Engine, 1 horse, by Ramsbottom, working order; 2,000c.p. Arc Lamp. Offers.—W. HUTCHINSON, Liversedge.

Dynamos, four, two by British Electric Light Coy.; 3 Serrin Arc Lamps, switch boards, brushes, carbon, speed indicator, coil, &c. Offers.—W. HUTCHINSON, Liversedge.

Wanted a 4½in. or 4in. Iron **Lathe**, or pair 4½in. Lathe Heads, cheap, in good condition, in part exchange and part cash.—A. TURNER, Roydon, Ware, Herts.

Photographic Rolling Press, size of steel plate 18in. by 12in.; exchange for back-geared lathe, 5in. centres, iron bed with slide-rest.—C. H. HATCH, Photographer, Alderley Edge.

Iron **Foot-Lathe**, 4in. centre, 3ft. 6in. bed, 3-speed flywheel, crank and treadle, compound slide-rest (nearly new), hand rest, and 3 Tees, 3 face plates, 3 chucks, carriers and tools, fret-saw attachment, saws, &c., all as good as new. Offers.—EDWARD FRANCIS, St. Austell.

One dozen pure nickel silver **Teaspoons**. Will exchange for anything to value of 3s. 6d.; sample, 4½d.—GILBERT, Oxford-road, Sheffield.

Wanted, a 2 H.P. **Steam Engine**, complete and in good condition. Will exchange cash and a ¾ H.P. Engine, valued at £7.—Particulars to S. H. HIGGS, 20, Castle-street, Reading.

Organ Bellows, for 6 or 8 stop organ; Organ Accordion (Busson's) on stand. Exchange, offers; fretsaw wanted.—B. MARTIN, Overton-road, New Humberston, Leicester.

52in. **Bicycle**, in good condition, with lamp, bell, spanner, &c., strong, and suitable for a beginner. Can be seen by appointment. Wanted good air-gun, and part cash. For value see Sale Col. advt.—C.E. K., Lady Cross, Gayton-road, Harrow.

Lancaster's **Lens**, worth £1. Will exchange for electro-motor to drive sewing machine.—LAING, Bridge of Earn, N.B.

Vertical **Slide-Valve Engine**, brass cylinder, 2in. diameter, 3½in. stroke, cylinder tight and perfect, worth 50s.; offers. Wanted dynamo, lantern slides, &c. Photo two stamps.—DUCKWORTH, 10, Cedar-road, Leicester.

Saddle Boiler and Piping, &c., new, 34s., or exchange lathe.—J. LAND, Miller's-green, Wirksworth, Derby.

Coil, on polished mahogany stand, dovetailed, ebony ends to coil, with condenser, 100 sheets, quite new; exchange for microscope or anything in the mechanical line.—H. J. LONEY, Post Office, Gosport.

Wanted, a strong 5in. **Poppet Headstock** in good condition. Offers.—WALKER, JUN., Balance-street West, Uttoxeter.

Wanted, small Screw-cutting **Lathe**, in exchange for two good bicycles, 53in. and 55in., this season. What offers?—PETER GOUGH, Wellington-street, Bilston.

Vertical **Slide-Valve Engine and Boiler**, 1in. bore, 2in. stroke, with water gauge and fittings complete. Will exchange for organette and music. — E. BAILEY, 2, Bainsbech-terrace, Northwich, Worcester.

For exchange, Stanley-Gibbens **Stamp Album**, in good condition, containing 420 stamps, for Newman's "Butterflies and Moths," or entomological apparatus.—S. HOPKINS, Elmwood Villa, Poole.

Dynamo Castings for six 5 candle-power lamps, partly finished. What offers?—HAMES, 5, Oriel-terrace, Oriel-road, Homerton, E.

Offers wanted for first 22 parts of "**Dante's Inferno**," by Cassell, excellent condition.—W. ARMSTRONG, 30, Queenshead-lane, Handsworth, Birmingham.

Conservatory Stove, terra-cotta, Doulton's make, nearly new, and stove-pipe, cost £5 10s. What offers?—C. J., 17, Elam-street, Camberwell.

12 **Magic Lantern Slides**, in mahogany frames, 12in. by 3in. Wanted graphoscope lens, or reading glass, about 5in. diam.—J. BRYAN, Photo, Bridlington, Yorks.

Wanted, **Magic Lantern and Slides**. Exchange horizontal trunk steam engine, medical coil and battery.—W. FREEMAN, 4, Powlett-street, Throston, Hartlepool.

Gunmetal hand **Numbering Machine**, 1⅝lb. Covered Wire (been used on coil), and Crest Album, for large lens.—JOHNSON, 64, Wellingborough-road, Northampton.

Wanted, 4in. **Expansion Joint Hot Water Pipes** in exchange for "Thompson's Gardener's Assistant," in good condition.—D., 8, Marston-place, Cottle's Oak, Frome.

Horizontal **Steam Engine**, 6in. stroke, 3in. bore, 24in. flywheel, new. Exchange for a small lathe, complete, to the value of £3.—Stamped addressed envelope to P. PITMAN, Mellor, Marple, near Stockport.

Chest of **Mechanic's Tools**; book, "Every Man His Own Mechanic," Spon's "Mechanic's Own Book," Engine-making, finished Parts of Engines, Musical Box, Exchange.—Above.

Splendid **Magic Lantern**, with 60 slides, all complete, in fine mahogany case. What offers?—J. GREIG, Rock-road Cottage, Killarney.

Dynamo (small), lights four 5 c.p. lamps, laminated armature, mahogany base, in good order. What offers?—H. BOARDMAN, 26, Mill-street, Luton.

Wanted, a round **Brass or Copper Tube**, about 18in. long, 7 to 9 diameter. Offers. Must be true inside. Exchange.—T. TIPPING, Painswick, Gloucestershire.

48in. **Bicycle**, nearly all bright, condition as new, pair 5½in. Lathe Heads. Ornamental Slide-rest, with tools. Exchange Safety Bicycle.—F. POYNTER, Eton College.

Large cylinder **Electrical Machine**, Leyden jars, mahogany stand, and 48in. Bicycle, Roller Bearings, Lamps, &c. Exchange for Lathe or Telescope.—WALKINGTON, Stoneyrock-road, Leeds.

Wanted, Hopkins's and Rimbault's work on the **Organ**. Offers. Also to exchange Quarter-plate Camera.—BURTON, Ringwood.

Bicycle, 52in., good, no rubbish; exchange for lathe or Engine, or useful Tools.—GLOVER, 12, High-street, Derby.

4-stop **Organ Soundboard**, new, professionally made; 12 extra channels for octave coupler. What offers? Lathe wanted.—J. BELL, 58, Gladstone-street, Monkwearmouth, Sunderland.

8in. Magnet, 3in. **Electric Bell**, best make, battery and case, and bottle Bichromate, good as new. Violin or Lantern wanted.—NEWMAN, Boarded-lane, Reading.

Vertical **Boiler**, 2ft. high, new water gauges, safety-valve, small steam gauge, ⅞ pump. Offers. Sketch, 2 stamps.—Letters, W. SMITH, Bilston-road, Wolverhampton.

Wanted, half-plate **Symmetrical Lens**. Will exchange Electrical Apparatus Motor, Coil, Batteries.—W. RICHARDSON, Day and Son, Westtown, Dewsbury.

Cylinder **Electrical Machine** and accessories, in box fitted. Cash, or good 14 keyed A Clarionet, Albert Model Patent C Sharp.—Particulars, TEAGUE, Ashcott, Bridgwater.

Scientific Books.—What offers? "Steam Engine" (Goodeve), pub. 6s.; "Electricity" (Jenkin), pub. 3s. 6d.; "Popular Lectures on Science" (Helmholtz), pub. 12s. 6d.

Books.—"Electricity" (Fergusson), published 4s. 6d.; "Electricity" (Deschanel), pub. 4s. 6d.; "Electricity" (Pepper), pub. 2s. 6d.; "Electricity" (Tyndall), pub. 2s. 6d.; "Acoustics, Light, and Heat" (Lees), pub. 2s. 6d.

Books.—"Advancement of Learning" (Bacon), published 4s. 6d.; Dr. Scheiegel's "Philosophy of Life," pub. 3s. 6d.; Works of Shakespeare (Globe Edition), 3s. 6d.; "Faraday as a Discoverer" (Tyndall), 3s. 6d.

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Books.—"Geometrical Drawing" (Binns), published 5s.; "Solid and Descriptive Geometry" (Edgar and Pritchard), pub. 3s. 6d.; "Solid Geometry and Conic Sections" (Wilson), pub. 3s. 6d.

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"**English Mechanic**," Vols. VIII. to XX., unbound, XVIII. to XXVI., bound, all clean and perfect. What offers?—MCCULLOCH, 10A, North-street, David-street, Edinburgh.

Fifty Photo. **Lantern Slide Views**, mostly Scotch. What offers? want ¼-plate camera.—Address, FINLAY, 182, Trongate, Glasgow.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Economic Cookery.—Patent Heat Conductors for roasting, 2s. 6d., baking, 2s. 3d.; boiling, 2s. per pair, carriage paid. See ENGLISH MECHANIC, Oct. 15, 1886, page 147.

The Patent Heat Conductors save a family pounds a year.—Agent, TALLACK, 28, Hatton-garden, London.

New Illustrated Price List of **Screws, Bolts, and Nuts** for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

Wimshurst Influence Machine.—Sole manufacturers of new and improved pattern. 12in. from 30s.—KING MENDHAM, and Co., Bristol.

Deposition of Smoke.—Complete Apparatus to perform this never failing experiment, with static electricity, 5s. 6d. and 10s. 6d.—As above.

Standard Ohm, in boxwood cylinder, guaranteed correct to ten thousandth of ohm, 18s. 6d., with copper poles, 21s.—As above.

Galvanometer Cards for tangent and ordinary combined, vertical, astatic, reflecting, and unmounted compass cards.—As above.

Variable Resistance Incandescent Lamp Stand, invaluable for battery power, vide ENGLISH MECHANIC, Oct. 16, 1885, price 3s. 6d.—As above.

Write for **King, Mendham, and Co.'s** large new and reduced Price List, post free, 4 stamps.

"**Beginner's Guide to Photography**," one shilling. Wholesale of the publishers, LEJEUNE and PERKEN Hatton-garden, London.

"**Beginner's Guide to Photography**," one shilling. Free from abstruse technicalities. Retail of Opticians and Booksellers.

Electric Depot, 10, Deansgate, Manchester. Handiest shop in the trade. Largest stock. Greatest variety. Lowest prices.

Catapults, 7d., 1s., 1s. 2d. Square Elastic, 2d., 3d. 4d. yard. Round, 6d., 9d.—MOODY BELL, Cheltenham.

Leclanche Batteries, 14s., 16s., 24s. per dozen. Sample, 1s. 9d., free.—SEDDON, 5, Queen's-road, Chadderton, Oldham.

Wheel-Cutting to 12 inches diameter in brass only.—CLEGG, 18, Belinda-street, Hunslet, Leeds.

Planing to 12in. by 12in. by 8in. Boring, Turning, Screw-cutting, Slide-rests, &c.—CLEGG, as above.

Aerated Water Machinery.—Repairs, Renewal, Additions, &c., skilfully executed.—N. St. G. WILCOCKS, 45, Avon-street, Bath.

Soda Water Machine, bargain. Engraving free post.—NATHANIEL SAINT GEORGE WILCOCKS, Bath.

Carbon Plates, best quality, cut and moulded, plain and capped; quality cannot be surpassed.—GEO. G. BLACKWELL.

Pebble Carbon.—Graphite for Leclanche cells, splendid conductor; price very low.—GEO. G. BLACKWELL.

Manganese Oxide specially prepared for Leclanché batteries; high strength and purity, greater E.M.F., constant action; been in use 15 years with immense satisfaction; 7, 14, and 28lb. packets. Prices on application.—GEO. G. BLACKWELL, 26, Chapel-street, Liverpool.

Mica or Talc cut for all purposes by C. JOHNSON, 7, New Oxford-street, W.C. Mica chimney covers, &c.

Grease Making without rosin oil.—Sample and particulars from J. M., 6, Hamlet-street, Bootle, Liverpool.

Mica or Talc.—RICHARD BAKER and Co., 9, Mincing-lane, London.

Lathes for every trade and every fancy. We make upwards of 250 varieties.—BRITANNIA CO.

Catalogue of Lathes and Parts, finished or rough, also of other Tools, six stamps.—BRITANNIA CO.

List of Second-hand Lathes and Fret Saws, one stamp.—BRITANNIA CO., Colchester.

London Showrooms.—Britannia Co., 99, Fenchurch-street. All correspondence Britannia Works, Colchester.

Lathes, Files, Steel, Saws. Cheap, good. List, 2 stamps. Cash or hire.—ROBINSON, Catherine-street, Sheffield.

Printing Presses from 10s., complete with type. Instructions for amateur printers, 1d.—ADAMS BROS., Daventry.

Turning Woods for Amateurs.—Box, Cocus, Lignum Vitæ, Snake, from 3d. per lb.—HARGER BROS., Settle.

Skates (Acme), highly recommended, good value, steel plates, 4s. 3d. pair, free.—HARGER BROS., Settle.

Organ Metal **Pipes**, workmanship and material guaranteed; lowest prices.—SHIELD, Little Green-lane, Small Heath, Birmingham.

Wood Planing.—Hand power 120, steam-power 1,200ft. per minute. Illustrated circulars free.—G. HAZELAND, Par, Cornwall.

"**The Wilcocks Eclipse**" turnover bottler for patent stopper bottles.—Maker, N. ST. G. WILCOCKS, Bath.

"**The Wilcocks Power Cork Bottler**" for soda water, lemonade, &c.—N. ST. G. WILCOCKS, Bath.

Lathe Castings, &c.—See T. Taylor's advertisement in ENGLISH MECHANIC every other week. Established 1847.

6s. 6d. Complete.—Electric Bell, Battery, Push, Wire, Staples, and instructions for fittings.—WHITAKER, Electrician, Blackfriars, Salford.

"**The Electric Light and How Produced.**"—A pamphlet of illustrated instructions for making dynamos sent post free postal order One Shilling.—ALFRED CROFTS, Dover.

Carving Tools.—Set of 22, warranted, handled, well assorted, by post, 11s. 6d. See illustrated catalogue.—LUNT'S.

Saws, Disston's American, agent for same. Planes, new, London, malleable iron and gunmetal, every description.—LUNT'S.

Vices, bench, parallel steel jaws, to open 3½, 9s. 6d.; ditto 4, 15s.; ditto 4¾, 21s.—LUNT'S.

Tools, every description. See illustrated catalogue. 90 pages. Send 4 stamps.—A. S. LUNT, 297, Hackney-road, E.

Corundum for Aluminium or other purposes.—RICHARD BAKER and Co., Mica Brokers, 9, Mincing-lane, London.

Brass Castings of Model Engines of all classes, in sets or otherwise. These castings are the best in the trade, and have obtained the highest testimonials from amateurs and others in all parts of the United Kingdom for cleanliness of moulding, ease in finishing, and correctness of detail and design; being models of engines of modern construction. Boilers supplied of every type to suit the above from stock or to order. Fittings of all kinds, feed pumps, governors, safety valves, steam gauges, water gauges, &c. Comprehensive price list, post free, two stamps.—LUCAS and DAVIES, 21, Charles-street, Hatton-garden, London.

Corundum Wheels.—RICHARD BAKER and Co., Mica Brokers, 9, Mincing-lane, London.

Electrical Stock.—Clearing surplus under cost. Medical Coils, plated, with slide, 15s. Invalid Bell Sets, 8s. 6d.

Terminals, 20 per cent. off list. Wire, Electro-Motors, Batteries. Write for list.—759, Old Kent-road, S.E.

Two built **Wooden Booms**, about 60 feet lengths, by about 30in. diameter, with 16 and 18 strong iron hoops, also rings on each. Used for ballasting light ships during removal.—42 Box, Post Office, Newcastle-on-Tyne.

An **Overhead Traveller**, with winch attached, to lift 2 tons.—42 Box, Post Office, Newcastle-on-Tyne.

A heavy **Circular Saw Bench**, in good condition, with about 15 5½in. metal rollers, in strong metal standards.—42 Box, Post Office, Newcastle-on-Tyne.

Electric Bell Sets, comprising bell, battery, push, and 25 yards of wire, 7s. 6d. Catalogues of apparatus free on application to HUNTER and Co., 56, Wincheap, Canterbury.

Boilers, Vertical, Portable, and Cornish, one horse-power upwards.—GRANTHAM CRANK and IRON COMPANY (Limited), Grantham.

Strong 3½in. **Lathe Head Castings**, powerful back-gear, 32lb., 5s. 6d. Bearings conical or plain.

Taps, Dies, Reamers, Screws made to order. Reply stamp.—JARRATT, 15, Short-street, Queen-street, Leicester.

Lead Electric Accumulators made up and burned. Any class of chemical work done. Soldering superseded.—HOWELL and BRIGGS, Practical Plumbers, 58, Rokeby-street, Stratford.

Marlborough **Tricycle**, quite new, to be drawn for, tickets 1s.—SMITH, 40, Calverley-road, Tunbridge Wells.

Self-feeding and Hand-feeding **Drilling Machines** for fine work. Write for list.—F. GREENAWAY, Maker, Slough, Bucks.

First-class **Lathe** (equal to new), with compound geometric, eccentric, and spherical chucks.—GEO. PLANT, Alsager, Cheshire.

Selection of interesting **Microscopic Slides** for Sale, from 6s. doz.—S. HARRISON, Dalmain-road, Forest Hill.

Powerful **Hydraulic Press**, to 500 tons, steel cylinder, 18in. ram, to be Sold, a sacrifice.—CAM.

Splendid **Launch Engine**, two 3in. single-acting cylinders, £25.—CAM and SON, Excelsior Works, Worcester.

Notice.—The following **Instruments**, by Troughton, and Sims are for Sale at CLARKSON'S, Astronomical Telescope Maker, Bartlett's-buildings, Holborn:—4in., 5in. Y Theodolites; 5in., 6in. Transits; 10in., 14in. Dumpy Levels; Miner's Theodolite, Pentagraph, Pillar Sextant, Pocket Sextant, 20in. Transit, 3¼ Astro. Telescope, well mounted, and 2¾ Astro. Telescope, Dollond, equatorially mounted, cost £50; price of this, £20.

Painter's Stencil Patterns; 6 dado borders, 2s. 3d. 6in. Alphabet, 3s. 3d.—J. DEAN, 179, Princess-street, Manchester.

Gas-Engine, one H.P. Otto (Crossley's), in first-rate condition.—98, King's-road, Camden-road, N.W.

Wood Planing.—Hand-power 120, steam-power 1,200ft. per minute. Illustrated circulars free.—G. HAZELAND, Par, Cornwall.

Metallic **Violin Strings**, acknowledged success, six Firsts, post free, 1s.—JOHN ELARCO, 24, Fern-grove, Liverpool, S.

Soda Water Machine, gas-work, turn-over bottler, recipes, &c., for working, £20; particulars free.—WILCOCKS, Bath.

Bentley's Electrical Stores.—The cheapest house for bells, batteries, wires, and fittings.—7, Newton-street, Manchester.

Dynamo, 60-candles, improved armature, 40s. Photo., 5 stamps.—D. WALTON, King-street, Hebden Bridge, Yorks.

Dynamo, 30c.p., improved armature, 26s. Photo., 5 stamps.—D. WALTON, King-street, Hebden Bridge, Yorks.

Experimental Dynamo, improved armature, 14s. covered wires from 1s. 4d. per pound, castings, &c.—D. WALTON.

Piles.—Agonising cases cured first application.—T. Palmer's Indian Ointment, 13½d.—Chapel-terrace, West Auckland, Durham.

"**Palmer's Prescriptions, 2s.**," Positive Cure for Skin, Urethral Diseases, &c. State symptoms.—Chapel-terrace, West Auckland, Durham.

Lathe, 5in. centre, 3ft. 3in. bed, slide-rest, jaw and 4 other chucks and tools, £17.—S. SMITH.

Lathe, 4in., 4ft. gap bed, screw-cutting, change wheels and chucks, complete, £20.—S. SMITH, 11, West-street, Soho, W.C.

Model **Electro Motor Castings**, with base and wire, complete, free, 1s. 6d.—HAILEY, 19a, Villars-street, Liverpool.

Entirely New Discovery, **Tinolite Soldering Flux**, a crimson fluid, has no fumes and no after-rust.

Tinolite, a great boon to Jewellers, Metal Workers, &c. Ask those who have tried it.

Tinolite for easy soldering, tinning, &c., 1s.; double. 1s. 6d.—HERBERT JONES, Broadfield, Wallasey, Cheshire. Agents wanted.

Mesmerism.—Complete Written Instructions, sure and certain success, 1s. 6d.—W. THOMAS, 22, Clarendon-road, Anfield, Liverpool.

Circular Saw Table, suit 3in. to 6in. centre lathe, adjustable fence, loose piece full length of saw slot, takes saws to 9in. Particulars, stamp. Litho, 3d. Castings, 3s. 6d. Planed and fence fitted, 8s.—PATRICK.

Vertical Planer, utilises ordinary slide-rest on the lathe without alteration, suit 3in. to 6in. centre lathes, weighs 35lb. Photo, 6d. Castings, 10s.; planed, 22s.; finished, 50s. Reply, stamp.—PATRICK, Chelmsford.

"**Sheet metal Workers' Instructor**" (Warne's)—Few copies cheap, covers slightly soiled.—94, St. Augustine's-road, N.W.

48 plain photograph **Lantern Slides**, Windsor Castle and others, 3¼ square, 8s. Sample, 4d.—LIMBY, Kew, Surrey.

44 Java, 8s. Coloured Photographs, 8s. dozen. Sample, 8d. Coloured Tracings, 6s. dozen. Sample, 6d.—LIMBY, Kew, Surrey.

Brass **Model Engine Castings**, rough and finished, best quality. List, stamp.—WOOD, Dalley-street, Broughton, Manchester.

American Organ, full compass, new, perfect condition, fine tone, powerful swell, price only £5 10s.—J. HAYES, 32, Magdala-road, Upper Holloway, London, N.

"**English Mechanic**," for sale, 480 numbers, price £1.—W. HARDT, 165, Pentonville-road.

West London Electric Works.—Crampton Electric Bell, 3½in. nickel-plated, 7s. 6d. Indicators, Pushes, Burglar Alarms. Trade supplied. Lists, 1d.—4, Studland-street, Hammersmith, W.

Watt, Winnall, and Co., Electrical and Mechanical Engineers, Atlas Works, Bromley-street, Commercial-road, E. Electric Locomotives from 25s. each. All work done on the premises. Send for price list, 2 stamps.

Gelatines for tracing magic-lantern slides, 3¼ size 4½d. per dozen.—Address, PHOTO, 182, Trongate, Glasgow.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 17, 1886.

MICROSCOPICAL ADVANCES. — XV.

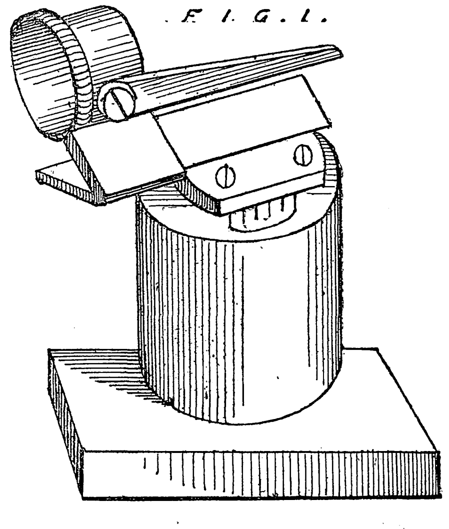
By DR. ROYSTON-PIGOTT, M.A. Cantab., F.R.S., F.R.A.S., Memb. Roy. Coll. Physicians, Fell. Cambridge Phil. Society; formerly Fellow of St. Peter's College, Cambridge.

On the Circular Solar Spectrum.

EXPERIMENT 1.—To proceed: A very fine 1-15th Ross, No. 20,315, mechanical action of screw-collar most admirable, marked *wet*, with large margin for correction. This glass is used to-day (Nov. 10, 1886) as a condenser; a mercurial bulb nearly 3-4th inch diameter is placed 18in. distant, opposite to a bright window. The exquisite miniature is most beautifully defined. Observed with a Seibert (1-16th) made to my order, the miniature is now magnified 1,000 times, and retains all its brilliance of detail; demonstrating the high quality of this very satisfactory Ross 1-15th.

Look at this picture and then on this. A travelling microscope, by Moginnie, enjoyed

FIG. 1.



a 1-4th objective. This very miniature, so exquisitely formed by the Ross 1-15th and displayed by the Seibert 1-16th, is ruined by it absolutely.

Substituting a white watchface, the whole thing is submerged in a sort of thick London fog; replace the Seibert 1-16th, everything is brilliant; the minute dots and the name James Pyott most perfectly distinct, yet the power with the Moginnie "quarter" was only 200! A eyepiece.

A plane silvered mirror spoils the definitions. An Amici prism nearly doubles the light by internal reflection. The details of its miniature prospect are most clear. As a rule the observing objective should only be about half the power of the condensing objective.

The prospect is now observed with a superlative 1-10th immersion. The steeple of All Saints', 400 yards distant, is sharp and clear.

I may now relate the following experience:—I had constantly found, in pursuing these researches, that either achromatism was sacrificed to aplanatism, or that the attainment of achromatism destroyed the brightness and truth of aplanatism.* The following incident is worthy of attention:—Whenever, in watching the heliostat, the sun was clouded over, the microscopic miniature-perspective of the room and distant apparatus reappeared; and, after various adjustments, I obtained a perfect definition free from the white mist of spherical aberration,

* Aplanatism means absence of spherical aberration.

FIG. 2

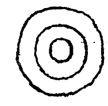


FIG. 3

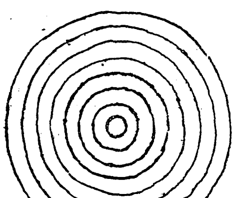


FIG. 4

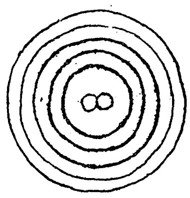


FIG. 5

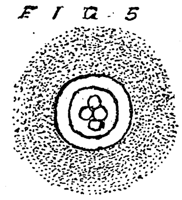
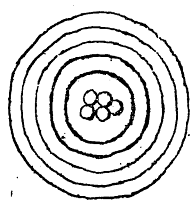
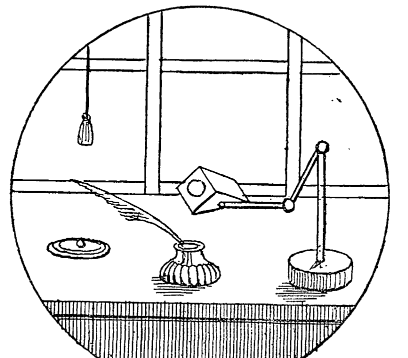


FIG. 6



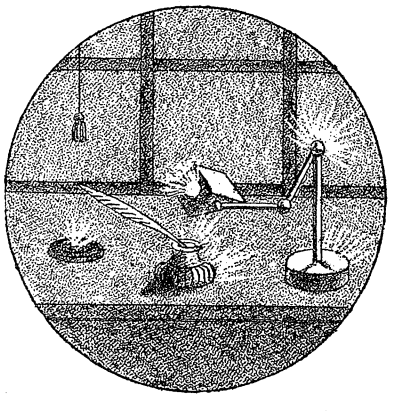
and as clear and sharp as the definition of a first-rate opera-glass. The prism and lens of the heliostat then gave a pretty picture of the passing clouds, as well as small details of

FIG. 7.



the distant objects*; but the instant the sun began to shine, before the rings dazzled the sight, every shining point appeared haloed with a corona of orange and red. I

FIG. 8.

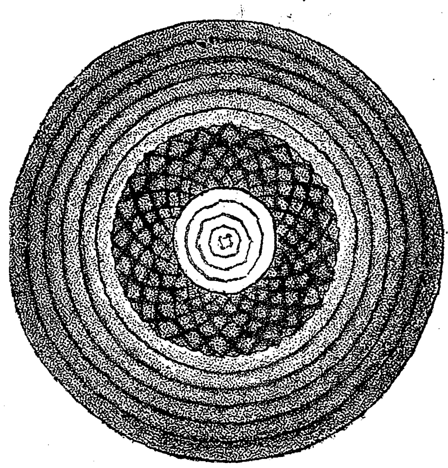


now turned aside the prism; then, every polished point in the full sunshine exhibited the same orange and red halo. Again, in the shade, the picture resumed its sharp definition. Waiting again for the sun, forth shone the orange haloes; the collar corrections were diligently plied till the halo nearly disappeared. The sun passed behind a cloud. To my astonishment, the former sharp clear prospect was now *bedimmed with a general white mist*, utterly obscuring all the details so beautifully clear before. The appearance of this white mist above the best focal plane now convinced me that the best modern English glasses, when rendered achromatic by screw-collar adjustment, beget a residuary spherical aberration, which obscures many delicate structures; and that until this important fact is acknowledged, an insuperable bar to the development of the finest definition will continue to exist.

* The window should be thrown open.

In these combinations regard was had to whether the pair of glasses were intended for the dry or immersion principle. The immersion system is valuable for the increased

FIG. 9.



volume of the cone of rays radiant from an illuminated particle mounted in balsam, a much larger pencil reaching the object viâ water than can possibly be effected viâ air; the critical angles of total internal reflection being so much larger in passing from glass into water than into air.

All these appearances were most gorgeous in brilliance on a fine day, when the sun blazed in a clear blue sky. The additional stand for carrying extra lenses or objectives is given at Fig. 1.

EXPLANATION OF FIGURES.

FIG. 2.—Primary rings finely defined at the first visible focal plane.

FIG. 3.—Secondary rings, at a deeper focus. The central disc should have been squared off.

FIGS. 4, 5, and 6.—Development of two discs instead of one; also of four irregular discs showing the existence of displaced centres and irregular diffractions.

FIGS. 7 and 8.—The miniature prospect of the distant window is displayed sharply in Fig. 8. So soon as the sun began to shine, the blazing prism being quenched by turning it aside, every brilliant point became irradiated with an orange-red halo (Fig. 9). If the colour were corrected by change of the general adjustments, so as to destroy halo, then the prospect in Fig. 8 became enveloped in a strong white mist of uncorrected residuary aberration.

FIG. 9.—In this case the heliostat was placed nearly 40ft. distant. The internal lenses of a fine $\frac{1}{4}$-objective being all removed, the thick front only was employed to form the miniature on the stage. A peculiar irregularity in the central jet-black rings is supplemented by extraordinary eccentric lines bordered by a new order of peripheral rings, obeying a different order of expansion. Viewed under Powell's best dry $\frac{1}{8}$th; a $\frac{1}{2}$in. single plano-convex lens being used as eyepiece.

In the next article I propose to describe my compensating eyepiece, given in *Proceedings* of the Royal Society, 1873.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—XVII.

By an Analytical Chemist.

Boiled Oil.

(233.) THIS is ordinary linseed oil which has been boiled with a certain proportion of "driers." The object of boiling and of adding driers is to increase the drying properties of the oil. In this operation the specific gravity is increased more or less, according to the length of the boiling; and the colour is darkened. Generally speaking, the longer the boiling, the higher the specific gravity, the darker the colour, and the better the drying properties. This darkening of colour is one of the great drawbacks to the success of the process, and the adoption of steam heat, instead of that of a direct fire, has not only diminished the number of accidents, but has also enabled the manufacturer to produce a paler article for the same degree of boiling.

(234.) The tests are practically the same as for linseed oil.

The specific gravity, however, is liable to much variation, depending, of course, on the use for which the oil is intended. It may vary from ·933 to ·967. Oils of ·933 gravity are, as a rule, under-boiled, and are little (if at all) superior to unboiled oil. Some of them, however, dry very well, even with a small proportion (about ·2) of driers. Oils of ·967 gravity are called "burnt" oils, and are prepared specially for printing purposes. These do not contain driers always. Of "burnt" oils there are three varieties—"weak," "medium," and "strong." The gravities vary from ·939 in the "weak" to ·957, or more, in the "strong."

"Double-boiled" oils are also met with. The gravity usually varies from ·945 to ·957; but occasionally falls as low as ·939 and rises as high as ·962.

"Steam-boiled" oils usually range in gravity from ·938 to ·953.

The great bulk of boiled oils—at least 70 per cent.—lies between the gravities of ·939 and ·949; and for general purposes oils of these gravities will be found suitable. From ·940 to ·945 are perhaps the best limits.

(235.) *Drying properties.*—Spread on glass, as described in Art. 230 C, an ordinarily good oil should dry in from 16 to 24 hours.

(236.) *Driers.*—The estimation of the amount of driers in boiled oil is of some importance. Five grammes of the oil are weighed in a porcelain basin, and gently ignited over an Argand until all the carbonaceous matter is destroyed, and nothing but a pinkish-grey ash remains. This is then weighed, and multiplied by 20 for the percentage. An oil containing too little driers will probably dry very slowly, while one containing an excess will dry so rapidly that the paint in which it is used will have an undesirable tendency to crack. The quantity of driers may vary from mere traces to 1·4 per cent. Out of some 250 samples recently examined, only three exceeded the higher limit, these amounting to 1·5, 1·8, and 2·8 per cent. respectively. Only 20 per cent. of the samples examined contained more than 0·5 per cent. of driers, so that one-half per cent. may be regarded as the ordinary maximum limit. Of those falling below 0·5, fully 66 per cent. lay within the limits of 0·1 to 0·3.

The ash should be tested qualitatively for the presence of lead by adding a few drops of acetic acid and of a solution of chromate or bichromate of potash, to produce a yellow precipitate.

(237.) The presence of adulterants is more difficult of detection in boiled than in raw oils. The oil may have been adulterated before boiling, or of very poor quality. Due attention to the tests given above, and under the head of Linseed Oil, will, however, enable one to distinguish between the suitability or otherwise of any sample. The time required for drying to a hard surface is all-important, for unless a boiled oil dries rapidly it has no special value above an unboiled oil; and although it may be absolutely pure, still, as a boiled oil it must be regarded as a failure. If the specific gravity be low and the driers high, these are indications that the oils have been boiled insufficiently, and that an excess of driers has been added to improve the drying properties; and although the oil may dry rapidly, its commercial value must be less than that of an oil properly boiled. In drying, an oil must neither be too quick nor too slow.

(238). There is one fraud which is very commonly practised, very difficult of detection by chemical tests, and quite as objectionable as any other form of adulteration. I refer to the addition of raw linseed oil to boiled oils of high specific gravity. A mixture of the two is made to bring the gravity within the approved limits, and then sold as boiled oil. This mixture dries very slowly, and is in every way inferior to a genuine boiled oil. A little experience enables one to recognise it; the odour of raw linseed remains undisguised, and the percentage of driers usually falls below the average.

NOTE.—The position of the parenthesis—(" at 100° F.")—in the table of specific gravities given in No. 1130, p. 253, is incorrect. The words refer to cocoanut oil only, and therefore belong to the line immediately below. The other gravities are taken at 60° F., as stated in par. 217.

(*To be continued.*)

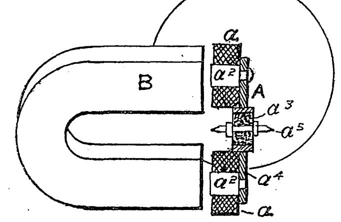
PROF. S. P. THOMPSON'S DYNAMO TELEPHONES.

A METHOD of making more powerful telephones than those of the well-known type has been recently patented by Prof. Silvanus P. Thompson, who describes his invention as consisting of dynamo telephones which will serve either as transmitting or receiving instruments of great power. It is well known that any dynamo-electric or magneto-electric machine will serve either as a generator of currents or as a motor. In such machines there are usually two distinct parts respectively called the field magnet and the armature; the relative motion of one or both of those organs generate currents, or if currents from an external source traverse the armature, mechanical motion results. And in such machines it is usual to make the field magnet a very powerful magnet (either permanent or temporary) having great magnetic inertia and the armature of small magnetic inertia and relatively light.

The improved telephones act on the same principle as that on which dynamo electric machines (including magneto-electric in that term) of any one of the known types act, but Prof. Thompson makes the armature, or some part thereof, capable of vibration instead of the usual rotation on an axle, these vibrations being communicated either from the armature to the listener's ear or from the speaker's mouth to the armature by suitable mechanism or mechanisms or simply by the intervening air. The form of the armature may be any of the well-known patterns—such as the Gramme ring, the Siemens drum, or other form—but he prefers in some cases to modify and simplify the manner of grouping or connecting the coils. The commutator common in dynamo-electric machines is not used. It is of advantage that the coils of the armature should be so grouped that they occupy the position where the magnetic field is strongest, so that any small motion given to them may have the greatest induction effect in transmitting or receiving, and so that any small current traversing the coils may produce the most powerful effect in receiving, the coils of the armature, which may be of fine well insulated copper wire, are connected in the line circuit. The coils on the field-magnets (if any) may be arranged either in a local circuit or in line or as shunt to the armature coils. It is advantageous to laminate the cores both of the armatures and of the field-magnets. When the armature is pivoted on or about an axis, a cushion or sleeve of elastic matter may be applied at the said parts or axis. When the armature or its core is mounted on a spring, the spring may be either straight or coiled, or instead of a spring or cushion, a mass of yielding material may be substituted. Internal magnets or electro-magnets may be placed within the armature to reinforce the magnetic field, thus enabling the self-induction and resistance of the armature coils to be reduced.

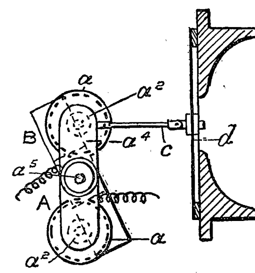
Figs. 1 and 2 of the accompanying drawings show in views at right angles to each other a dynamo telephone on the magneto principle, the armature A being mounted to vibrate (on the pivot a^5 mounted in any suitable supports) in front of the poles of a permanent magnet B. The are two coils a, on the iron cores a^2, carried by an iron yoke a^4, mounted on an elastic hub a^3, and suitably pivoted. A short and light stiff connecting-rod c makes the necessary communication between the armature and the

FIG. 1.

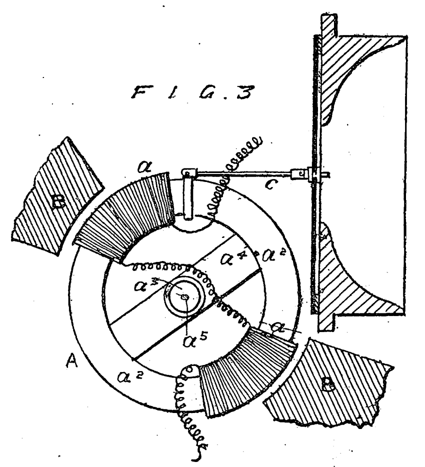


diaphragm d. It is found desirable in setting up the instrument to give to the armature a slight lead with respect to the field-magnets. This has double effect, it causes any small change in position to have a greater influence on the magnetic field, and it also gives a mechanico-magnetic back attraction which serves to keep the diaphragm in a state of initial tension. The diaphragm may be of mica, celluloid, parchment, aluminium, or any metal, whether magnetic or not, its functions being purely

FIG. 2.



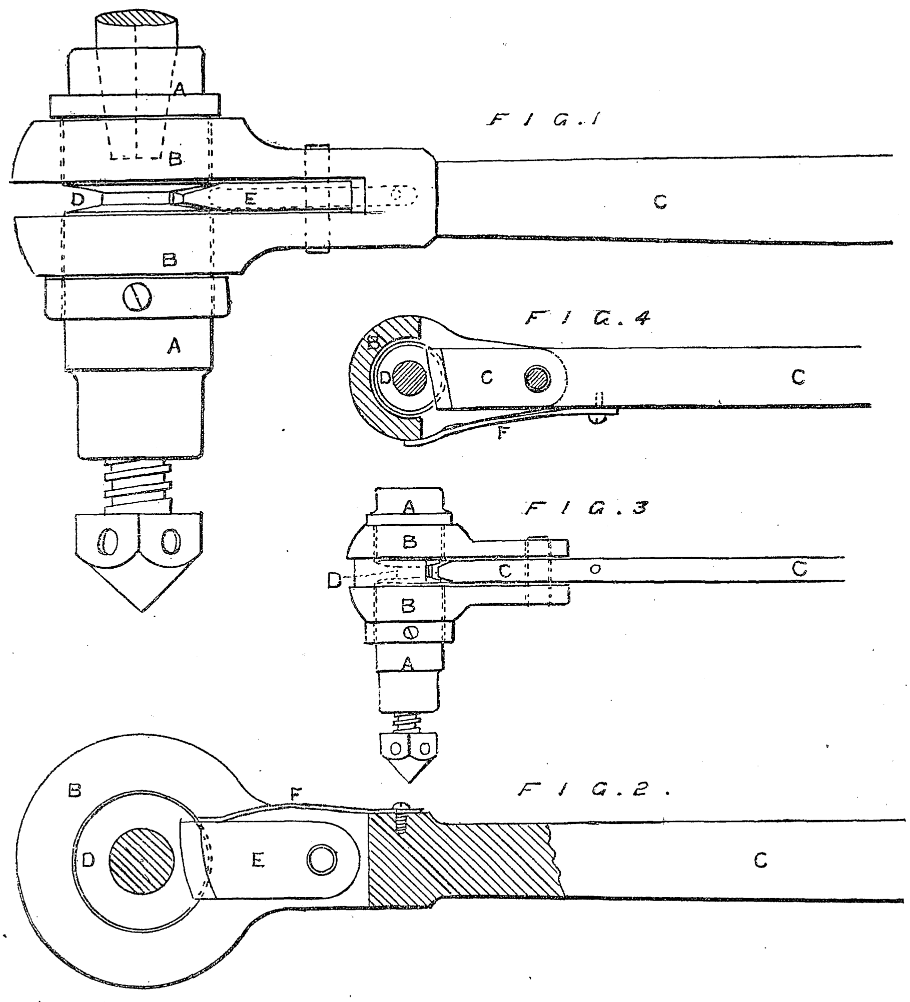
acoustic. Fig. 3 shows a ring armature, resembling that of the well-known Gramme dynamo, but having coils grouped in two sets only, connected in series (or parallel, if desired, for low resistance). The ring is pivoted as before described and connected to the diaphragm as shown, and corresponding parts to those shown in Figs. 1 and 2 are marked with the same letters of reference. The ring may be



made with protruding teeth, as in the Pacinotti dynamo. The patentee does not limit the invention to the precise details described in his specification, for they can be varied without departing from the nature of the invention; for example, the armature may be a soft iron piece without coils, mounted and connected as described in proximity to the poles of an electro-magnet.

IMPROVEMENTS IN HAND DRILLS OR TOOL CARRIERS.

THE annexed diagrams illustrate the improvements in hand drills or tool carriers recently patented by Mr. J. L. Shorrock, of Manchester-road, Accrington. The body of the



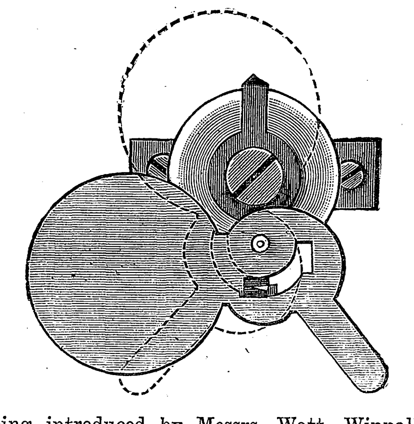
drill carrier A is turned down in the centre, to carry the box or bearing B of the handle, C, of the brace; in the central part are a groove or grooves D, which are turned slightly out of truth, or may be true, and in a recess or recesses formed in the box B are a corresponding number of pivoted tongues E, their ends clipping or gripping on the sides of the groove or grooves D. The pivots of the friction tongues in the box B being parallel to the tool holder A, when moving one way the tongues bite on the sides of the V or other shaped grooves D, and by reason of the grooves being out of true the tongues bite at different points each movement during one revolution, which thus renders them lasting and durable. A spring F is used to keep the tongues E in action, and retain them in their bearings. The tongue or tongues, instead of being pivoted, may form part of the handle or lever C (see Figs. 3 and 4.) The tongues and grooves may be either semicircular V, or any other suitable recessed form, the lever C being pivoted to the box or bearing B. The number of pivoted friction tongues may be increased as required. Fig. 1 represents the improved tool in plan; Fig. 2 is an elevation partly in section. Fig. 3 shows in plan a pattern in which the end of the handle forms the gripping tongue, and Fig. 4 is a sectional elevation of Fig. 3.

AN EXHIBITION OF REPOUSSE WORK.

ONE of the most attractive shops in "Old London Street," at the Inventions was that wherein Mr. Gawthorp and his assistants gave practical demonstrations of the art of hammering thin brass into artistic designs—known as Repoussé work. We gave Mr. Gawthorp's instructions in the last volume (pp. 182, 204), and announced that he intended to hold an exhibition of amateur work in the present month, under the patronage, amongst others, of the Marquis and Marchioness of Breadalbane. At 16, Long Acre, then, a very creditable display of amateur work can be witnessed by any one who likes to call up to the 23rd inst., a variety of objects being on view which will not unlikely set a good many amateurs at work in a rather neglected branch of art. There are altogether six classes, two being confined to set pieces. The first, Class A, is a head of "Ceres" on a panel, for which Mr. J. E. Lucas takes the silver medal, and Mr. H. Hodge, the bronze medal. In Class B, a panel with a design of "Laurel and Snake," Mrs. W. Clarke takes the silver medal, and she also obtains the bronze medal in Class C for an oblong salver in copper, the subject being a bird about to attack some cherries. Mr. L. Haslope has a nice pair of sconces in Class D, and Mr. H. Massé has a fine box in thick brass (Class F), the design being worked on the surface. Altogether there are 76 exhibits, which serve to show clearly enough to how many purposes repoussé work lends itself, and at the same time display the skill and artistic taste of the worker. We would recommend any of our readers who may be in the vicinity of Long Acre to pay a visit to this interesting "First Exhibition of Amateur Repoussé Work."

THE QUADRANT LOCK INDICATOR.

WE illustrate in the annexed engraving the "quadrant lock" indicator for electric bells which has been patented, and is now



being introduced by Messrs. Watt, Winnall, and Co., of Bromley-street, Commercial-road, E. The illustration sufficiently explains the construction. The catch is carried by the armature, which is attracted by the extended poles of the single magnet, and the indicator disc drops as shown. When replaced, the catch falls into the notch in the quadrant, and the disc is held securely in position until the armature is again attracted. The manufacturers say that a 12-hole indicator of this pattern occupies no more space than a 6-hole of other makes; but its chief feature is the fact that the indicator disc is practically locked in position, and is not likely to fall by the motion of a ship, for instance, or by being shaken.

JUPITER AND HIS "RED SPOT."*

By PROFESSOR C. A. YOUNG.

PROBABLY all our readers know that Jupiter is by far the largest of the sun's planetary family, and not only the largest, but in many respects the most beautiful and interesting. The sun and moon, and the earth's twin sister, Venus, are the only brighter objects in the sky; and Venus and the moon owe their precedence merely to their nearness. Jupiter makes his circuit around the sun in a little less than twelve years, travelling in an orbit about five and one-fifth times as large as the earth's. At "opposition," when he rises at sunset, and is nearest to us, his distance is about 390,000,000 miles; while six and a half months later he is remoter by the full diameter of the earth's orbit—186,000,000 miles. Of course, there is a corresponding variation in his apparent brightness; when nearest, he is nearly three and a half times more brilliant than when farthest away, and his light is about equivalent to that of fourteen first-magnitude stars like Vega. He is never, however, quite bright enough to be seen easily by day, as Venus can.

He is by far the largest of the planets, both in bulk and mass. His mean diameter is a little over 86,000 miles—nearly eleven times that of the earth, and fully one-tenth of the diameter of the sun itself. This makes his volume more than thirteen hundred times greater than the earth's. If we represent the earth by a marble, Jupiter would be a football, and the sun a globe 8ft. or 9ft. in diameter.

The planet's mass is not proportional to its bulk; it is only about three hundred and sixteen times that of the earth; and, comparing its mass with its volume, it appears that the planet's average density is about one-fourth that of the earth, and only a little greater than that of water—a fact always to be borne in mind in considering the phenomena which the telescope reveals upon his apparent surface; if the planet be not wholly a ball of vapours, it is clear that the outer portion which we see can hardly be more than a cloudy envelope.

In a telescope of any size, Jupiter is a splendid object—a noble disc accompanied by four bright moons, the first heavenly bodies of whose discovery we have the record. They were the earliest fruits of Galileo's telescope, found by him in 1610. The planet's disc is not quite circular, but is plainly flattened at the poles, and marked with dark belts, usually four in number, one on each side of the equator, and one near each pole. In a small telescope these belts generally look pretty smooth and regular; but in a large instrument they are seen to be made up of cloud-like wisps and filaments of a great variety of form and colour. The belts are not permanent features, like the markings visible on Mars, but evidently mere cloud-streaks, arranged and combed out, so to speak, by the rotation of the planet in some way not yet clear. The trade winds upon the earth, it is true, at once suggest themselves as an analogous phenomenon, but with a striking and important difference. Near the earth's Equator the motion of the atmospheric currents is always westward; so that clouds in those latitudes, as seen by an observer (on the moon, for instance), would appear to complete their rotation more slowly than clouds in higher latitudes, where (as in the United States) the prevailing drift is eastward. Now, on Jupiter the case is reversed; on this planet, as on the sun, all objects near the equator move eastward faster than those which are near the poles. Of course, the question at once arises, whether this does not indicate that the constitution of the planet resembles the sun more than the earth, as may well be the case. It seems likely that this peculiar law of surface rotation is in some way a necessary consequence of the loss of heat by a warm body in a gaseous or fluid condition; but the complete explanation is yet to be given.

The filaments and cloudlets of which the belts are composed are continually changing in form and size. The changes are apparently even greater and more rapid than the reality, because of the swift

* From the *Popular Science News* (Boston, Mass.).

rotation, which in two or three hours completely alters the aspect of the disc. As a general rule, the real changes are rather gradual, so that only seldom any considerable alteration, such as would be easily seen with a power of 300, would be effected in less than two or three days. Any well-marked, conspicuous feature usually persists for weeks, and even months; gradually passing, however, into something quite different from what it was at first. But, now and then, there are sudden, and one might even say paroxysmal, changes, which in a few hours transform the whole appearance of a region larger than the entire surface of the earth.

One of the striking things about the telescopic aspect of the planet is the richness of colouring in its various markings. Browns, reds, and yellows are predominant; but greens and purples are not infrequent. Probably their origin is similar to that of our own sunset hues, though less vivid, because the clouds and vapours of Jupiter's atmosphere are illuminated with a sunlight only a twenty-fifth part as bright as ours, and because, too, we are not favourably placed to catch the brightest of the reflected rays. Among the different conspicuous markings which every now and then appear upon the planet, the most noteworthy are certain large oval patches of a more or less pronounced ruddy hue; and in striking contrast with them, the so-called white spots, some of them so small and brilliant as to look almost like sparks of fire. The white spots appear most frequently near the planet's equator, and these are sometimes of considerable size; but they are found also in the higher latitudes. Usually they are rather short-lived, but sometimes endure for months. One which has been much observed of late has already been watched for several years. It is near the equator, and owes its interest to the fact that it is found to drift eastward relatively to the great red spot at the rate of 260 miles an hour, completing its diurnal rotation in about 9 hours and 50 minutes.

The great red spot, which for eight years now has been the object of so much interest, is an oval of about 30,000 miles in length, and 8,300 in width. It was first noticed in 1878, by several independent observers. Its genesis was not seen; but it was fully formed when first perceived, and probably originated a few months earlier, when the planet was near the sun, and out of reach of observation. It is situated at about 30° south latitude, and owes its name to the strong brick-red or maroon colour which characterised it during its earlier years.

There are some reasons for thinking it identical with markings of similar form and size (but not colour) which have from time to time appeared upon the same part of the planet's disc before (in 1792, 1858, and 1869-70); but of this we cannot be quite certain. If the spot had a constant, definite rate of rotation, which we could determine with accuracy, we could easily reckon back to 1869 and 1870, when Mayer and Gledhill observed their curious oval ring upon the planet, and determine whether or not their object occupied the same place upon the planet's disc. But the rotation period of the red spot is variable; not greatly, but still sufficiently to render hopeless any such attempts to determine whereabouts upon the planet's disc it ought to have been at any given moment a dozen or twenty years ago. In 1879 it made its diurnal circuit in 9 hours 55 minutes and 34 seconds. In 1881 the period was over 4 seconds longer, the seconds being 38·1; in 1883, 39·7 seconds; and last spring, 40·7 seconds. These differences are not caused by any uncertainty of the determination, but indicate a real change, due either to a *drift* of the spot, or a real lengthening of the planet's day.

The white spot before referred to showed a somewhat similar change of period, but more irregular, ranging from 9 hours 50 minutes and 2 seconds, to 9 hours 50 minutes and 9 seconds. It is worth remarking, by the way, that certain small, *dark* spots near the equator have showed the still shorter period of 9 hours 48 minutes; while certain white spots, observed in 1885, in the south polar belt (latitude 50° +), gave a period of 9 hours 55 minutes and 11·1 seconds—nearly half a minute less than the red spot, which was 20° nearer the equator.

In its youth the red spot was somewhat irregular in its behaviour, putting out prongs and processes here and there, and apparently crawling about a little on the planet's surface. At first the belts seemed to stand in no relation to the spot; in fact, in 1879-80 the usual south equatorial belt was either wholly wanting or very faint. But in 1882 this belt came out again strong and clear, and pushed its southern edge out to and past the spot, but without touching or distorting it in any way. A notch was formed in the edge of the belt, leaving a clear, bright channel two or three seconds wide between the belt and spot, as if there were some mutual repulsion between them, the two being nearly of the same colour, and apparently (but not, by any means, certainly) of the same constitution and material. The less conspicuous belt, south of the spot has not shown the same aversion to it; but in 1885, and again last spring, extended its filaments at times, so as to cover apparently about one-third of the width of the spot. I say apparently, because no one really knows which was uppermost. It is natural to suppose that the red spot, which has shown such a degree of permanence and stability, is lower down than the cloudy forms which make up the belts; and such is the general, though not universal, opinion among astronomers. But as to the real nature of the spot, we have no satisfactory explanation, and speculation is baffled. A continent emerging, a floating island on an ocean, lava poured out over a region exceeding the earth's whole area, smoke and steam from some long-continued eruption, such are some of the different hypotheses that have been suggested. But the low density of the planet (low in spite of its enormous mass) almost forces us to think of it as only a cloud formation of some kind.

How long the spot will continue visible, no one can tell; in 1882 it began to fade, and faded still more in 1883 and 1884. In 1885 it seemed to be on the verge of extinction; the central portion had either lost all its colour, or was veiled by a whitish cloud; so that, though undiminished in size, it was only a narrow, pinkish ring—a mere skeleton-ghost of its former self. Last spring, however, the veiling cloud was gone, and the spot was rather more distinct—certainly as easy to see as in 1884.

THE MICROSCOPICAL EXAMINATION OF BUTTER AND FAT.

THE question whether the microscope affords a sufficiently accurate means of distinguishing butter from fat and its preparations has attracted much attention in the United States, as will be remembered. The Editor of the *American Monthly Microscopical Journal* says:—"We first received some time ago slides from Dr. Taylor containing crystals from the fat of beef taken from the caul fat of the ox. We then, after examining them, obtained a sample of butter known to be good, and subjected it to microscopic examination. It contained no crystals of any kind except a few crystals of *halite* or common salt. This was a sign that the butter was good, according to Dr. Taylor's test, for butter ought to show no crystals of fats, because the fats of the butter have never been heated and allowed to cool and crystallise after the manner required by the condition for the formation of these crystals. The butter thus examined was then heated in a watch-glass to boiling, over a Bunsen lamp, and allowed to boil vigorously for a few moments, and then set aside to cool. Examined shortly after boiling, it contained no crystals, but after several hours it was again examined. It now presented a very different texture from that proper to butter; was granular, and broke up readily into a number of very small rounded masses. A bit of it was placed upon a slide and covered with a drop of oil. In this it readily broke up into a mass of very minute grains, distinctly visible to the naked eye, but very small. Microscopic examination showed these to be small spherical bodies, with a general mutual resemblance. The same facts as these were described in Dr. Taylor's article. Our observations were made for the purpose of confirming this description, and were in accord with those of Dr. Taylor. Very recently we have received from Dr. Taylor a set of thirteen very beautiful photo-micrographs, illustrating this subject. Two of these were taken by Mr. Walmsley, of Philadelphia, and the rest by Dr. B. Persh, of Washington. We cannot leave them without one word upon their beauty as works of photo-micrographic art, and perhaps that word can be as well said at the beginning as at the end of what we have to say of them. Of the photo-micrographs, four are of beef fat, and show plainly the characteristic crystal as figured in Dr. Taylor's article. Two of the micrographs are of lard crystals. Two more of the micrographs represent the crystals of butter. The other five pictures are from slides of oleomargarine. Of these, two contain, evidently, a great deal of butter, for in the picture at least one half the crystals are evidently butter crystals: but besides these are numerous crystals of beef and lard. From these photo-micrographs there would be no difficulty in picking out at once the one made from pure butter, and as these were made from pure butter it follows that pure butter can be detected at any time, microscopically, in this way. But while this study is full of interest in the investigation of the various butter crystals, and it is beginning to appear that various butters may be distinguished by slight variation in the butter crystals, it is not necessary in examining butter and its substitutes to detect frauds that the butter crystals be seen at all. The butter of the stores is not so formed as to give rise to any fat crystals. The fats in it are never heated beyond the temperature of the animal body, and hence are not placed under the conditions required for crystallisation. Therefore, butter unadulterated ought to show no crystals whatever present. Only yesterday, Nov. 13, we received from Dr. Taylor two samples, one of butter, the other of oleomargarine. We requested several persons to taste these and pronounce upon their relative merits, and attempt to distinguish them by the taste. The butter was universally pronounced to be the inferior article, and the experimenters, who had been farm-bred boys, though they didn't know oleomargarine by the taste or look, judged that sample the better article, and hence they concluded it more likely to be butter. To the taste it was butter, but under the microscope there was a great difference between the two. The butter sample was destitute of fat crystals of any sort; but the oleomargarine was largely composed of two sorts of crystals, resembling the one fat and the other lard.

LATHES AND LATHE CENTRES.*

THE requisites of a good speed lathe are a well-fitted spindle, having a taper hole bored in front end for centres, and a thread cut on the front end for face-plates, leaving a good liberal shoulder for them to bear against. The lathe should have wooden cones on both spindle and countershaft, in order that the lathe may be stopped and started quickly. The smallest end of cone on spindle should be towards the front end. This will give more room when working close to the lathe head, as in turning the back side of a piece on a face plate. The tail centre should be in line with the spindle, and have a taper hole the same as in spindle, then all centres and chucks that are fitted in the live spindle may also be used in the tail spindle. If the live spindle has brass boxes, see that they are well supported by the housings. The boxes should not be much longer than thickness of housing, otherwise they are liable to spring and wear unevenly, which will soon make them run hot. The tail spindle should be moved by a screw, and provided with a clamp for fastening firmly at any point.

The saddle and rest should be made so as to be adjusted and fastened in any position, without the use of a wrench, or any tool except what constitutes a part of the saddle or rest. A great many rests are fastened in position as regards height by a square-headed set screw, and every time any change is made in the position it is necessary to first find the wrench which fits this screw, and if a monkey wrench is used, it will, of course, have to be adjusted to fit the screw before using. How much better a set screw fitted with a lever handle works, both as regards the rest and also the operator's temper.

The speed at which a lathe should run depends upon its size and the work to be done. A very good speed for a lathe that will turn 12in. in diameter would be on the fastest speed 4,500 revolutions, and on the lowest speed from 500 to 800 revolutions. This cannot be considered as an arbitrary rule for all classes of work, as there is a great difference in the work done by the same size lathe in different shops, and it isn't every 12in. lathe that can be coaxed or compelled to run 4,500 turns a minute. Faster speed than this means an extra fine lathe or a loose spindle and excessive wear. If you are fortunate enough to possess a lathe that can be run at this speed and keep cool, don't let anybody tinker with it on any pretence, for in nineteen cases out of twenty they will do it harm. Even taking out the spindle to clean it is bad. It is better to clean it without removing it from the boxes, and a still better way is to use such oil as won't make any dirt, unless you let it get hot enough to burn the oil. To prevent this, put a piece of raw-hide between set screw and tail end of spindle, keep both boxes well oiled, and don't get the bolt too tight.

Never locate the counter directly over the lathe spindle. Put it back so that the belt won't be exactly vertical. This helps the belt a little. Then use a belt as wide as possible, lace the belt with wire or shave down the ends and lap them and glue them. After the glue has set, sew the splice as belts are sewed, which are made without rivets, using a small thin lacing and pounding it down flat after sewing. Make the belt just tight enough to do the work. Then if you find that the belt slips, it is likely that you are trying to make the lathe do a job that properly belongs to the big lathe, or perhaps you are working on the same principle as one of my former shopmates, who, when he had a piece in the lathe that had a good deal to be turned off, would point his gouge at the most prominent point, shut up his eyes, and jam in the gouge. If the lathe didn't stop, or nothing broke or gave way, he usually succeeded in jamming off considerable wood, but his method was rather hard on tools and on the lathe.

The centres for driving work may be of many different forms, some of which I have endeavoured to show by drawings.

Fig. 1 looks and works very nicely while it is kept in good order, but it is rather difficult to

* Extracted from a paper by Mr. F. W. BARROWS, in the *American Machinist*.

FIG. 1.

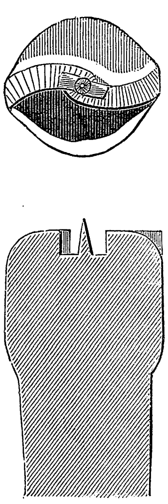


FIG. 2.

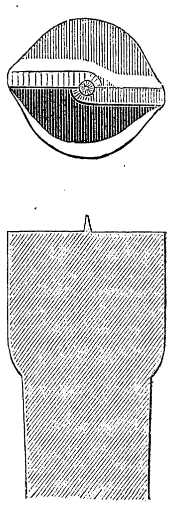


FIG. 3.

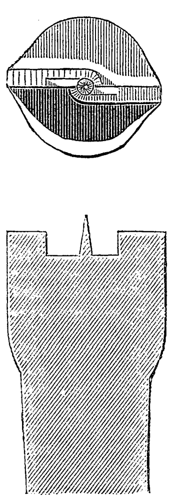


FIG. 4.

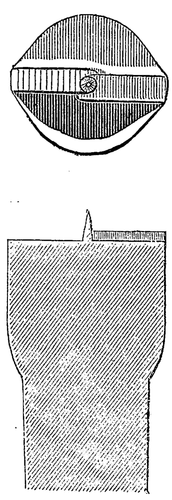


FIG. 5.

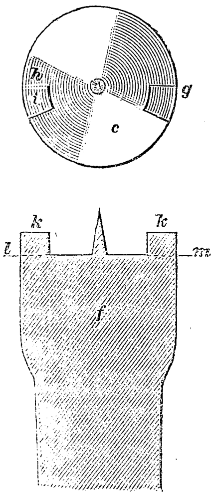
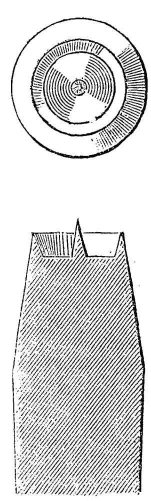


FIG. 6.



repair if the wings get broken, and it is also one that is expensive to make in the first place. That shown by Fig. 2 costs less and works fully as well as Fig. 1. This one may have a notch filed in one wing to locate its position in the piece to be turned, and insure its being always put back in the same position in a job that has been taken out of the lathe for any reason.

The one shown by Fig. 3 is the same as 2, except that a space is cut between the centre point and the wings, one of which is wider than the other, to locate its position in the piece to be turned.

Fig. 4 shows a form similar to 2, except that the line of wings form tangents to central point instead of radial lines. This form may be marked by filing a notch in one wing, as in 2, or by cutting a space, as in 1 and 3. It is best on all of these four centres to have the wings cut away where they join the centre point, as in 1 and 3, in order to sharpen the spurs without spoiling the centre point; also to give room to turn up the centre when necessary.

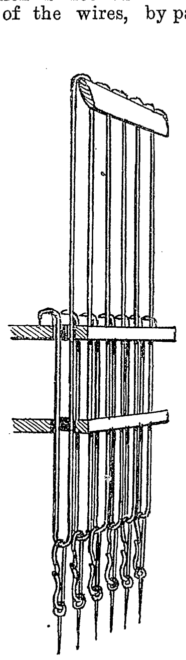
Fig. 5 shows two views of another form of spur centre, *c* being an end view, while *g h i* show the location of spurs. This is the best form I know of, and its having two spurs on one side and only one on the other makes it possible to replace any piece of work that has been taken out of the lathe, and to be sure that it will run true. More points may be left if it is thought best, as in making this centre it is turned up with a longitudinal section like *f*, then the ring at *k* is cut away, leaving the spurs *a g h i*, and as many more as you wish. This centre is intended to be forced into the work up to the line *l m*, then it has no corners to catch the clothing, or rap the fingers. This is another good feature.

The central point on all these different centres should be kept a little longer than the spurs or wings; in order to locate the centre in the work accurately, keep this point always turned true at an angle not over 23°, to avoid crowding open the joint on split patterns. The tail centre may be an ordinary 60° centre, but this form is likely to crowd open the joint, and for a job that has a long spell in the lathe it is liable to wear towards one side of a split pattern, as one side is almost invariably softer than the other. A centre having a slender point, with a ring around it from $\frac{3}{8}$in. to $\frac{3}{4}$in. in diameter, will prevent both these troubles. It should have a section like the one shown in 6. I have shown both this dead centre 6 and the spur centre 5, as being made from a single piece of steel, but an improvement is to put the centre point in each as a separate piece, then if Stubbs' steel is used for this point it may be easily replaced if it gets broken. I have turned small split patterns of hard wood without any fastening but the dowels, and such as was afforded by centres like 5 and 6. This wouldn't be a good way as a rule, but it shows that the centres are both excellent in their way. A centre might be designed for live spindle that would safely hold small light work, and would be a desirable tool.

IMPROVED JACQUARD HARNESS.

In the ordinary Jacquard machines, the devices carrying the harness of the loom consist of iron hooks provided on their lower ends with twisted cords, to which are attached the collets carring the respective threads of the harness. It has been found difficult to make these cords the same length, so that they would raise the threads of the harness equally. The invention herewith illustrated, which has been lately patented by Mr. James Jackson, of 18, and 20, Albion-street, Paterson, N.J., dispenses entirely with the twisted cords, and attaches the collets carrying the threads directly to the hooks.

Each hook consists of a vertical rod formed at its upper end with a bend, which engages in the well-known manner with the cross bar attached to the lifting frame, which raises the hooks and, consequently, the harness of the loom in the usual way. The lower part of the rod is bent upon itself, and in the bend is hooked a collet formed of spring wire bent and twisted, as shown. Each thread of the harness is provided with the usual loop on its upper end, which is hooked to the collet. The parallel parts of the wires, by passing through



apertures in the stationary grates, are guided in their up-and-down motion in such a manner that the hooks retain their relative positions to each other, having no sidewise or endwise motion whatever. On the lower end of the hook is a bend that passes over a ridge on the upper grate, in the downward movement of the hook. This prevents the hooks from going further down, and they assume the same position they had before being raised. In transferring the threads from one machine to the other, the upper ends are simply unhooked from the collets, or the latter are removed from the hooks.—*Scientific American.*

FILTRATION OF WATER.

At a recent meeting of the German Congress of Naturalists and Physicians, Dr. Plagge read a memoir on the filtration of water, in which he argued that the essential task of filtration is to free water from infectious matters. As such matters consist chiefly of bacteria, the value of a filter must be judged according to the efficacy in the destruction or removal of the bacteria present in the water. The distinction of the bacteria into pathogenous and non-pathogenous is here unimportant, since a filter which allows the non-pathogenous germs to pass will not keep back those which are pathogenous, while, on the other hand, we are justified in assuming that a filter which keeps back all other bacteria will give protection against infectious matters.

Most of the ordinary domestic filters, and especially those containing as their material spongy iron, carbon, stone, gravel, and cellulose, do not—according to the author's observations—come up to the above requirement. On the contrary, there is generally found a marked increase of organisms in the filtering material. Experiments made with pure cultures of typhus and cholera prove that such filters allow these infectious matters to pass without hindrance. Better results were obtained with clay and asbestos filters of different constructions (Chamberland, Breyer, Olschewsky, Arnold, and Schirmer), as for a certain time they yielded water perfectly free from germs. However, it was not found practicable with any of these apparatus to obtain water perfectly free from microbia. According to Hesse, asbestos strongly compressed, and especially dense cells of clay, form a filtering material which yields water permanently germ free. On this point the author is for the present unable to decide, since these apparatus have not been produced for practice, and he has not been able to procure such.—*Chemiker Zeitung.*

EXPERIMENTAL BALLOONING.*

By FRED. W. BREAREY, Hon. Sec. to the Aëronautical Society of Great Britain.

THE Society which I have the honour to represent has never advocated the employment of the balloon as a means of aërial locomotion for everyday purposes of transit. It is on record under what circumstances we value it, but ignore it as an auxiliary to mechanical efforts. We are passing through a period of excitement and extravagant expectation, the outcome of a few experiments with balloons conducted under favourable circumstances. The periodicals, scientific and otherwise, have accustomed us to a repetition of the experiments of those few French inventors who have been able, through the liberality of their Government, to put into practice their notions of the requirements of aërial navigation—viz., levitation as against gravitation. The newspapers in England have apparently confined their reports to experiments conducted in France by French aëronauts with French money. They have quite disregarded those equally successful attempts made in France by a late member of this society with the aid of English money prior to the Meudon experiments. The name of that member was Mr. Frederick A. Gower, who lately was cast away in a balloon, the particulars of which can never be recorded, as no trace of him has been discovered. I am able to give extracts, however, from a memorandum forwarded on the 14th June, 1883, to Prof. Tyndall at the Royal Institution by Mr. Gower as follows:—"A series of experiments which have been carried on in the neighbourhood of Paris for the past two years yielded results this afternoon which seem to me worthy of general attention, from the fact of their having included the driving of a large balloon fairly against the wind by steam power. The aërostat in question consists of an envelope of gold-beater's skin in the form of a cylinder, with rounded ends, and flattened somewhat at the sides. Its length is 30 mètres, and diameter 10 mètres, with a capacity, say, of 2,000 cubic mètres, and a lifting power when filled with hydrogen of something over two tons. A car of wickerwork, fortified with brass tubes along its length beneath, is suspended by netting in the usual manner for nearly the whole length of the balloon. At or

* Read before the Aëronautical Society, December 11.

near the central point of this car is placed a double cylinder horizontal engine of 5 H.P., made almost wholly of bronze. From this extends a shaft of steel tubing $1\frac{1}{4}$in. in diameter, and provided with knees to allow of slight deflections, straight to the forward end of the car, where it is geared to a nearly upright shaft of larger size, which serves to supply the power to an upright flywheel, or fan, about $1\frac{1}{2}$ mètre in diameter, placed exactly upon the line of the centre of the aërostat, at a right angle to its length and about 6in. from the envelope. The blades of this wheel are of wood, one centimètre in thickness, and having an area of about 0·19 of a square mètre each. They are quite flat, and set perpendicularly to their axis, which is itself as nearly horizontal as possible. The wheel is not, therefore, designed to have any propelling power as a screw, and is apparently capable of no function other than that of rarefying the air in its vicinity when turned at a high rate of speed." Here follows a detailed account of what Mr. Gower considers a successful experiment. This I omit. But I cannot avoid noticing a significant paragraph in this memorandum. He writes: "A very gentle breeze was blowing from the north, and the machine was held by the forward end (that of the fan wheel), in order that the stern might swing exactly into the line of the wind's direction. The engine was then started upon the same conditions of speed as before, and the balloon was released, *except that a man at each end walked by the car with small bags of sand, which he hung upon the car, or removed, as the slight changes in equilibrium demanded.* The machine yielded a foot or two to the slight airs, then gathered headway and moved forward directly in the 'eye of the wind,' which was blowing at from three to four kilomètres the hour." It must be understood that I have emphasised, as far as italics will allow me, all that is said about the means taken for preserving the equilibrium of this balloon, whose length is 30 mètres to 10 mètres diameter. The significance of these italics will be strengthened by what I shall have further occasion to observe. The *Morning News*, till lately published in Paris, says: "The successful experiment by Mr. Gower was made on June 14, 1883, and was witnessed by a large number of people, who have attested its success. There can be no question that, notwithstanding Frenchmen have done much in the way of invention towards this achievement, it was an American, aided in part by English capital, who first constructed and drove against the wind a large balloon, and this more than a year before the experiments at Meudon." At a lecture delivered at the United Service Institution by Mr. Gower shortly before his balloon fatality, I asked him how he maintained the shape of his balloon, seeing that it was upon its shape that he so much depended for success. He replied that there was no other stiffening but that which arose from distension by the gas. I remarked that the shape was likely to be altered by the act of propulsion against the atmosphere, and consequent compression of the gas. This he admitted. It follows, therefore, from this absence of rigidity, that the rate of progress through the air must be limited by the ability of the envelope to sustain the pressure of the compressed gas. An analogy has been attempted to be drawn between the balloon and the fish. Undoubtedly the fish can swim against a strong current: but consider the difference in the structure of the two. The body of the fish is homogeneous throughout; whereas the only substance of the balloon is that which is comprised in its thin envelope. Upon this absence of rigidity General Hutchinson comments in his article upon "Navigable Balloons," inserted in the *Broad Arrow* Sept. 12, 1885. He quotes Gaston Tissandier, whose pamphlet advocates extreme lengths, up to 1,000 yards even, and who hopes, he says, to attain "the speed of express trains, and command over nearly every wind." In fact, we are having over again the extravagant speculations of the first experimenters and writers in aëronautics. In the conclusion of his article, General Hutchinson, who is a great advocate for extension of length, naïvely remarks: "Another question is, how best to impart the requisite stiffness to the envelope, and such a constantly-preserved automatic pressure as will keep it (with its embracing net) when only partially filled with gas *constantly* stretched under all conditions of altitude and temperature?" Yes, I think the General will find the attainment of those conditions a poser; for let us see what shaped gas envelope is recommended—viz., a cylindrical form "as the best of forms," and "because," it is said, "the less its diameter the less the bursting strain"; and also that "it is the simplest form to construct when made of prepared silk—merely breadth of the material joined at the selvage." Therefore, we are free to imagine, simply as a model (because the proportions would be much greater), a sausage the length of this room, and about 3ft. thick, with both ends cut off, and two extinguishers substituted. But the outer skin of this sausage is its only substance. Its gaseous interior is subject to uncertain vagaries, depending upon temperature and pressure. As well attempt to propel a spirit level with the air-bubble maintained in the centre as propel such an apparatus against a wind. And this observation is apropos of my italics. To stiffen such an apparatus so as to make it effective would add too much weight, so that this aërial sausage might just as well be stuffed with pork. Yet the most difficult problem of all is left to the last, as one of the minor details. Alluding to Mr. Gower, and the loss of himself and balloon at sea, one is led to reflect upon the many narrow escapes from death which have occurred to aëronauts within sight of land, and their apparent helplessness under such conditions. Now it appears to me that there has been a want of mechanical devices to meet exigencies of this nature. It is evident that when an accident of this kind occurs it is seldom through a catastrophe such as a rupture, but nearly always through condensation of the gas, and the descent into the sea is gradual. The weight carried and the balloon are nearly in equilibrium, the man being a little heavier. Now these are the conditions which I should like to see carried out in a small experimental balloon without a valve, car, or ballast, the aëronaut sitting saddlewise armed with a punting pole shod with a termination fitted to push off from the surface of water, trees, houses, and land. The punter in a tideway keeps himself from shore under the influence of the stream with a pole. Is it not feasible that the aëronaut so equipped could keep his balloon under the influence of the aërial tide by pushing from whatever may be underneath him? A push of 40lb. would be equivalent to nearly 1,000ft. of gas added to his balloon; therefore, I think many a ducking would have been saved by the simple provision of a suitably-shod pole suspended from the car ready for use. A pole shod with a circular disc, the upper portion of which sloped upward, would perhaps be suitable in this case.

USEFUL AND SCIENTIFIC NOTES.

Dietetic Fallacies.—1. That there is any nutriment in beef tea made from extracts. There is none whatever. 2. That gelatine is nutritious. It will not keep a cat alive. Beef tea and gelatine, however, possess a certain reparative power, we know not what. 3. That an egg is equal to a pound of meat, and that every sick person can eat eggs. Many, especially those of nervous or bilious temperament, cannot eat them; and to such eggs are injurious. 4. That, because milk is an important article of food, it must be forced upon a patient. Food that a person cannot endure will not cure. 5. That arrowroot is nutritious. It is simply starch and water, useful as a restorative, quickly prepared. 6. That cheese is injurious in all cases. It is, as a rule, contra-indicated, being usually indigestible; but it is concentrated nutriment, and a waste repairer, and often craved. 7. That the cravings of a patient are whims, and should be denied. The stomach often needs, craves for, and digests, articles not laid down in any dietary. Such are, for example, fruit, pickles, jams, cake, ham or bacon with fat, cheese, butter, and milk. 8. That an inflexible diet may be marked out, which shall apply to every case. Choice of a given list of articles allowable in a given case must be decided by the opinion of the stomach. The stomach is right and theory wrong, and the judgment admits no appeal. A diet which would keep a healthy man healthy might kill a sick man; and a diet sufficient to sustain a sick man would not keep a well man alive. Increased quantity of food, especially of liquids, does not mean increased nutriment, rather decrease, since the digestion is overtaxed and weakened. Strive to give the food in as concentrated a form as possible. Consult the patient's stomach in preference to his tastes; and if the stomach rejects a certain article, do not force it.—*Journal of Reconstructives.*

THE production of lead in the United States in 1885 was 129,412 short tons. Total value, at an average price of 81dols. per short ton at the Atlantic coast, 10,469,431dols., a decline of 10,485 tons and 67,611dols. in value from the product of 1884. The production of white lead is estimated at 60,000 short tons, worth, at $5\frac{1}{4}$cents. per lb., 6,300,000dols.

A FRENCH inventor proposes to use electricity for bleaching paper pulp in the following manner. A solution of chloride of magnesium is used. This is of the strength of about 16° Beaumé. On passing a current through, electrolysis taking place, various chemical reactions occur, setting free divers oxychlorides, which, so it is said, effectively bleach the fibre.

AN ingenious process for giving a silver surface to iron has recently been devised in Austria. The iron is first covered with mercury, and silver is deposited upon its surface electrolytically. The iron is then heated to about 300° C., and the mercury evaporates, leaving the layer of silver on the surface of the iron.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE December meeting was held on Friday, the 10th, at Burlington House. J. W. L. Glaisher, Esq., in the chair. Capt. Robt. Dowling, the Rev. Robt. Sparke Hutchings, the Rev. Henry Pool Slade, and Mr. Washington Teasdale were elected Fellows of the Society. On the motion of Mr. Inwards, seconded by Sir James Cockle, Messrs. H. Sadler, R. Bryant, and R. J. Lecky were appointed auditors of the society's accounts for the past year.

Mr. Buckney described a chronograph which had been sent from Melbourne by Mr. Ellery for the purpose of being exhibited at the Colonial Exhibition. He said the principal feature worthy of remark is the parabolic pendulum controlling the clock which drives the drum of the chronograph. It is a modification of Huygens' parabolic pendulum, and was described by Mr. Ellery in the *Monthly Notices* for Dec., 1875. The pendulum revolves about a vertical axis, and as the driving power is increased, and the pendulum flies outwards, it unwraps two wires by which it is suspended from the evolute of a parabola, so that the bob of the pendulum flies outwards in a parabolic arc, and the time of revolution is always constant, however large the circle described. I believe that this chronograph was made at the Melbourne Observatory. As the drum is driven by the parabolic pendulum, a siphon pen containing aniline ink is carried along the drum making a spiral line, which is broken every second by a current from the standard clock of the Observatory—in this case the circuit is made and broken by a chronometer beating seconds. The drum goes for about two hours and a half, and the control of the parabolic pendulum is so perfect that a line may be drawn along the paper on the drum bisecting the seconds marks, and showing that there is not a variation of a tenth of a second in the driving during that time.

Mr. Ranyard asked why the driving of the drum could not be controlled by the standard clock, as well as the motion of the pen. This would insure the seconds marks being in a line, if that was considered necessary. Though the parabolic pendulum was perfect, theoretically, for a constant temperature, it cannot be compensated for heat changes, which may make a greater difference in the rate than if a circular arc were substituted for the evolute of the parabola.

Mr. Buckney said that the less work the standard clock was given to do the better. He believed that the temperature difficulty was practically got over by the whole instrument being inclosed in a glass case; in a period of two hours and a half the changes of temperature were practically inappreciable.

The Astronomer-Royal said that the object of this pendulum was not to insure uniformity of motion for a long period of time; but uniformity from second to second. It is in that respect that the parabolic pendulum is superior to any other. The regularity of the trace produced on this chronograph may be taken as evidence of the accuracy of the going of the driving-clock; but the chronograph-clock is only required to divide the seconds which are registered from the standard clock.

Col. Tupman said that this chronograph was not new: it had been in use for more than ten years. He had seen one in Adelaide, one at Melbourne, and one at the Observatory, Christchurch, New Zealand—and they all worked very well.

Mr. Common said: I think, so far as I can see, that the direction in which improvements in chronographs will be made is the direction in which the Americans are working. They get rid of the barrel altogether, and use a revolving wheel, which can be depressed at any particular moment, and registers the hundredth part of a second. The clock itself registers the whole seconds and the minutes.

Mr. Maunder read a paper on "Mr. Sherman's Observations of Bright Lines in Stellar Spectra." He said that Mr. Sherman had described the bright lines as appearing as beads on the spectrum. This was not possible, unless the spectrum of the star was a mere line; but he distinctly stated that he was using a cylindrical lens, which would have widened the bright lines as well as other parts of the spectrum. Mr. Sherman also states that he used a slit which subtended 6 minutes of arc in width, while the diffraction discs of the stars examined would be about 3 seconds in diameter; so that the slit would be 120 times as wide as the disc of the star, and the measures of the positions of the lines observed would be absolutely unreliable unless he knew where the star was with respect to the jaws of the slit.

Mr. Knobel read a paper by Dr. Copeland on the *Nova Andromedæ*. Immediately on the receipt of the telegram with respect to the change in the nebula at Dun Echt, a circular was sent out, and observations of the nebula were commenced. When the new star was first seen on the 1st Sept.

1885, it appeared to be of about the 7½ magnitude. With the spectroscope only very slight indications of bright lines could be detected. The continuous spectrum of the star resembled that of the Great Nebula. On Sept. 10th it extended from between B and C to half-way between F and G. By the 15th Sept. the Nova had fallen in magnitude, and only traces of two bright lines could be made out. On Oct. 1st those two bright lines could still be detected. On Oct. 19th the spectrum was continuous, but not uniform. The Nova then appeared as of the 8·7 magnitude. On Jan. 2nd it had fallen to the 13·5 magnitude. On Jan. 30th it was not certainly seen. On Feb. 2nd there was no trace of it to be seen with the 15in. refractor. It seems to have decreased irregularly, fading more rapidly at first than afterwards.

Capt. Noble said: There seems to be some difference as to the colour of the star. When I first examined it, after receiving the Dun Echt circular, it was in company with my wife, who is one of the rarest visitors to my observatory. To me the new star appeared to be blue, and my wife said, directly she saw it, "It is like a tiny electric light." To my eye, it remained blue for the first few days, and then afterwards certainly became reddish.

Mr. Ranyard: I can confirm Capt. Noble as to the change in the colour of the nova; it appeared to me first as decidedly blue, and afterwards, as it grew smaller, as reddish.

Mr. Bryant: Did you observe it with both eyes?—I saw it as red with my right eye, and a totally different colour with my left eye.

Mr. Knobel: I can confirm Mr. Bryant as to the colour of planets observed with the right and the left eye: they look to me of an entirely different colour.

Mr. H. Sadler: Dembowski made a similar observation with regard to the colours of double stars; viewed with the right and the left eye, the colours appeared to him entirely different.

Col. Tupman read a note on an erratic meteor observed by Mr. B. J. Hopkins. He had in a former paper described observations of several meteors whose paths were not straight. But the phenomenon was not common. Mr. Denning had informed him that out of 1,300 meteors observed by him in 1885 only four were erratic. On the 4th of December, at 18 hours, he noticed a meteor as bright as Jupiter, which appeared in Ursa Major, and after moving through some 30° it appeared to divide, and the remainder of its path was pursued in a parallel path, but at a higher level than the first portion of the path. The meteor was moving slowly, and there could be no doubt about the phenomenon—it was not an optical illusion.

Mr. Ranyard: I have never seen one of these broken-pathed meteors, but there seems to be an accumulation of evidence proving that such paths are occasionally observed. Assuming their existence, I think that they may be explained by supposing that a projecting portion which causes the meteor to *skid* to one side from its original direction of motion is suddenly broken off or burnt, so that it becomes detached. The resistance offered by the atmosphere would be entirely changed, and it would suddenly begin to skid in a new direction. If, for example, the meteor were like a ball with two projecting wings, or a mass with two crystalline spicules projecting on either side, and one of them was torn off owing to evaporation, due to heat, the body would begin immediately to skid in a new direction.

Capt. Noble: I conclude that Mr. Hopkins does not refer to the trail or streak left behind the meteor, for such streaks have frequently been observed to be curved by the wind.

Col. Tupman: Mr. Hopkins certainly does not refer to the streak left behind the meteor. Such streaks have been observed by Smith, of Athens, and others to be bent by the wind sometimes in more than one direction; and I do not think that the phenomena observed by Mr. Hopkins can be explained, as Mr. Ranyard suggests, though, no doubt, the breaking off of a projecting portion may give rise to a sudden change of path. The meteor observed by Mr. Hopkins seems to have gone on moving in a parallel path a little above its former course. I think that there must have been two meteors, and that the one appeared just as the other was disappearing.

Mr. Ranyard said: I agree with Col. Tupman, I had not properly understood Mr. Hopkins's observation. As there is time before the meeting closes, I should like to mention a matter connected with the paper I read at the last meeting, on the rich group of meteors observed on the 27th of November last year. It has been assumed by most meteor observers that on such an occasion only a small amount of matter comes into the earth's atmosphere, and that a meteor as bright as a first or second magnitude star may be caused by a minute particle of matter no larger than a mustard seed; but I think that there are some considerations which render it very probable, if not certain, that the meteoric particles which give rise to meteors visible to the naked eye are considerably larger than mustard seeds. We may take it that small meteors seldom enter the atmosphere and penetrate to a depth much below 70 miles. Therefore, with the exception of meteors which appear in the zenith. They must mostly be seen at a distance of 100 miles or more from the observer's station. We know that a standard candle seen burning at the distance of a mile appears only a little brighter than a first magnitude star. Therefore, neglecting absorption, it would take an electric lamp of nearly 10,000c.p. at a distance of 100 miles to give the light of a first magnitude star; and a lamp of nearly 100c.p. to give the light of a sixth magnitude star. Meteors giving less light than this would only appear as telescopic meteors. I think that we may pretty safely assume that a meteor which gives the light of a sixth magnitude star has a surface as large as that of the incandescent portion of the carbon in an electric arc lamp which gives the light of 100 standard candles. For the carbon used for electric lighting is a very refractory substance, which gives a greater light — that is, it needs a greater temperature of incandescence before it is driven into vapour than other substances which have been experimented with. If metal or stone rods were driven into vapour by electricity, they would not give nearly so much light as carbon rods of equal size; then, again, the carbon in the electric lamp is comparatively quiescent. It is not subject to the pressure, or torn by the bombardment of cold air, to which the meteoric surface must be subject, which would remove the incandescent matter as rapidly as it was formed. If my reasoning is correct, a much greater amount of matter enters the earth's atmosphere during a meteoric shower than has hitherto been supposed, and a great deal may enter the earth's atmosphere and be driven into vapour without ever being seen at all. Such matter would in time find its way to the earth's surface, and when we consider geological periods of time would have a sensible effect on the growth of the earth and the shape of continents.

The meeting adjourned at a quarter to ten.

WESTERN MICROSCOPICAL CLUB.

On Monday week the members, accompanied by their lady friends, responded in large numbers to the invitation of Dr. and Mrs. N. Tirard, of 28, Weymouth-street, W. After a cordial greeting by the host and hostess, and some attention to the creature comforts liberally provided, the visitors proceeded to the spacious drawing-room. Here, under more than a score of microscopes, were displayed a collection of beautiful and minute seeds and the sparkling crystals derived from these and other sources. All were in illustration of the various forms of materials from which drugs were extracted, as well as of the drugs themselves. Dr. N. Tirard, F.R.C.P., alluded to the fact that the new British Pharmacopæia almost ignored the microscope, only in eleven cases referring to it as of use in determining crystalline forms. In the case of starch, cotton-wool, yeast, lupulin, and kamala, it is noticed as being of use for observing their forms. During solution of aloes and elemi in spirit, crystals are stated to be observable by the microscope. In the ordinary forms of catechu, light carbonate of magnesia, and precipitated sulphur, it is also noted that crystals may be detected by its use. A last reference is made to the shape of the crystals of arsenious acid observable by the microscope. Nowhere does the "B. P." refer to chemical reactions in which the microscope would be of service in determining the characters &c., of the various drugs. Dr. Tirard pointed out specimens of strychnine and brucine crystallising from hot solutions in combination with reagents, such as picric acid, bichromate of potash, and auric chloride. The microscopical characters of these bodies alone, and then the distinctive characters of their compounds, were pointed out and practically exhibited. Reference was also made to other drugs, interesting either on account of their beauty or novelty. Splendid crystals of caffeine, salicylic acid, platino-cyanides, &c., kindly contributed by A. W. Gerard, Esq., F.C.S., came under the first heading; while strophanthus, hamamelis, lacnanthes, and a number of new antipyretics, hypnotics, &c., generously brought by W. Martindale, Esq., were of interest from their novelty. Amongst those contributing microscopes and objects were Messrs. Bartlett, Gwinnell, Moore, E. and R. T. Swain, Tebbs, Tirard, White, Woodward, and the hon. sec., Mr. A. W. Stokes.

The next meeting will take place on January 3rd, at the house of Mr. E. E. Halford, when Mr. B. B. Woodward, F.G.S., will introduce the subject of "The Radula of Gastropoda."

PROF. COLLETT, the well-known Norwegian zoologist, announces that the beaver is now extinct in Northern Norway, but estimates that about 100 are still in existence in the south, chiefly in the province of Nedenaes.

SCIENTIFIC NEWS.

THE comet discovered by Barnard (1886 *f*) has now passed its brightest, and by the 21st will be only 18 as compared with unity on Oct. 5. It is, however, visible in the early evening, and will no doubt be frequently observed. An ephemeris for Berlin midnight, compiled by Dr. Svedstrup, of Copenhagen, reads—

	R.A.	N. Dec.
Dec. 21.	18h. 34m. 18s.	10° 32·2′
26.	19 6 32	7 13·7

Finlay's comet (1886 *e*) is also decreasing in brightness, and on Dec. 22 Berlin midnight is in R.A. 23h. 6m., S. Dec. 6° 16·7′.

One of the two small planets discovered by Dr. J. Palisa on the 31st of last March he named Augusta (254); he has now named the other (255) Oppavia. No. 257 which he discovered on April 5 he has named Silesia, and No. 260 (Oct. 30) Huberta.

The deaths are announced of M. Jules Lichtenstein, whose investigations in connection with the phylloxera are well-known in France; and of Prof. M. Websky, a distinguished German mineralogist.

Babu Prasanna Kumar Sarvadhikari, for many years principal of the Sanskrit College, Calcutta, and author of several mathematical treatises in Bengali, is also dead.

The opening meeting of the 104th session of the Royal Society of Edinburgh was held last week, when the president, Dr. John Murray, delivered an address. In the course of his remarks he said that, with a total and increasing membership of 507, the question was beginning to be raised whether they had not arrived at a time when only a limited number of Fellows should be elected each year. He discouraged this idea. The time had passed when it was possible to number the elect either in science or literature. Every energetic scientific man able to assist in the discovery of new facts, new principles, new processess, and new knowledge was a new strength to the Society, and ought to be welcomed. One of the best evidences of the prosperity of the Society was to be found in the great increase in its publications, which during the past three years probably surpassed in size and importance those of any other society in the United Kingdom; and he emphasised the importance of keeping the illustration of these transactions up to a high standard of artistic merit. Dr. Murray also urged the importance of founding a national library for Scotland; of having a bathymetrical survey of the fresh-water lochs; and of securing a Government grant for the Ben Nevis Observatory, which he described as "certainly the most important meteorological observatory in the kingdom." It appears that out of the £15,300 annually voted by Parliament for meteorological purposes, Ben Nevis receives no more than £100, which is a bare equivalent for the mere clerk-work necessary to supply the office at Westminster with a complete set of the observations.

The following are the arrangements for the lectures before Easter at the Royal Institution:—Prof. Dewar six lectures (adapted to a juvenile auditory) on "The Chemistry of Light and Photography;" Prof. Gamgee, eleven lectures on "The Function of Respiration;" Prof. Rücker, five lectures on "Molecular Forces;" Prof. Max Müller, three lectures on "The Science of Thought;" Mr. Carl Armbruster, five lectures on "Modern Composers of Classical Song;" and Lord Rayleigh, six lectures on "Sound." The following are the probable arrangements for the Friday evening meetings before Easter:—Sir William Thomson, on "The Probable Origin, the Total Amount, and the Possible Duration of the Sun's Heat;" Mr. W. Baldwin Spencer, on "The Pineal Eye in Lizards;" Mr. Edwin Freshfield, on "Some Unpublished Records of the City of London;" Mr. E. B. Poulton, on "Gilded Chrysalides;" Mr. W. Crookes, on "Genesis of Elements;" Capt. Abney, on "Sunlight Colours;" Mr. V. Horsley, on "Brain Surgery in the Stone Ages;" Archdeacon Farrar, on "Society in the Fourth Century A.D.;" Mr. G. J. Romanes, on "Mental Differences between Men and Women;" and Lord Rayleigh, on "Colours of Thin Plates."

At the annual general meeting of the Society

of Telegraph Engineers and Electricians, Sir Charles T. Bright was elected president, the new vice-president being Mr. W. Crookes, F.R.S., and the new Members of Council, Major C. F. C. Beresford, Dr. J. H. Gladstone, Mr. H. R. Kempe, Sir D. Salomons, Bart., Messrs. J. Brockie, Colin Brodie, and C. H. B. Patey.

In the course of the discussion which followed the reading of Major-General Webber's paper on "Glow-lamps, their Use and Manufacture" at the Society of Arts last week, Mr. W. H. Preece said that the term "glow-lamp" ought to be generally adopted; but Prof. Ayrton thought one reason why the name "glow" had been slow in coming into use was because it suggested a feeble sort of light as compared with incandescence, which suggested a bright light. Mr. Preece complained that the lamps are too long-lived, and stated that after 500 hours a 16-candle lamp descends as a rule to about 8. He prefers a lamp which maintains constancy, and there is no mode of attaining that more effective than the use of secondary batteries.

The *Electrical World* expresses the belief that, as regards expense, cars equipped with accumulators can be run, at least, at two-thirds the cost of cars on cable roads, and there is moreover the immense advantage that each car carrying its own power is an independent unit, whereas the slightest accident to a cable paralyses the whole service. The London *Electrical Review*, however, contains a paragraph which, if the statements are borne out in practice, removes the question from electrical accumulators, as compared with steam-driven ropes or cables, for our contemporary says:—"We have just had submitted to our inspection a system of underground conductors for electrical tramways which bids fair to effect quite a revolution in the present methods of conveying the current to the motor. We can only at present say that the conductor is entirely inclosed, so as to be quite unaffected by any external influences. There is no central channel, no slots; the contacts, which are not of the rubbing kind, are out of sight and reach, they cannot wear out, and we have no hesitation in saying that it is by far the best thing of the kind which has ever been brought before our notice."

At the meeting of the Bristol Naturalists' Society last week, Mr. W. P. Mendham read a paper on the deposition of dust and smoke by electricity, in which he stated that in lead works a large part of the smoke consists of a very fine oxide and other compounds of lead, and in order to save this it has been customary to make the smoke pass through miles of flues. But lately experiments on a large scale have been made to test the value of electricity in causing a rapid subsidence of the lead-dust, and have met with some success. It is probable that the same results may be obtained in other dusty manufacturing processes. By the aid of the limelight and magic-lantern, and some ingenious apparatus specially constructed for the occasion, Mr. Mendham was enabled to illustrate his lecture very fully. In the discussion which ensued, Mr. T. Morgans remarked that in flour-mills and coal-mines it would be unwise to attempt to use electricity for precipitating the dust on account of its very inflammable nature. Mr. W. Shenstone suggested the use in such cases of water containing some hygroscopic substance, such as glycerine or treacle, to retain the dust and prevent it rising again into the air. Prof. Ramsay, the president, alluded to the fact that water containing deliquescent salts had been tried. Thus, in Paris, some years ago, a solution of calcium chloride had been used to water the roads, in the hope that the salt would remain moist and prevent dust being formed. But it was found that in very hot weather the salt became dry, and itself formed a dust so irritating that its use had to be abandoned. He further stated that in Hall's leadworks at Shirehampton the lead dust is most effectually retained by causing the smoke to pass through thick flannel bags—a process much less expensive than the use of electricity would be.

Mr. Harold B. Dixon, F.R.S., Fellow of Balliol College, Oxford, has been appointed Professor of Chemistry and Director of the Chemical Laboratories in Owens College, Manchester.

Mr. W. Fawcett having been appointed director of the public gardens and plantations in Jamaica, a vacancy has been occasioned in the botanical staff of the British Museum.

The Minister of French Postal Telegraphy has sent to Brussels a delegate to arrange for establishing a telephonic line between Paris and that city. The price for the use of the telephone will be 5f. for a period of five minutes. It is the first step on record towards an international telephonic system.

The purity of Alpine air has been demonstrated by Prof. Tyndall and others, and a similar claim has been made for the air of the Mid-Atlantic. Lecturing recently on the action of micro-organisms on surgical wounds, Prof. F. S. Dennis, of New York, stated that during his last trip across the Atlantic he made some experiments to test the purity of the air about 1,000 miles from land. He employed capsules of sterilised gelatine, and exposed them for fifteen minutes. One capsule was exposed in the state room upon the main deck of the steamer. Within eighteen hours over 500 points of infection had developed. Two capsules exposed in a similar manner in a cabin on the promenade deck, where the circulation of air was free, showed five or six points of infection each ten days afterwards. A capsule exposed over the bow of the ship was found to be entirely uncontaminated.

A meeting was held at University College, Liverpool, last week to consider the proposed rules for the Liverpool Biological Society, which were adopted after a little discussion. The annual subscription will be one guinea, with an entrance fee of 10s. 6d.; student members or associates paying 5s. per annum. The meetings will probably be held on Saturday evenings, in University College; tea at 6.30; chair to be taken at 7 o'clock. The first meeting will take place on the third Saturday in January (15th), and it will be open to the public. There will then be delivered the presidential address, and the night for future meetings will be ultimately settled. No entrance fee will be charged until October, 1887, when the second year begins, for the sessions of the society will run along with the terms of the university, as the meetings are to be held in the college building and the university professors form an important part of the society. The scope of the society is very wide, including zoology, botany, palæontology, anatomy, physiology, and embryology; and the members who have already joined fairly represent these various branches of biological investigation. It is proposed to hold meetings fortnightly during the session from October to March, and then prosecute outdoor researches during the summer months.

In announcing the list of papers to be read at the autumn meeting of the Iron and Steel Institute on p. 60, we included one "On the Treatment of High-class Tool Steel," by Mr. A. Jacobs, of Sheffield. That paper was not read, because the "editing committee" did not think it suitable. Mr. Jacobs has accordingly published it (Sheffield: Pawson and Brailsford) with the correspondence that passed between him and the secretary of the Institute.

FROM a study of 32 years' observations of thunderstorms in the Vienna region, Dr. Hann finds that there is a double maximum of frequency. The greatest number occur in the first half of June, the second smaller maximum is in the end of July; between these is a secondary minimum. (Thunderstorms hardly ever occur in winter.) This agrees with observations in Munich. In Brussels most thunderstorms occur in the second halves of June and July. The daily period in Vienna shows a chief maximum about 3.20 p.m., and a secondary one at 1.2 a.m. The spring and summer storms come mostly from the east and south-east, and seem to belong to Mediterranean depressions, coming up from the Adriatic, as those of late summer seem to be on the south or south-east border of Atlantic depressions.

Jumbo's Measures.—The "mighty heart" of this deceased elephant weighed 40lb., and he measured from the sole of the forefoot to the top of the back between the shoulders 12ft.; his greatest circumference was 18ft.; his head, behind the eyes, had a circumference of 10ft. 4in.; the circumference of the forefoot was 5ft. 7in.; the length of trunk 5ft. 11in.; and the greatest width of ear 5ft. 5in.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of he* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

STELLAR AND NEBULAR PHOTOGRAPHS—"THE COMPANION TO THE OBSERVATORY" FOR 1887 — THE REAL WORK OF AN ASTRONOMER—EDIBLE VERMIN—KEEPING PIGS IN TOWNS—SYMPATHETIC VIBRATION —PHOSPHORESCENT INSECT—RULES OF GRAMMAR — STARS VISIBLE FROM THE BOTTOM OF A WELL—RANGE OF THE BAROMETER—THE RISING AND SETTING OF A STAR AS SEEN FROM POINTS ON THE EQUATOR DISTANT 180° — AXIAL ROTATION OF A BUILDING ON THE EARTH—DOES IT BOIL ?

[26591.]—SINCE writing the second paragraph of letter 26544 (p. 300), I have had an opportunity of inspecting two cyanotypes by M. E. von Gothard, from stellar photographs which he has taken, and, as one of them represents the glorious "Sword-handle in Perseus" (H 33 and 34), of comparing it with the photograph by the MM. Henry Frères of the same region. M. von Gothard's print is, as nearly as may be, on a scale of one half of that of the MM. Henry; but it is curious and instructive to note how numerous are the extremely minute stars identifiable upon them. Small, however, as M. von Gothard's star discs are, they lack that extraordinary approach to perfect circularity which forms such a distinguishing characteristic in the marvellous Parisian charts. The second cyanotype of which I have spoken is a very remarkable one, representing as it does the Ring Nebula in Lyra (M 57). Its major axis in the print measures just ·08in.; but it shows that the light of the ring is far from being equable, while the minute star following it is most distinctly imprinted on the plate. This power of rendering extremely minute points of light visible appears to me to be one of the most valuable which celestial photography has conferred upon us.

I spoke in letter 25330 (Vol. XLII. p. 489) of a new calendar and ephemeris for the astronomical amateur, which had just come out under the title of a *Companion to the Observatory*. As I write, the second issue of this really valuable little book lies before me; and I can only extend to it all the commendation which I bestowed upon the first annual part. It contains every one of the excellences which distinguished that, and exhibits one or two improvements besides. Imprimis, the Longitude of the Moon's Terminator is given for each day—a boon to the young selenographer—for whose benefit, too, the co-ordinates of about 100 of the principal lunar formations are given. Next, the whole of the phenomena of Jupiter's satellites are tabulated, and not merely the eclipses. These additions have involved the suppression of the lists of "Remarkable Nebulæ" and "Noteworthy Double Stars," a matter of very little moment to any one who has Clark and Sadler's "Star Guide" to refer to. Last, but not least, the editors have introduced a most sensible innovation in their table of Occultations of the Stars by the Moon by reckoning the angles of disappearance and reappearance from the *true* north point of the Moon round the E., S., and W., just as in measuring the position angle of a double star. Why such last-named angle should be measured from the bottom of the circle of reference in a direction contrary to that in which the hands of a watch travel, and that of a point on the Moon's limb from the top of the circle in the same way that watch hands go round the watch-face, it is simply impossible to say;—nothing but the pig-headed scientific Toryism of the institution in Verulam-buildings affording the slightest explanation of the difference. Perhaps now that this improvement has been initiated by Messrs. Maunder, Downing, and Lewis, it may find its way into the *Nautical Almanac*—whoever lives to see it.

The mention of the *Observatory* suggests to me to recommend the perusal, in the current number of that serial, of a report of an address delivered at the laying of the corner-stone of the new Astronomical Observatory at Carleton College, Northfield, U.S., by Miss Mary Bird, the assistant in mathematics and astronomy. I would especially advise all those to read it who picture to themselves astronomers lying luxuriously on their backs on handsomely upholstered sofas of the last degree of mechanical refinement and ingenuity, and gazing on Lunar detail, the wonders of the Saturnian system, or the clusters in Perseus, Cygnus, and Lyra, in a warm, comfortable, and convenient apartment. A better or more truthful description of the mere "grind" of ordinary observatory work it would be difficult to find anywhere.

As Mr. Stanley Smith (letter 26561, p. 304), does not seem to be, in American parlance, "nasty particular" what he eats, he might, I think, try squirrel with advantage. I had one, which I had shot, cooked one day; albeit, I had not the pluck to taste it. A gentleman more courageous in this respect than myself did, however, eat some, and his verdict was that it was "as delicate as any chicken" he had ever tasted. Gipsies cook hedgehogs by rolling them up just as they are in clay and inserting this in their camp fire. When cooked, the spines, skin, and all come off in the clay, leaving the white meat perfectly clean and free from all impurity.

The friend of "One Willing to Learn" (query 61050, p. 311) only spoke the bald literal truth when he told him that he could at any time obtain the removal of pigs kept in a town under such circumstances as your correspondent describes—always supposing that the swine are a nuisance; and this complainant must prove. But local boards have large powers in the way of making by-laws, and it was held in the case of the Wanstead Local Board v. Wooster that a by-law prohibiting any occupier of a house in a populous town keeping pigs within *one hundred yards* from a dwelling-house was reasonable and valid. The inspector of nuisances, or his employers, would proceed under 38 and 39 Vict. c. 55, s. 47 summarily before a magistrate. If he refused or neglected to take steps, and the neighbours suffered from the presence of the pigs, then I think that their owner would be indictable at common law for misdemeanour in creating a public nuisance. If "One Willing to Learn" is resident within the jurisdiction of an urban or rural sanitary authority, he had better get a copy of their by-laws and study it.

In reply to query 61077 (p. 312), a great deal depends upon the material of which the wall is composed. He would be a long time, for example, in starting a clock in beat by the aid of a synchronously-going one, were both attached to a wall of damp clay or sand.

The insect—or more accurately, myriapod—seen by "W. E. D." (query 61091, p. 312) was the familiar Scolopendra electrica. As it generally lives in holes its light is not so often seen as that of the common glow-worm: but it may be sometimes found in potting-sheds and such places. Generally, when it crawls along a path it leaves a phosphorescent trail behind it. Some of the foreign sorts of Scolopendra are poisonous; but our little British species is quite harmless, though not very inviting to look at.

As "Doctor Medicinæ" (query 61099, p. 313) invites the opinion of your readers generally as to the correctness or incorrectness of such a phrase as "It is me," I, as one of them, would merely say humbly that it seems to me not only ungrammatical, but positively cacophanous. I would certainly join issue with him on the question of this solecism being a "custom." That, I would venture to assert, depends largely upon the social rank of the utterers. I can only speak for people in the position of those among whom I live and mix, and assuredly they do *not* say "It is me," but invariably "It is I." See Matthew xiv. 27, Mark vi. 50, John vi. 20, &c. I should like "D. M.'s" authority for the assertion that the best authors employed the expression "You was," "in the latter part of the 18th century," save as putting it into the mouths of characters in plays and novels. A single example from either Johnson or Goldsmith will suffice. Having said which, I may add, however, that with the concluding clause of your correspondent's query I am entirely in accord; believing that grammar was made for man—certainly not man for grammar.

Query 61101 (p. 313) is rather vague, because the only stars visible from the bottom of a well would be the bright ones which in these latitudes are near the zenith at their meridian transit, such as α Cassiopeiæ, α Persei, Capella, γ Ursæ Majoris, γ Draconis, or α Cygni; while in the case of a total solar eclipse probably every star of the first magnitude—and even conceivably a few of the second—which happened to be above the horizon might be discerned. What stars these would be would, *ex necessitate*, depend upon the time of year at which the eclipse happened.

In reply to the first question contained in letter 26583 (p. 325), I have had the mercury in a standard barometer in my hall as high as 30·672in. (this was on Jan. 17, 1882), while on Wednesday night last, at 12 o'clock, it registered 28·210in., and was even then sinking. It stood at 30·466in. at 9 a.m. on Nov. 24 ult. Between 9 p.m. on Dec. 7 and 9 a.m. on Dec. 8 (i.e., in 12 hours) it fell 0·958in. "M. C. B." will probably read something of the disastrous gale which accompanied and followed this.

With reference to query No. 2, of course a star which would be rising to an observer on the Equator, would be setting to another man removed from the first by 180° of longitude; and equally, of course, refraction would, so to speak, cause such rising and setting to overlap—in other words, calling the first observer A, and the second B, A will see the star some 2m. 19s. before it is above his geometrical horizon, and B for the same time after it has sunk below his. Hence, it will be visible to both simultaneously for 4min. 38sec., or thereabouts.

The third question put by "M. C. B." is not a very easy one to answer definitely; but, of course, a building situated in latitude 45° would describe a mean path about the earth's axis, between one situated at the Equator and another on the Pole. This is a type of query eminently calculated to "let in" those gentlemen who insist that the moon has no axial rotation at all.

"Weald" (query 61145, p. 333) is labouring under a slight misapprehension. Vapour is given off by water at all temperatures between its freezing and boiling-points. Say that it is heated to 65° Fahrenheit, and the vessel containing it is taken into a room of which the temperature is 34°; then will the invisible vapour become converted into minute vesicles of water by condensation, and the water will "steam." Perhaps a very simple experiment may suffice to convince "Weald" that water is always giving off vapour in a gaseous form. It is simply to fill a teacup with it, and place the cup out in the middle of a field on a fine summer day. He will find that the contents of the cup have very materially shrunk by eventide.

A Fellow of the Royal Astronomical Society.

SIRIUS.

[26592.]—As the report in the ENGLISH MECHANIC for November 19th of Mr. Gore's interesting paper did not give either the value of the parallax he used, or the elements of the orbit of Sirius employed, I was unable to account for the discrepancy between Auwers and himself. Since then I have, of course, read his paper, and equally, of course, I have found his figures correct, assuming the parallax, semi-axis-major, and period which he gives. I would remark, however, that Henderson does *not* give a parallax of 0·150″, but 0·23″; while Abbe gives from Maclear's much more numerous and trustworthy observations from 1856 to 1863 with the Cape Transit circle (nearly a facsimile of that at Greenwich) 0·27″. With this parallax, if the mean distance of the *comes* is not greater than 8·31″, the mass of the system is not above twelve times the solar mass. Henderson's observations were made with the old mural circle. Gyldén's parallax of 0·193″ (*Bulletin de l'Acad. de St. Pétersbourg*, VII. p. 365) is the result of a discussion of the observations of Maclear and his assistant from August, 1836, to January, 1838. Auwers' orbit is founded on the observed irregularities of R.A. and Decl., and with Dunér's correction to the angles it seems to satisfy the observations from 1862 to 1882 fairly well. I give the elements obtained by Auwers, Plummer, Colbert, and Mann for comparison. There is an interesting note by Mr. Plummer on the "Motion of the Companion of Sirius" in *Monthly Notices* XLII. p. 56.

	Auwers.	Plummer. (Elements A)	Colbert.	Mann.
T	1843·275	1891·51		1898·182
☊ (1825·0)	61° 57·8′	48° 46′	42·4°	10·2°
λ	18° 54·5′	219° 30′		250·1°
i	47° 8·7′	55° 0′	57·1°	53°
e	0·6148	0·5046	0·58	0·7515
a	2·3307″	8·32″	8·41″	8·31″
P.	49·399yrs.	50yrs.	49·6yrs.	49·46yrs.

$\mu = 7{\cdot}26°$

Mr. Gore will find Auwers's elaborate investigation in *Publicationen der Ast. Gesell.* No. VII. The pos. angle of the *comes* is probably now about 24°, and the distance 6·5″. It will soon be getting a very difficult object, even with the great refractors of the present day; but in 1882 it is said to have been seen at Baltimore with only a $4\frac{1}{10}$in. refractor, and in 1883 with a 5in. On the 2nd of December, 1882, the companion was seen by Mr. Todd with the 12in. refractor at Mount Hamilton "as readily as a satellite of Jupiter."

December 11. **H. Sadler.**

V CYGNI.

[26593.]—In answer to Mr. I. W. Ward's letter (26570, p. 322), I herewith send the additional observations of Mr. Birmingham, taken from his MS., and those of my own up to the present date:—

1882.	May 28	8·0 +	Birmingham
	29	8·0 +	"
	June 4	8·0	"
	Nov. 6	10 – 10·5	"
	13	Larger	"
	Dec. 6	8·8 – 9·0	"
	29	Smaller, not over 11	"
1883.	Jan. 7	10·0	"
	Feb. 3	10·2	"
	Nov. 13	8·0	"
	Dec. 6	9 – 9·5	"
1885.	Dec. 1	8·5	Espin $17\frac{1}{4}$in. equatorial
	15	8·7	"
	25	8·3	"
1886.	Jan. 4	8·2	"
	15	8·3	"
	18	8·0	"
1886.	May 6	10·0	"
	Sept. 14	11·5	"
	Nov. 17	11·0	"

Mr. Ward's suspicion that there are are two maxima would seem to be the actual fact. I should have placed the maximum either at 1886, Jan. 1st, or 1886, Jan. 18th. We may certainly fix a maximum on 1882, May 29, and allowing three maxima to have taken place, we should have from 1882, May 29th, to 1886, Jan. 1st.

$$P = 440 \text{ days} \pm$$
$$V \quad 8{\cdot}0 - 12{\cdot}0$$
Epoch 1886, Jan. 1st.

We should thus have for the next maximum the middle of March next, or March 18, with a smaller maximum a month previously. Mr. Baxendell's estimate of maximum magnitude is evidently a whole magnitude at least too small.

T. E. Espin.

ASTRONOMICAL—α ARIETIS—CORRECTION—A CLEFT.

[26594.]—My sketch of this group is wrong. D is to be brought ¼th of the distance nearer to α, and G half the distance. It is nearly on the same parallel with D. C, F, D form an isosceles triangle, having C D for its base. Line 8, after "C" a "full stop." Line 13, for "G" read "C." A fine cleft was seen the 10th inst., crossing from N. to S. A ring plain near Vasco da Gama on the N.W., which seems to answer to *e* of Beer and Mädler. Good libration is necessary to see it well.

C. M. Gaudibert.

COMET *f*, 1886.

[26595.]—I am very pleased to see that my letter on p. 301 has resulted in the publication of "Excelsior's" interesting description (letter 26572, p. 322) of his observation of this comet on Dec. 6th. I would like, however, to point out that your correspondent, in attributing to me a mistake I have not made, himself falls into error. The shorter of the two tails was, and, of course, still is, on the *preceding* side of the nucleus, as seen with the inverting eyepiece usually employed with an astronomical telescope. "Excelsior" probably made use of a terrestrial eyepiece to view the comet with.

With regard to his second point of difference with me, I would just remark that, as is well known to all observers of comets, these bodies frequently undergo striking and rapid changes of form as they approach the sun; getting brighter as they near that luminary, details of structure previously invisible or non-existent, begin to be seen. It thus follows that a description of a comet having reference to a particular date does not as a rule hold good for its appearance as seen on some other day. For instance, in my description of this comet as seen by me on Nov. 22, I particularly mention that no nebulosity was visible with my instrument, in the space between the two tails; but on the occasion of my last observing the comet with the same telescope, viz., Dec. 5, I found the space between the tails filled up with very faint cometary matter. Therefore, as "Excelsior's" remarks apply to the comet as seen by him on Dec. 6, he will at once see that he had very good reason for not seeing it as I described it in my last letter.

B. J. Hopkins.

Forest Gate, E., Dec. 14.

L. A. S. CIRCULAR No. 11—METEORS WITH CURVED PATHS—M 31—M 32—COMET BARNARD—B 277—U CYGNI —V CYGNI.

[26596.]—In your reproduction upon p. 258 of the L. A. S. Circular No. 11, I observe that the epoch of the places is given as "1885." This is a misprint for 1855. This misprint indicates that other copies of these Circulars are like those that come to myself—so faint as only to be deciphered with considerable difficulty. I take notice of this matter in order to draw attention to the difficulty

of making out the Circulars with certainty, and of suggesting that copies be printed a little more plainly.

I notice that Mr. Ranyard spoke at the recent meeting of the R. A. S. about meteors with *curved* paths. I have seen several of these. One was a Perseid, seen on Aug. 10, 1881. It was a very fine meteor. To my note is added, "Path somewhat curved at termination." My notes contain mention of several other meteors with similarly abnormal paths, perhaps seven or eight altogether. The most curious case was one in which a slightly curved path was terminated by a sharp turn, so that the line indicating the path in my sketch looks as though it were ended by a little hook. In a third case, I have a note to the effect that the path, a short one, was curved in the manner of a scimitar. There could be no mistake here, for the meteor, which was a brilliant one, travelled slowly, and left a trail which marked its course. The radiant of the former would appear to be that near Polaris, belonging to the stream mentioned under dates Sept. 21 to 25 in the list of meteor dates under September in the *Companion to the Observatory*.

In connection with the reported continued change in M. 31, I may say that the few times recently when I have seen this object, I have never been able to detect anything the least like the *Nova*. The suggestion, however, which the asserted reappearance conveys is well worth attending to, and it is to be hoped that the nebula will be watched to discover if any changes are really occurring. On November 1st I made this note of its appearance: "Beautiful; filmy. Central condensation not at all marked. Could be traced a great way *n.f.* in finder." It seemed to me on this occasion that the nebula was more *filmy* than before.

As to M. 32, I see that a correspondent in the *L. A. S. Journal* has been drawing attention to "a stellar appearance in it," which he had not noticed before. In a letter in "Ours" about the Nova Andromedæ, I mentioned that on Sept. 17, 1885, M. 32 seemed to be very bright. The following are some observations of this nebula, made with my 3¼in. Wray.

1884, Oct. 11.—E.p. 45. Small; round; very bright; cometary in aspect. Air pretty clear.

1885, Sept. —12. E.p's. 45 and 145. As before. Small; round; bright; definite. Equally condensed in centre. Air very clear.

Sept. 17.—E.p's. 45 and 145. With both powers nucleus seems unusually bright and definite. Moonlight. Conditions poor.

Sept. 26.—Ep. 45. The nucleus again seemed very bright. Conditions poor.

Sept. 30.—45 and 145. This nebula was seen to be bright in the centre. Def. good; but air not clear.

1886, January 5.—45. Very bright and definite. Conditions fairly good.

Nov. 1.—145. Small; bright; definite. Conditions fairly good.

If the nucleus of this nebula should turn out to be variable in distinctness, it would be a very remarkable fact. It is, of course, excessively improbable that the nucleus of a star cluster should be variable in brightness; for this would imply, either, that there was *one* star within it so much brighter than its companions that variation in it affected the magnitude of the united light, or that a number of the component stars were variable; and in a similar range and period: and neither supposition is very probable. But the conjecture might well be hazarded that the nucleus of such a cluster as M 32 might well be variable in *distinctness*, for it is plain from the spectrum that the light from the cluster has to pass through an absorbing medium; and if this medium should vary in thickness or in absorbing power, the visibility of the nebula, and consequently the distinctness of the nucleus, would naturally be affected. In this way, we might learn something about the phenomena and changes of the dark, absorbing, masses which may exist in space.

Comet Barnard has been an exceedingly fine object, and I do not think it speaks altogether well for the enterprise of some of "ours" that it has not been more fully commented upon. It cannot have been much seen, for I noticed that the *Athenæum* announced it as being visible to the naked eye (of the 5th mag., I think it was said) at a time when it was really very bright. I have found the longer tail at least 12° long, and the head large and very luminous, and fully as bright as a 3rd mag. star. I will communicate further on this matter; but meanwhile would inquire if the spectrum has been observed?

B 277 has been at a maximum, and is at present a magnificent object. Its colour is full scarlet. On the 17th ult. it was full 7th mag. and a striking object. Since that date it has decreased.

I am much obliged to "F.R.A.S." for the trouble he has taken to try and answer my question about U Cygni; but I am not surprised that nothing is to be found in the authorities he names, seeing that Birmingham speaks of having "discovered" this object. The stars are in the *Durchmusterung*, therefore they must have been there to have been observed; and it is thus made clearer how strange a thing it is that so very splendid a pair should have escaped detection so long. It is not likely that searches in the region were *always* made at a date of *minimum* of the red star; and yet it appears difficult to account for so strange an overlook, for it is hazardous to assume that the exceeding richness of the tints is only of recent date. I hope we may hear more of the matter; and hope, too, that more observations will be forthcoming.

As to V Cygni, I am much obliged to Mr. Maunder for his remarks, and will certainly try to get the observations he speaks of as being useful. There is a valuable letter *re* V Cygni, by Mr. Ward, in "Ours" for Nov. 6, 1885. I am obliged, too, for the information as to the spectrum of U Cygni. It seems difficult to get specific information as to the spectra of individual stars. Is there any work giving anything like a complete list? Perhaps Mr. Maunder would be kind enough to tell me the spectra of R Boötis, R Arietis, T Cancri, R Sculptoris, and S Orionis, and also of Messier 15. I wish them, in order to add to some comparative tables.

S. Maitland Baird Gemmill.

HORIZONTAL WIND POWER.

[26597.]—SEEING on page 267, Vol. XLIV., a favourable notice of my horizontal wind power, it occurs to me that this would be just the thing to drive a dynamo to store up electricity for power or light, as the machine may be made cheaply, and safe in any storm, with very little attendance; and as I think I did not give any description of the stationary engine, but only of the portable ones used for ploughing, &c., I will endeavour to describe one which will be safe, cheap, and of considerable power.

The principle of the machine is this: that each sail is placed at a right angle to the arm that carries it, and if moved from that position it presses a spring that acts to restore it to its former position. The larger and wider the sail, the more powerful the spring required, and the larger the sweep of the end of the sail; therefore, for handiness and safety, the narrower and more numerous the sails the better.

For a cheap and strong power for driving dynamos, &c.—for the shaft I would have a long balk of deal timber, square, and tapering to the top, as they are imported. The bottom end should be rounded for 6in. up it, but left the full size it will be when the corners are rounded off—and this shall be the bearing on which it shall turn—in an iron socket made fast in brickwork. On the lower end, and temporarily fixed at 3ft. or 4ft. from the bottom, should be placed a wheel, which is to give off the power of the machine. Above this, and at a convenient height, should be fixed a casting of iron having twelve sockets, to hold the ends of twelve arms; and above this, and at a proper height to receive the sails, should be fixed a second casting to hold the ends of twelve other arms, and above this and on the top of the shaft a socket in which the shaft should turn, it being rounded off as at the bottom for that purpose. The lower arms should be of yellow deal, 3 by 4½, and 14ft. long. Directly over these should be twelve lighter arms of the same length, to carry the tops of the sails, the bottom ends of which turn on the lower arms.

The lower arms should be supported near their outer ends by tension rods of strong galvanised wire, such as is used for fencing, made fast to the shaft; the top arms, in like manner, by tension rods to the shaft above them. On the top side of the lower arms, and on the underside of the upper ones should be bored holes to receive the spindles in which the sails turn. The arms are to have their deep sides perpendicular. Between the outer ends of each two arms should be a rail, 4½ by 3, to connect them together, and also to carry sails. These rails are also supported by tension rods, like the arms; and above them should be other rails to carry the upper ends of the sails. The sails, of which there are to be 60, are made of half a 14ft. yellow deal, cut diagonally from ½n. on one side to ½in. on the other, which will make two sails 2½in. thick at one side, and ½in. thick at the other, and 9in. wide. The top and bottom ends of each sail should be sawn off from the thin side to 2½in. of the thick side, leaving a piece to form a spindle on which the sail is to turn.

Holes in the end of each arm, and also in the rails between the arms, are made to receive these spindles, and pieces of sheet-iron placed in them for the spindles to turn on. The spindles on the top of the sails should be shorter than those on the bottom, as the springs will be fixed to the sails at the bottom, and they have more strain on them there.

As the sails will turn on their thick sides, the wind will have more power to turn them from their positions than if they turned on a spindle near the middle, so that the spring must be strong; they may be made of ash fixed to the lower end and on the outside of the sail, and just so long as to turn without touching the next sail; this will be about 27in. long, and by being fixed to the sail, 18in. will be the length of the active part of the spring.

To support the other part of the spring a second rail must be fixed inside the outer one, much slighter than the outer rail, as it will only carry the springs. This second part of the spring will be just so long as for its end to meet the end of the first when the sail is in its proper position of a right angle to the arm.

A cord to run through the end of the second spring will be made fast to the end of the first spring, and tie the two together when the cord is tight; but set the sail at liberty to turn any way when the cord is slack; and if the cord is brought to a pulley on the shaft, and then down it, the sails may be put into action, or released to turn edge to wind by tightening or loosening this cord. If the cords of the 60 sails are fixed to a ring to slide on the shaft, all the sails may be released or fixed to the springs at once.

Five sails will be placed in each division, one on the arm and the four others on the rails between them, and will turn one between the arms, and the other four between the bottom rail and the other rail fixed between the upper arms to carry the tops of the sails. Each sail will have springs as described, and cords from them to the shaft.

The shaft, which will be so long as to be considerably above the tops of the sails, will be supported by tension rods, from the top socket in which it turns to the ground around it. If not long enough for the tension rods to clear the upper arms, they may be carried over poles fixed in the ground just outside the lower arms, and thence to the ground.

As the 60 sails will have a surface of nearly 600ft., a very considerable power will be obtained at small expense. For the 60 sails, will require:

	30	deals 14ft.			
The lower arm	6	,,			
The upper (3 by 3)........	4	,,			
The lower rail	3	,,			
The upper rail	2	,,			
The stays for upper arm	1	,,			
	—		£	s.	d.
	46 at 2s..............		4	12	0
The balk, say			1	0	0
Iron work (except wheel)			4	8	0
			£10	0	0

Say, an equal sum for workmanship, and about £20 for the whole.

A great source of power in these engines is that each sail coming up to the wind is pressed inside the circle described by its spindle, and flies outside of it when going down the wind, and is in the best position for the wind to drive it as well as having increased leverage on the arm and shaft, and as it presses harder on the spring the spring yields more in that position, and the sail exposes greater surface to the wind than when coming up to it.

If machines of this sort were placed on hills and waste places, such as commons, &c., I think we should get our towns lighted cheaply.

Seeing the inquiry of Mr. Browne on page 303 of the 3rd December, as to the power, &c., of the horizontal wind power referred to by Mr. Collingridge, I will supplement my letter by saying that the mill I describe will give a power of ten horses when the wind presses 2lb. per foot on the sails. The best total width of sail I found after experiment was about one-third more than the diameter of the circle described by the sails, so that the 60 sails, 9in. wide, will be 45ft., and the diameter of the circle 30ft.

In the portable mills I used for ploughing, the sails were six in number, each being 6ft. wide and 12ft. high, and the arms 12ft. long, and I have had seven ploughs on the rope at one and the same time, the rope being drawn by two mills, and as the soil was stiff and heavy, three horses were always used on one plough, so that the two mills gave off 20 H.P. at that time; but the wind was a good stiff breeze. Our usual number was two ploughs to each mill.

Philip Vallance.

[26598.]—AFTER Mr. Raymond Browne had made sundry criticisms (letter 26557) on my reply to query 60817, he says, "And there he leaves us." If Mr. B. would kindly refer to the original query he will find that it was not my business to go further than answer the several points raised, which I submit I have done.

With respect to the inquiries Mr. B. has favoured me with, I may say the largest model I have made on this horizontal plan was ½H.P., given on friction brake on its vertical axle (not having the room to put up a large mill, I have to be contented with steam-power, its cost of fuel, and its attendance). Experiments show that a fair proportion is: Length of arms, 8ft. from centre; sails, 7ft. high and 6ft. wide, kept by a spiral spring at right angles to the arm, when not acted on by the wind: such a size will give in a wind of 2lb. to the square foot 4H.P.

If anyone interested in wind-power will refer to

Mr. P. Vallance's description of his patent (ENGLISH MECHANIC, Vol. X. p. 631), it will save much unnecessary description, as the chief improvement I have made is to adapt the louvre boards of the modern vertical mill, controlled by a governor, to Mr. Vallance's solid sail form, and thereby getting nearly the same steady speed, whatever work, and whatever wind.

Albert Collingridge.

CUTTER BAR.

[26599.]—I REPLY to letter 26584. The small steel which is rolled to suit the Haydon tool-holders is easily tempered, after it has been shaped, either filed or ground. A blowpipe and an ordinary gas-burner suffice for this purpose.

As these small tools are so portable, it is a good plan to sharpen several at a time. Mushet's steel cannot be filed, and this will to many be an objection. The experiment shall be tried with Mushet; and perhaps "Evod" will give the result of his test, as it will interest many.

M. A. Bear.

Britannia Works, Colchester.

MOVEMENTS OF DIATOMS.

[26600.]—IN answer to "Londiniensis" (26590), I beg to say that, whilst disclaiming any title to be regarded as an authority on the subject, no theory as to the source of motion of diatoms that I have met with seems satisfactory. Although I have studied the living forms for years, I am quite unable to account for the marvellous phenomenon.

By Prof. W. Smith it is referred to forces operating within each frustule and originating in the vital operations of growth which may cause the surrounding fluid to be drawn through one set of apertures and expelled through another.

The existence of apertures is clearly established, and is exemplified in the mineralised forms I had the good fortune to find in the London clay; but granting this, if the motion be the result of aqueous currents, how is it that one does not see some evidence of this outside the diatom? If anyone with better apparatus than mine has seen small particles influenced by the supposed endosmose and exosmose, I shall be glad to receive information.

Some diatom motion that I have observed has been clearly attributable to the superior attractive force of an associated group lying near, and I have sometimes thought that the molecular movement first observed by Dr. Robert Brown in 1827 should be taken into account.

Still, as far as I know, the problem as to the motive power has yet to be solved. The movements certainly are wonderful, and when watching the more active forms, it is hard to disposses oneself of the idea that they are sentient organisms. Especially is this the case with *Bacillaria paradoxa*, which, being well known, need not be described.

In conclusion, I would point out that the power of motion seems to be largely dependent upon form. The discoidal and triangular diatoms are generally, if not always, immobile; those that are boat-shaped move freely, and the most active are those of linear outline.

I may briefly add that I have quite recently met with some of these last-mentioned in the London clay, all that I had previously found in that formation having been either discoidal or triangular.

W. H. Shrubsole.

INCANDESCENT LAMPS—TO MR. SHIPPEY.

[26601.]—PRESSURE of business has prevented me replying to the questions asked by "Iota" on page 285 ere this. I may now say in answer to question (1) That there is as yet no scientific discussion as to the real cause of the "halo" effects which sometimes surround a carbon filament, but to create which the lamp must be considerably over-incandesced; but even then this photospheric effect does not occur in all carbon conductors alike, even when run at the same pressure of E.M.F.

Filaments made of cotton threads, felt, or carbonised paper, if not properly baked, are apt to show this optical delusion far more than filaments made from bamboo, Mexican fibre, rhea grass, gold-beater's skin, or the cellulose materials used in lamp manufacture, simply because filaments made from the latter materials are less porous, and therefore can be made more dense during preparation, and by the several improved methods and secret processes now applied in the manufacture of carbon conductors used in incandescent lamps, this to a great extent is overcome.

My own opinion is that the term "scintillation," as used by "Iota," is not a correct word, as no carbon conductor (wrongly described by some inventors as a filament) ever emits any sparks whatever; it being simply a photospheric or "halo" effect caused by the resistance and brought about by the nature of the carbon conductors used, which effect I have noticed shows itself more plainly in a lamp with a bad vacuum, probably caused by the minute molecules floating about in the bulb, which are being absorbed, and again emitted according to the temperature, whereas in lamps of very high resistance made with cotton or paper filaments, I think the effect is then caused by the unevenness of the materials used, which emit something from the innumerable points of fluff thereon, also by any surplus flow of current through the materials above described, all of which slightly expand when the lamp is overrun or strained beyond the actual voltage or normal candle-power. There are probably other causes, which is a subject well worthy of research. My own experiments have taught me that a properly-baked carbon when treated by the bisulphide of carbon process is less porous, far more dense, and stronger than filaments made by and under the so-called flashing processes adopted by Edison and Swan. I find that when made under the bisulphide treatment they are more refractory, will stand a higher pressure, consequently, being harder, will allow a greater flow of current to pass through the carbon conductor, and this without producing the "halo" effect frequently noticed in lamps when overrun. Many beautiful lamps are suddenly destroyed by inexperienced electricians switching on the full current, which, I may mention, is very detrimental to a cold filament inclosed in vacuum. I have always advised, where batteries are used, in order to prolong the life of a lamp, that it is better to arrange the cells so as to switch in an extra cell if required after the lamps have been run a short time under their normal voltage, as by this means the lamps are gently warmed, and proper expansion takes place; they are then better able to bear the full force and pressure of current flowing through the leads.

Many amateurs have also a habit of unduly switching on and off the lights merely for show, forgetting that by so doing they are damaging their lamps. This should be avoided as much as possible, as such a course is detrimental to the lamps in use. When a dynamo is used, a little resistance should always be used in the circuit, which is easily cut out when the lamps have run a short time, and are giving the full light required.

As to question (2): If the 12-volt low-resistance lamp alluded to was one of our battery lamps, it would be made according to our patent of Mexican fibre, whereas the 25-volt 10c.p. lamp, containing a fine conductor, would probably be made from "rhea grass," as used for our Standard lamps, but specially made to run 2 or 4 in series on 50 or 100-volt circuits in combination with lamps of high resistance. Candle-power is candle-power, whether produced from a 12 or 25-volt lamp; but voltage and resistance is another matter—the higher the voltage the less the ampères absorbed. It may be mentioned that some types of lamps are good for one thing but not suitable for another; for instance, the Edison lamp is of high resistance, and specially suited for central station lighting, being made of 100 to 500 ohms resistance, according to requirements, whereas the lamps manufactured and sold by my firm (under recent discussion) are of specially low resistance, say, from 3 to 20 ohms resistance according to voltage, and, consequently, would not be suitable for central station lighting, but for battery work, where a few ampères, more or less, is of no object, or for separate domestic lighting, where one has to resort to a small gas-engine to run a few lights only, either direct or by accumulators, then for these purposes I do not hesitate to say, from an economical point of view, there is nothing better than a low-resistance lamp, which, of the two, is far more difficult to make, especially when even resistances and a given voltage are required to produce same effect.

I have not made photometric measurements as to the difference of light produced from a short thick carbon conductor over that of a long, thin one of same voltage and power, but will do so when I can spare time, and will, with the Editor's permission, report the result of my tests in the pages of the "E. M."

Arthur Shippey.

PAVY'S AMMONIACAL CUPRIC SOLUTION.

[26602.]—ALL your chemical readers owe a debt of gratitude to Mr. A. H. Allen for the generous way in which he gives most valuable information. In his reply, however, to inquirers on sugar titration (letter 26549) he, unwittingly I am sure, does injustice to one of the most delicate and exact processes of sugar estimation.

Mr. Allen states that in the case of diabetic urine containing but little glucose the Pavy blue liquid cannot be employed. Yet on page 229, Vol. I., of his latest edition of "Commercial Organic Analysis" Mr. Allen shows that 1cc. of the Pavy solution equals ·0005 glucose, while in the ordinary Fehling selution 1cc. = ·005 glucose. So that, in fact, you can deal with solutions by the Pavy method that are ten times as dilute as those that the ordinary Fehling solution is used for.

I frequently use it for diabetic urine, diluting this to 10 or 20 times its volume and running it into 10 or 20cc. of the Pavy solution. It is not necessary to precipitate the albumen, since this only forms a little more ammonia (fatal to ordinary Fehling solution) and does not influence the result. It is, however, too delicate for qualitative use, for it shows the minute proportion of glucose normal to all urines.

A preliminary trial is made in a test tube with Fehling's solution, and if glucose be indicated the Pavy solution can be used for its estimation. The Pavy ammoniacal cupric solution will show ·05 per cent. of glucose in a urine, that is, half the amount quoted by Mr. Allen as the lowest indicated by any other process. The advantage of the Pavy fluid in use is that the fluid remains always transparent and clear, passing gradually from a blue to a colourless state. In the ordinary Fehling method you look through a cloud of steam at a more or less blue fluid that gets thicker and muddier each moment with red particles so that it is almost impossible to say when the blue colour disappears. Pavy solution will keep; Fehling will not. It is to be regretted that Mr. Allen, usually so exact, has in one or two other points mistaken the Pavy process in his otherwise admirable work. Particulars of the method of working, apparatus, calculation, &c., of this process, I should be happy to supply if required.

Alf. W. Stokes, Public Analyst.

TRICYCLE MATTERS.

[26603.]—THE difference in weight between 40in. and 50in. wheels is, of course, something, but not much, and I cannot assent to the assumption made by Mr. R. G. Bennett (No. 26555), p. 303, of current volume, that "the tricycle can be made so much lighter" with small wheels. The axle and framework generally to be as strong must be as heavy *cæteris paribus* in both cases—size of wheels excepted. If the increased ease of propulsion arises from the larger diameter of the steering wheel, clearly that is not in consequence, but in spite of, the smaller diameter of the driving wheels.

I thank "Doctor Medicinæ" for his suggestion, but fear that he has forgotten the impolicy of prescribing for his patient without a personal interview. Now I am old and heavy, and could no more "step off my horse without allowing it to stop" than I could "go in for" a race—my movements are more like those of the bear than the antelope. Again, I presume "D. M." would find it easier to walk up the hill without his tricycle, than to drag it up after him. Certainly I should; but pushing it up before me is quite another matter. I would rather do that than walk up without it; it is something to bear upon, and it takes my weight off my legs. Here is another instance of one man's meat being another man's poison.

Gamma Sigma.

NASMYTH'S BRASS FOUNDRY.

[26604.]—APROPOS of my article on Brass Foundry in the "Amateur Workshop," the following extract from James Nasmyth's admirable autobiography may be of interest to many of your readers:—

"I got up early in the mornings to work at my father's lathe, and I sat up late at night to do the brass castings in my bedroom. Some of this, however, I did during the day time, when not attending the university classes. The way in which I converted my bedroom into a brass foundry was as follows: I took up the carpet so that there might be nothing but the bare boards to be injured by the heat. My furnace in the grate was made of four plates of stout sheet-iron build with fire-brick corner to corner. To get the requisite sharp draught I bricked up with single bricks the front of the fireplace, leaving a hole at the back of the furnace for the short pipe just to fit into. The fuel was generally gas coke and cinders saved from the kitchen. The heat I raised was superb—a white heat, sufficient to melt in a crucible six or eight pounds of brass.

"Then I had a box of moulding sand, where the moulds were gently rammed in around the pattern previous to casting. But how did I get my brass? All the old brass works in my father's workshop drawers and boxes were laid under contribution. This brass being for the most part soft and yellow, I made it extra hard by the addition of a due proportion of tin; it was then capable of taking a pure finished edge. When I had exhausted the stock of old brass, I had to buy old copper or new in the form of ingot or tile copper; and when melted I added to it one-seventh of its weight of pure tin, which yielded the strongest alloy of the two metals. When cast into any required form this was a treat to work, so sound and close was the grain, and so durable in resisting wear and tear. This is the true bronze or gunmetal.

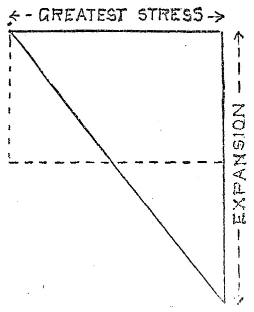
"When melted the liquid brass was let into the openings until the whole of the moulds were filled. After the metal cooled it was taken out, and when the room was sorted up no one could have known that my foundry operations had been carried on in

my bedroom. My brass foundry was right over my father's bedroom. He had forbidden me to work late at night as I did occasionally on the sly. Sometimes when I ought to have been asleep I was detected by the sound of the ramming in of the sand of the moulding boxes. On such occasions my father let me know that I was disobeying his orders, by rapping on the ceiling of his bedroom with a slight wooden rod of ten feet that he kept for measuring purposes. But I got over that difficulty by placing a bit of old carpet under my moulding boxes as a non-conductor of sound, so that no ramming could afterwards be heard. My dear mother also was afraid that I should damage my health by working so continuously" (p. 115).

J. H.

ON THE MODULUS OF ELASTICITY.

[26605.]—THE modulus of elasticity is sometimes obtained by noting the elongation produced in a rod of the material by a given tensile stress.



In this method let L = original length of the rod, l = the elongation produced by a stress of $p$lb. per square inch, then modulus of elasticity = E = $\frac{Lp}{l}$.

But as the stress p can be produced by heat as well as by mechanical force, another means of obtaining E suggests itself.

It is obvious that when a bar of metal is heated say 1°F., and first prevented from expanding in the direction of its length, and then suddenly allowed to expand, the work done by the heat can be represented by the area of a triangle as in sketch; also that it can be as well expressed as: Greatest stress × half expansion, as per dotted lines.

Again, as the linear expansion of a body is $\frac{1}{3}$ of its cubical expansion, only $\frac{1}{3}$ of the heat energy is available for doing the work of linear expansion.

Taking a bar of wrought iron, 1ft. long × 1 square inch in section to weigh 3·3703lb., specific heat of wrought iron = ·113, and expansion per degree Fahr. = ·00000676, then

$$E = \frac{3{\cdot}3703 \times {\cdot}113 \times 772 \times 2}{3 \times {\cdot}00000676} = 29{,}000{,}000\text{lb. per sq. in.}$$

nearly, which is the value usually given.

On trying the same formula with other metals, I found some to agree very well indeed with the tables; but others, lead for instance, were very far from coinciding.

By the way, E for lead is generally given as 720,000lb.; but from a table in "Ganot's Physics," it appears to be about 2,560,000lb.—much the same value as obtained by the above method.

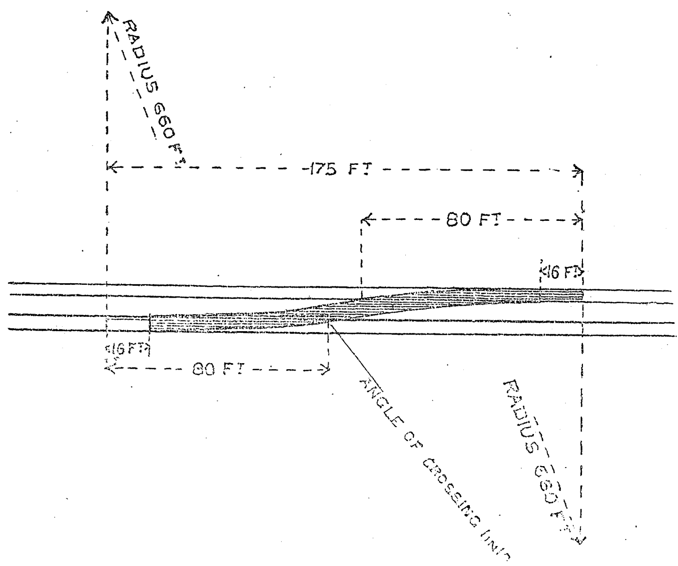
I should be glad if any reader will explain why this method does not appear to be universally true.

C. N. P.

DOUBLE-ENGINE RUNNING.

[26606.]—MR. STRETTON (p. 286, let. 26542) has done good service by writing you about the empty trains that are dragged about, particularly Scotch trains; and I hope those in authority will see the letter and act upon it. How we shall get on this winter if they don't reduce the loads I cannot tell; but we shall not be able to keep time. There is no mistake, the 800 class are a fine engine, and I don't wonder that Mr. Stretton speaks well of them; but he is rather hard on the 1667 lot. They are the only failures we have had, and when they get the new boilers, they will be all right. All our old drivers say there is nothing like an 800; but there is something in being used to an engine. Mr. Stretton was a pupil at the time when Mr. Kirtley brought out the 110, 170, and 800 classes eighteen or twenty years ago; and, although I don't think either our old drivers or Mr. Stretton are partial to them yet, we know that what one learns in early days often sticks in one's ideas. I admit that we have got ten failures; but I think we ought to set against them the number of good engines Mr. Johnson has put on our road. I have looked over the ENGLISH MECHANIC for many years back in the hope of finding a diagram of 800 class, but there is not one in your columns. Would any correspondent oblige by sending one?

Midland.



POINTS AND CROSSINGS.

[26607.]—MR. T. ATKINS (p. 329) has given us a very highly theoretical rule to lay out a cross-over-road, which he himself says would be no use to anyone without a good knowledge of mathematics.

As the reader who asked the question was a "Platelayer," I presume he will quite fail to obtain the few simple figures he wants, so I will help him as follows:—

(1) Decide where you wish one pair of points to be; (2) measure 175ft., which will give opposite end of cross-over road; (3) measure 80ft. from each point, which will give you the position of the crossings. Put in your crossings with an angle of 1 in 10, and your reverse curves with a radius of 10 chains or 660ft. Use switches 16ft. long, and you will have no trouble.

Theory is very good in its way; but "Platelayer" wants a few simple figures to enable him to perform his work, and I trust the rough drawing will assist him.

A Practical Man.

PASSENGER TRAINS AND PARTING COUPLINGS.

[26608.]—THE daily papers of Dec. 9th contained particulars of an accident in the Farringdon-street and King's-cross tunnel of the Midland Railway, which might have resulted in serious loss of life.

Accidents arising from the parting of couplings are of frequent occurrence; but so far as I am aware, no attempt has as yet been made to advise the driver when this has happened.

Happily a means, inexpensive, automatic in action, and reliable, is at hand in the coupling system now universally employed, both in passenger and luggage trains. All that is needed is a small battery in the guard's van, and a polarised magnet operating a disc fixed in some conspicuous place on the engine footplate. So long as the waggons or carriages are properly coupled up, the disc would show "All right," as a small current flowing round the polarised magnet would prevent its attracting the armature carrying the disc; but should severance of the couplings take place, the circuit completed through them would be broken, and the magnet at once pull the armature, carrying the disc to "danger," and give warning to the driver by ringing the bell.

The weight of the couplings would always insure electrical contact; but if objection be raised to this method of forming a line, any waggon or carriage could be fitted with the needful connections for, say, 2s. each, and since the return circuit would be completed through the rails, the total cost of fitting a train would not exceed 40s.

It becomes a question for serious consideration, whether upon our crowded underground and suburban lines, over which mixed trains follow each other in rapid succession, some such system should not be insisted upon. Labour would not be increased, but saved, and the driver would at once know when his waggons or carriages were properly coupled.

I am in no way interested pecuniarily in the adoption of this or any other system having the same end in view, but merely make the suggestion in order that the travelling public may know that a remedy for this very frequent class of accident exists.

Francis M. Rogers, F.C.S.

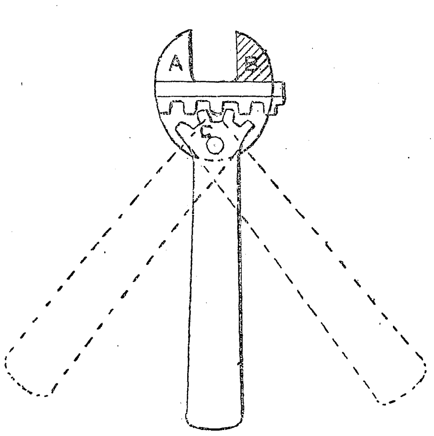
RANGE OF BAROMETER.

[26609.]—IN reply to "M. C. B." (letter 26583), I offer a few observations from my meteorological records of the last six years. During this period the highest point attained by my barometer (corrected for temperature and height above sea-level) was 30·87in. at 9 a.m. on Jan. 18, 1882; whilst the lowest, registered on the 8th of the present month at 11 p.m., was 28·02in. (similarly corrected for temperature and height). Taking this period as representative, the extreme range of the barometer in this locality amounts to about 3in. Frequently this range during 24 hours exceeds an inch, as representative of which I may mention that in the interval between 10.30 a.m. on Oct. 25, 1885, and 9.30 a.m. on the succeeding day (a period of 23 hours) the mercury fell from 30·08 to 28·97. The height of my station above sea-level is 525ft., and I may add, for the information of "M. C. B.," that its latitude and longitude are respectively 52° 30′ 23″ N. and 1° 56′ 38″ W.

Handsworth. B. A.

ADJUSTABLE SPANNERS.

[26610.]—AS you have illustrated three kinds of adjustable spanners lately in the "E. M.," we beg to send you a sketch of our patent adjustable spanner, which consists of a toothed jaw A sliding



in B, and worked by a toothed handle C. One of its chief advantages over other spanners is "that the handle can be placed almost at any angle with the jaws when they are placed at any size," by turning the handle out of gear, then placing the handle in the required position, and gearing up the jaws again. The advantage of this is obvious where nuts are awkward to get at.

Chas. Martin (pro Moore and Martin).

CONCERNING CHAMBER ORGANS.

[26611.]—IT is matter of great satisfaction to me that Mr. Audsley is able to speak as he does of my work upon the Mustel organ. I fear, however, time and distance must have lent no inconsiderable "enchantment to the view." I think, however, it is only right that I should say something as to the alleged great difficulty in playing the Mustel organ. Our friend, Mr. Audsley, much exaggerates it. I should think that it is quite as easy to play the Mustel organ with effect as his own chamber pipe organ. After a long experience of pianos, harmoniums, American organs, and pipe organs, of many sorts and conditions, I am satisfied that, instrument for instrument, the harmonium is the most difficult

of all to play really satisfactorily. But of all the harmoniums I have ever played upon, I have no hesitation whatever in saying that the Mustel is by far the easiest to play *effectively*.

Although until I saw the one I ultimately purchased I had scarcely ever seen a Mustel organ, yet, directly I put my hands upon it, I took to it as readily and as easily almost as the proverbial duckling to its water, and I fancy the experience of anyone who had the slightest musical capacity would be the same. There is nothing like the Mustel organ for *drawing out* one's musical capacity. Let those of your readers who contemplate the purchase of a Mustel organ first learn the rudiments and fingering upon any common instrument, and look forward to the Mustel when they have achieved some measure of capacity upon the smaller instrument suggested. They will then be in a better position to appreciate its marvellous beauties.

I heard the other day of a very good definition of the distinction between an American organ and a Mustel organ. I may be forgiven for repeating it. It is this: Upon the Mustel organ you may pray, sing, laugh, and, if need be, *swear*. Upon the American organ you can *pray only*.

I have regretted more than once that in reply to one of your correspondents I did not suggest to her that she should procure all the numbers of Mr. J. M. Coward's *American Organ Journal* (Metzlers). I know of no better arrangements either for the American organ or the harmonium. The selection of pieces, too, is far removed from the type so common in ordinary books of "voluntaries."

Country Solicitor.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60432.]—**Architecture.**—If what is meant by Classic architecture be not generally understood, it would be well to explain it here. Classic, when applied to architecture, signifies, just as it does when applied to literature, what appertains to ancient Greece and Rome, and the chief characteristic of Classic architecture is the horizontal principle of construction, as opposed to the vertical tendencies of the lines in the Gothic arches and gables. We may succinctly distinguish between Gothic and Classic by describing them as what is Gothic and what is not, since whatever is not included in these two terms is very rarely practised in this country. Gothic architecture is particularly advocated and enforced amongst us by the clerical parties, and particularly by the so-called Architectural Societies of Oxford and Cambridge; but these are really archæological societies, which greatly bar the progress of architecture as a true art. There can be no doubt, however, that Gothic for secular buildings is detested and execrated by the great majority of the English people. The great bulk of Englishmen must, no doubt, loathe to contemplate the expression of monastic austerity, the hideous deformity and mortifying meanness presented to their view by those forms of Gothic which constitute what its advocates, with unblushing audacity, have designated the "national style." No one should venture to foist this ghastly architecture of the cloister and of the tomb as being most in accordance with the national taste of the English people. With all the Gothic deformities and tomb-like vaults which have sprung up of latter years amongst us, we should be quite dead-sick of the style by this time. Instead of such revolting features, we would require that our eyes should rest on buildings presenting dignity of mass in their regularity of form, artistic proportions and longitudinal extension. In point of practical requirements it would be nonsense to deny, with regard to Gothic, that the narrow lancet window is quite unsuitable for this climate; that the tower and steeple are altogether useless; that such high-pitched roofs are extravagantly expensive; and that the staircase turret with its newel staircase is a most miserable make-shift for its purpose, and even a very dangerous structure for the aged and infirm. What a contrast between the Classic entrance portico approached by a wide-spreading flight of steps, and the unutterable meanness of the entrance to the new Law Courts. The style of architecture to be adopted should always be capable of presenting the building as a whole; but this is what Gothic is altogether unable to do if the building consists of a number of halls and chambers. In such cases Gothic can only present a patchwork appearance, which is always a dilapidated appearance, and just the same as if the building were made by addition to addition at different periods of time. The Americans are a very practical people, and to America indeed we can look for exquisite examples of modern design. Now, Classic is the favourite style with the Americans. Their great Capitol at Washington — built of white marble, and covering five acres of ground—is in the Roman Corinthian style, and is modelled after the Pantheon of Rome. With regard to the very important matter of colour in architecture, it is the case that a red or deep-brown colour in the walling takes away all architectural effect from the buildings. This colour should be avoided as much as possible, if it were only to afford some variety from the constant glare of the red brickwork. It is very desirable, then, that building materials in terracotta should be made in considerable quantities in imitation of white stone, and not so much like red bricks in colour. But what is the style of the new Law Courts? Well, to be sure, a new name had to be found in order to designate this phenomenal architecture. It was termed "Muscular" Gothic and also "Eclectic," and its different parts were made purposely all vieing with one another in deformity. The style was in defiance of all principles of art and of all regard for the purpose of the building, and it bore some relation to what was known in painting as "Pre-Raphaelism." An explanation of Muscular Gothic as applied to the Law Courts will be found in the *Architect*, September 2, 1871. This journal stated that the number of Muscular architects was so small that they might be counted on the fingers and thumb; and, as an instance of the corrupt system of selecting Government designs, it stated that a single individual, whom it named, so manœuvred matters as to insure the selection of a Muscular Gothic design for the Law Courts. In order to make architecture flourish, we should have an artistically competent and sufficiently representative body of judges to select the designs, particularly for Government buildings; and we should be particular to prevent any interference from those Mediæval lunatics, the Muscular Goths.—W. H.

[60523.]—**Battery.**—After Messrs. Shippey's letter and Mr. Bottone's answer to 61039, I am like a donkey between two haystacks. I rather lean, after what has been said, to the cell described by Mr. Bottone on page 561 of the last volume. Will that gentleman kindly tell me the size of carbons and zincs, and proportions of solution and number of cells required for the necessary lamps required, of Messrs. Shippey's make, for a room of the size mentioned? One great advantage I see in the above cell is that there are no porous pots, which are expensive and a constant source of trouble. Will Mr. Bottone please say if I am to couple up in parallel or series, and what size leads to use?—NEMO.

[60530.]—**Lens Grinding (U.Q.)**—If J. H. Wheat, whose query did not catch the eye of Mr. Lancaster, will take such information as an amateur can give, he is welcome to it. The finest emery will not polish a lens; it will only prepare it for that operation. Use putty powder. A "lead tool" may be the proper thing—I don't know; but I polish lenses up to an inch in a compound of beeswax and putty powder; melting the wax in a small clean iron spoon, then adding the powder till pretty thick, and pouring into a hollow turned in a piece of wood stuck into a bell-chuck. I am not aware if this is the way of the "trade"; but I get my glass that a ½in. magnifying lens will not detect a mark on it.—JAS. A. CAMPBELL.

[60700.]—**To Draughtsmen, &c.**—The method on p. 306 is just as correct as mine, given in the first reply, but surely is not so simple. The lines are in as many directions as you require parts, instead of in only two. Moreover, as the point E has to be found by prolonging so short a line as C A, it is certainly far less correct in practice (though as Euclidean in theory). That a "finite right line can be produced" is the weakest of Euclid's postulates, and by no means to be granted without limitation—indeed, practically, very much limitation.—E. L. G.

[60814.] — **Modified Leclanche Battery.**— Should not this querist give more information about this battery, or, at least, the date of the patent? Where did he find any mention of it?—NUN. DOR.

[60814.] — **Modified Leclanche Battery (March's Patent).** — The initial E.M.F. of this is 1·4 volt per cell; but this falls off in working to about 1 volt, so that it is necessary for lighting purposes to be able to switch on some spare cells. The resistance varies, of course, with the size of the cells, but as these have no porous pots in them it is low, being about ·03 ohm in the largest size. They are intended for intermittent lighting, cauterising, &c.—BARKER AND CO.

[60818.] — **Coil.**—I would recommend this querist to read up the many excellent descriptions of coils which have appeared in your paper, and to rebuild his coil. What does he mean by a coat of pitch and resin between the layers of the secondary?—J. W. B.

[60819.]—**Portable Electric Lamp.**—The battery inquired about under the name "Regent," was illustrated in No. 1112, as the "Maquay," the name of the patentee; and on p. 569, No. 1118, there is an account of an exhibition of portable and other lamps on this principle. It seems rather singular that the querist should not have looked in the index of the last volume; but I presume he really wants to know whether any of your readers have had personal experience with the lamp and battery.—NUN. DOR.

[60823.]—**Redecorating Harp.**—"Arpa" may as well clean off the paint and start afresh. Black paint rarely dries thoroughly hard when mixed as described; but if by cream "Arpa" means a paint made of white lead, it ought to have dried hard at least, especially as he rubbed each coat down with sandpaper. He should procure some best pale copal or amber varnish, and mix his prepared and ground colour with that, and he should take care to apply it in a room at a temperature of not less than 60°, free from draughts or dust. As to the gilt, trace the design in gold size, or paint in orange first, then apply gold size, and when the latter is tacky, lay on the leaf gold.—SAML. RAY.

[60825.]—**Draw-Vice.**—Wire of ·121 or ·171in. is suitable for short lines. As to sketches of the tools, you can find them in any catalogue of telegraph materials.—LINEMAN.

[60845.]—**Polishing Silvered Goods.**—This question has been answered several times since Mr. Sprague's articles a good while back. The "bobs" are made of leather discs—walrus hide, for instance, when single; but bull-neck leather when they are made of several clamped together. Felt, cloth, and calico are also used; but for silver-plated work most polishers use wooden bobs, covered with hard and soft leathers, and circular brushes, with dollies made of swansdown. Rottenstone, tripoli, crocus, and rouge are the chief polishing materials. With these the real black polish can be obtained.—NUN. DOR.

[60851.]—**Sheet Wax.**—Melt the wax, stir in some lampblack or other suitable pigment, and pour out on slabs of glass, marble, or other material capable of taking and retaining a good surface impermeable to the wax.—NUN. DOR.

[60911.]—**Steam Engine.**—I have not your original query by me, so forget if you gave particulars as to lap, if any. But from width of ports and travel now given, I expect it is ¾in., and you may increase this by pinning on ½in. at end of valve. This will enable you to cut off at about ¾ stroke if you give valve $\frac{1}{10}$in. lead. Of course you must set eccentric forward to give the requisite lead; this will not only open exhaust port earlier, but at same time also cushions earlier, and to that extent also saves steam, and if an engine running at a good speed is essential to smooth running.—T. C., Bristol.

[60936.]—**Oxygen.**—In preparing oxygen from potassium chlorate mixed with black oxide of manganese it is often a great inconvenience that the gas is given off in sudden rushes, and does not directly stop when the light is removed. To obtain this result the following mixture should be used—

Potassium chlorate	8	weights
Black oxide of manganese ...	2	„
Ordinary kitchen salt	1·5	„

All to be properly mixed and powdered. By this mixture the gas is given off at a uniform rate, which lessens directly when the gas is turned lower, and immediately stops when the light is taken away.—HOLLAND.

[60983.] — **Chloride Battery.** — If by "strength," this querist (p. 328) means E.M.F., there is no battery which has about three times the strength of the Leclanché per cell. If there were, it would surely be the subject of a patent. It puzzles me why such a request should be made, when a reference to Mr. Sprague's book, or, for that matter, any textbook of electricity—not to speak of back volumes—would show that a cell having an electromotive force much over two volts is unknown. I calculate we must invent some new elements before we get that. Perhaps by "strength" the querist means something else. If so, he will, no doubt, explain.—NUN. DOR.

[60985.]—**Tides.**—As no one has yet replied to the query of "E. F. S." in your issue of Nov. 26, I may say that by De La Rue's tables high water at Simon's Bay, on the Atlantic coast, is always 1 hour 6min. earlier than at Panama, on the Pacific coast. These two points are (as "E. F. S." is probably aware) at the extremities of the proposed ship canal across the isthmus.—B. A., Handsworth.

[60993.]—**Permanent Way.**—The stone-block sleepers were first used by Barnes in 1797. To go fully into the matter would take much space, and not be of general interest; and besides, it is all to be found in Stretton's "Railway Safe Working," to which your correspondent, "Permanent-Way Man," should refer for details."—PRACTICAL.

[61000.] — **Pipe Moulding.** — Thanks to "J. H." for his reply; I have received No. 985,

other numbers being out of print. Can you give me a sketch how they are done with a core-box, and if hot-water pipe cores are dried, and how the saddle (with stud) is fixed in core, as they are done in Glasgow? and oblige—H. S. H.

[61002.]—**Dynamo and Storage Battery.**—To EDWARD CONRY.—I observe, and will presently give you the details you require.—EDWARD CONRY.

[61012.]—**Annealed Zinc.**—Your correspondent "Dens" is certainly mistaken when he says zinc cannot be softened. Ordinary commercial zinc is quite malleable and ductile at a temperature a little below that of boiling water, and can be bent, folded, rolled, or hammered out with ease, although it is hard and brittle at ordinary temperatures. "Dens" is most probably a dentist, and unacquainted with zinc in any condition except as it appears when cold or when melted. If he will treat one of his zinc dies to about the temperature of boiling water, he will find it not much harder than lead, and he will be able to flatten one of his dies out on his anvil without cracking, if his zinc is clean.—THOS. FLETCHER.

[61019.]—**Brazing.**—A good "shop wrinkle" in brazing band-saws is—after filing the ends down to a proper scarf joint, ram a raw potato on to each end of the saw, just allowing the part to protrude that is intended to be heated. This keeps the saw cool, and before the potato gets cooked through the slit the joint should be complete, unless the operator has been too long over his job.—T. F. S. T.

[61048.]—**Electric Conductors.**—The information you furnish is not sufficiently definite to enable a practical answer to be given, for the following reasons:—(1) You do not say the minimum current and E.M.F. that will be required all along the 25 mile stretch. (2) You do not say what dynamos you mean to use; so that it is impossible to reckon what will be the loss of power by transmission through the dynamo—a quantity which, with different machines, varies from eight to forty per cent., and which varies also with the price; the most efficient machines costing, naturally, the highest price. Are you prepared to pay a good price for your plant? Your loss by leakage would depend entirely on how the cables were laid, the surrounding soil, and the particular time of year, as in dry summer weather it would probably be almost nil, while in wet winter weather it might be nearly 50 per cent. of your power, especially considering the length of your line. Even on a two-mile line at Blackpool, from 30 to 40 per cent. of the power is at times lost by leakage (when the weather is wet and stormy) and resistance in the jointings of the rails. In view of this, and of the great fact that you have water-power at command, and so have not to pay for coal and steam machinery, I should most strongly advise you to dispense with the main conductor along the line, and get your power from accumulators carried on the car; but that is your affair. The following items may possibly be of some use, but are of necessity only rough approximations, owing to the want of the definite information I have asked for above. If you cannot give this, as it is purely technical, then, if you will say what weight you want to carry or draw, e.g., a train of electric engine and five ordinary railway goods trucks, each truck carrying so much, or electric engine and three passenger cars, like an ordinary tramcar, each carrying so many passengers, and the trains required to move at such-and-such a rate, I may be able to assist you, and if you seriously contemplate forming such a line, and care to communicate with me by advertising your address, may be able to put you in the way of getting more substantial aid to your enterprise. I find, on going into the figures, it is impossible to give you a reliable answer without knowing more particularly the particulars of the trains to be run, the speed, and the number of trains that would be run at once. I presume you refer to a single line. Assuming that your electromotors would not take more than 100 volts as a maximum, your 170 H.P. would give you roughly, through the dynamos, about 100 volts and 1,000 ampères; but without the data asked for above it is impossible to say what amount of current you would require, and how much of the 1,000 ampères you could afford to sacrifice to the E.M.F. If you could do with 200 ampères, and could devote the H.P. represented by the remainder to the production of a much higher E.M.F. than 100 volts, you could afford a much smaller and less costly cable than if you required 800 ampères out of the 1,000, because the higher E.M.F. would enable you to maintain a minimum of 100 volts at all points along the 25 mile stretch. (This is by way of illustration only, and not by actual figures.) Another consideration is that with the continual wear of the travelling contacts on your overhead line, this being necessarily of soft metal, would rapidly wear out, and get thinner, and thus every week would require a slightly greater force to drive your trains than the one before, because your travelling contacts must press moderately hard on the overhead conductor to break through the resistance caused by oxidation of the bare wire in the air, and this pressure means wear and tear. Considering all things, and especially the fact that you get your power from water, and therefore probably for nothing, I should strongly advise your using accumulators carried on the car, like coals in an ordinary tender. These you could make for yourself, while as a counter-item saving not only the first cost of the overhead conductor and specially-jointed rails, but also the wear and tear of the first (unlike which the accumulators would improve with use), and everlasting trouble and expense in keeping good electrical contacts all along the rails over 25 miles of line. You can reckon for yourself how many joints there would be in such a length. An overhead conductor line that may be very practicable for two miles becomes a very different thing for 25, because you do not carry your power with you, as in the case of accumulators or steam. Where are your sources of power placed? Grouped at one end, or scattered along the 25-mile stretch?—EDWARD CONRY.

[61049.]—**Dynamo.**—We suppose you mean how can you avoid a complete breakdown? The only way we know is to short-circuit the faulty section by soldering a wire from one end of it on to the other. The bad section will then become charred right through, but the machine will work. We ran a Gramme A exciter in this state for a fortnight at an exhibition without any noticeable result, and we know that a flat ring machine was also working in the same state.—BARKER AND CO.

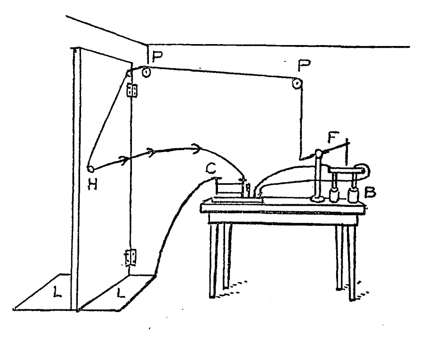
[61051.]—**Lens Shutter.**—If "Photographer" removes the hood of his lens, he will admit extraneous diffused light, which will tend to reduce definition, and consequently the picture may be partly lost in haze, owing to this cause. Of course, the hood must be removed if he wants this unscientific flap shutter to be of any reasonable size, which may be replaced by a large diaphragm rigidly fixed in front of the lens; then apply the flap shutter. I have been thinking myself of having an arrangement under electrical control, so that by simply pressing a push the exposure can be made, and on releasing it (the push) the lens is recovered. This may be effected by an electro-magnet and some convenient source of current, such as a bottle bichromate battery, and a disc revolving in front of the lens, as the rotating diaphragms only having one hole, instead of three or four, as generally. I leave it to others to devise further; perhaps Mr. Bottone will say something in this photo-electrical departure. I am well aware of the electric snap shutters that have been invented; but not of one that prolongs exposure, as the operator requires, and manipulated by electrical arrangements. There is a pneumatic one that fulfils this latter purpose, and may be of use to querist, only I believe it is rather expensive.—A. TREYER EVANS, Newport, Mon.

[61053.]—**Preparation for Mixing Bronze Powders.**—Seeing no one has answered this query, I venture to suggest "gold size," which can be obtained from any carriage builder.—A. TREYER EVANS, Newport, Mon.

[61054.]—**Magnets and the North Pole.**—Some years ago, when a boy, I remember reading of a vessel which sailed round some point of magnetic attraction, termed "The Magnetic Pole." It was stated that the needle of the ship's compass pointed towards the said point as the ship neared it, and, turning aside as the ship passed, continued to point in the same direction; and after the ship had passed, what appeared to be the centre of some great attraction, the needle of the compass was pointing nearly south, just the opposite to what it was a short time previous. I do not recollect in what particular book this statement occurs, as I have read several accounts of Arctic expeditions; probably some one of your many readers may have read the same account. Further, in support of this, I have an atlas with the "Magnetic pole" marked on it, the author giving its position as about 70° 20' North latitude, and 96° West longitude.—SIMPLEX.

[61055.]—**Varnish for Bright Parts of Bicycles.**—Rub the bright parts of bicycle with a little vaseline; that will prevent it from rusting, and is better than any varnish for the bright parts.—J. C.

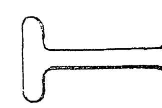
[61056.]—**Door Connection for Giving Shocks.**—Let a square of sheet lead be nailed on the floor outside the door instead of a mat. At some point near the door place a 1in. spark induction coil, with a two-celled lifting bichromate battery connected to its primary terminals. Let one of the secondary terminals of the coil be in electric contact with square of lead, while the other is similarly connected with the hasp and staple. Contrive, by a suitable length of string passing over a pulley, that the plates of the battery shall be lowered into the liquid directly the hasp is moved. The annexed sketch gives general idea of arrangement. C the coil, L L the leaden sheet, B the battery, F the lever to allow lowering of plates when the hasp is pulled. Of course, you will



require a check-string to prevent the battery being lowered when you yourself go in.—S. BOTTONE.

[61057.]—**Steam Launch.**—In answer to this query, I may mention to "Itchen" that his yacht, if yacht it may be called, is sadly out of proportion; in fact, I should call it a small barge. Surely there must be a mistake: 8ft. beam for a 22ft. 8in. boat! Why, this is considered to be a fair beam for a 40ft. boat. There are many boats built now 45ft. long with a beam of 8ft.; 5ft. beam for a 23ft. boat is ample. However, taking your boat as having a beam of 8ft., it will take much more power to drive it, as the lines must be very full in the boat you describe; and to drive her 7 knots an hour you will require an engine having a cylinder of not less than 6in. diam. by 6in. stroke, and having a boiler at least 4ft. in diameter. You may reckon that the engine and boiler will occupy 9ft. of the length, 23ft. I should have been pleased to go further into the question with you, but I think there has been a mistake. Anyway, write again, and I shall be pleased to assist you.—ENGINEERING MANCHESTER.

[61060.]—**Gut v. Leather Bands.**—From my experience, I certainly would prefer the 1in. leather belt to the two ⅜in. gut bands, as the latter are very apt to pull away at the thread of the hook and eye; as, if the hook or eye internal thread be sharp, it soon cuts away the gut, and if they be blunt there is no holding power. Also, two gut bands would be bad, even supposing you could adjust them to equal tension, as, if one came in two, you would have to shorten both. If you do use catgut, I should use one band of a larger size.



If anything tends to develop bad language, I think the breaking of a catgut band does. In a small steam lathe, you can pack the lathe up if you have to shorten the belt; but in a foot lathe you will have to put an extra piece in (with another hook and eye), or get another band. As regards the latter part of your query, there are several mechanical fastenings for uniting the ends of leather bands in the market; but for small bands perhaps as good a one as any is the brass one of this shape.—SEVERN TUNNEL.

[61061.]—**Engine and Boiler.**—If p is the pressure per square inch in the boiler, *above that of the atmosphere*, f the working load per sq. inch, t the thickness of the plates in inches, and r the radius of the shell *in inches*, then $p = \frac{f\,t}{r}$ Knowing f, t, and r, you can find the safe pressure. The f per square inch differs for different joints. For a single-riveted lap-joint it is 31,000lb., for other joints it is usually more. Thus, for a scarf-welded joint it is 46,000lb. The length need not be taken into account, as is seen from the formula.—A. E. RICHARDSON.

[61064.]—**Vertical Engine.**—The steam pipe requires clothing with non-conducting material, and probably it has many bends from boiler to engine. Your condenser is shut off too soon in both top and bottom of cylinder. The supply of steam in the up stroke is insufficient, either through defect in throttle valve or contraction in steam passage. The air-pump requires to be 12in. diam. and 12in. stroke.—S. M. S.

[61068.]—**Ramsbottom Safety-Valve.**—Is not W. H. Thurlow confused by taking the *centre* of hole A as the point where the spring acts, instead of the bottom of said hole? The *bottom* of the hole A should be level with the bottom of holes (or cups) B for the line of pressure to be a straight line. This would make it appear as if the hole were half its diameter too high up. If any

thing, I should think point A would be better a little below the level of B B to prevent any tendency of the lever to cant.—T. F. S. T.

[61071.]—**Planing Machine Tools.**—Probably because the feed is put on at the end of the cut (before the back stroke begins), instead of just before the fresh cut begins.—T. F. S. T.

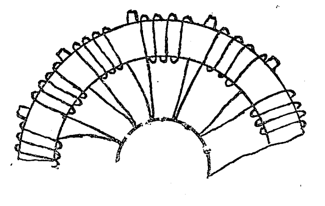
[61076.]—**Type-writing Ribbons.**—In negotiating for purchase of type-writers, I have understood that the ribbons could be renewed "at home" by getting similar webbing, and coating it with aniline dye and glycerine.—T. F. S. T.

[61078.]—**Red Rust from Sheet Tin.**—Ordinary "sheet tin" is only thin iron coated; most likely your "tin" has its coating injured, and the iron within yields the rust. Try brick-dust, or rottenstone and oil, and a good rub.—T. F. S. T.

[61079.]—**Lathe.**—I have found the same fault when the tool is blunt and round on the edge. It refuses to cut till sufficient pressure is put on with the slide-rest screw to force the blunt edge through the glazed surface it has formed; then it digs in and makes a groove. Keep your tools hard enough and thoroughly sharp.—S. F. S. T.

[61087.]—**Metallic Fire Alarms.**—The two best metals to use are silver and platinum. Very thin plates, of course, bend more readily than thick ones. A ribbon of each of the above metals united together by hard solder makes a good fire signal, if placed near the ceiling of a room, and joined with a battery and electric bell. Brass or copper and steel might act fairly well, but will not last so long. —A. E. RICHARDSON.

[61088.]—**Dynamo.**—You will not need to drive quite so fast, say, 1,400 revs. But you must not expect to get 60c.p. from the machine half the size figured. It will only give about 25c.p. The annexed illustration shows the mode of winding



and connecting to commutator strips. In words, it is "the end of one section forms the starting point of the next."—S. BOTTONE.

[61091.]—**Curious Phosphorescent Insect.**—"W. E. D.'s" "insect" is not an insect, but just an ordinary glow-worm.—GAMMA SIGMA.

[61092.]—**Hot-Air Motor.**—TO MR. SEAL.—To obtain ½-man power you will require working cylinder to be of 60 cubic inches capacity. The heater will have to contain about 100 cubic inches (when displacer is in it.) The displacer should not have more than 1½in. stroke. I have made these motors of the same design as given in "Ours" of April last to give out about 250 foot-pounds per minute. I have a new design for engines of ¼-man power and upwards, drawings to scale, of which I will give in these columns if you or any other reader of "Ours" would like to have them, and the Editor has no objection.—J. SEAL.

[61099.]—**A Rule of Grammar.**—Will Mr. Hall kindly say who made the "rules of syntax," one of which he thinks has not been grasped by a fellow correspondent?—G. W. M.

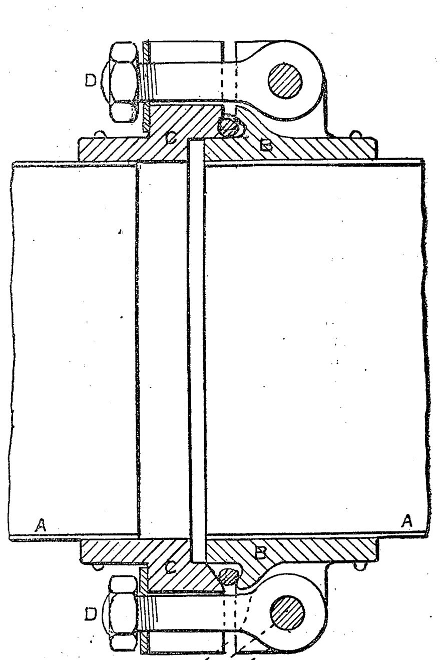
[61099.]—**A Rule of Grammar.**—"Weald" must forgive me if, for others' sake, I correct his answer to above on page 332. His French is all right, but his German example, "Es ist mich," is not only grammatically wrong, but a barbarism. Wrong in grammar because the German tongue, like all others I am acquainted with, *does* require the same case after as before the verb to be, and were a German given his choice between Es ist mich (it is me) and Es ist ich (it is I) he would undoubtedly choose the latter. And a barbarism because he would unfortunately never think of using either form, but say Das bin ich (it am I) or Ich bin es (I am it), accordingly as he wished to emphasise the *it* or the *I*. But this example does not clearly show the rule of grammar, because the neuter pronoun *Es* is the same in all cases: let us therefore substitute "He is I" or "I am he." Here we must avoid using the personal pronoun "He" (Er, nom.: Ihn, acc.) and substitute the masculine definite article (Der, nom.: Den, acc.:). The German would say, Der bin ich (*not* Den bin ich) for "he am I," and ich bin der (*not* den) for "I am he." Were I to construct this sentence according to "Weald's" faulty instructions, "he is I" would read "Er ist mich," and a German hearing this would infallibly understand him to mean "Er *isst* mich"—*i.e., he eats me*, which reminds me of my old master's favourite puzzle—viz.,—PES EST CAPUT.

[61099.]—**A Rule of Grammar.** — Unless "Doctor Medicinæ" wishes to be considered an uneducated man, I should certainly advise him to say "It is I," in place of "It is me." At the same time, however, I must say it is my firm belief that originally everyone, educated or not, used to make use of the latter expression until a lot of grammatical pedants ordered otherwise. We must not lose sight of what our language is derived from. It seems from "Weald's" reply that the German idiom, "Es ist mich," is the exact equivalent of "It is me," and I can add that the same idiom is also found in the Danish language, where this phrase is "det er mig" and not "det er jeg." I note Mr. Bottone's argument about "It" and "I" being really one and the same, and are, therefore, obliged to be both in the same case; true, so far as it goes, and it is also true that the nominative precedes the verb, from which circumstance he is quite at liberty to argue that the verb "to be" requires the nominative case to follow. But there is yet another way of arguing this matter—viz., that it is a rule that verbs govern the accusative case, so that it is quite correct to say "It is me," and, bearing in mind Mr. Bottone's argument, may we not fairly contend that in this sentence the word "it" should be considered as being in the accusative case the same as "me."—WHAT IS SAUCE FOR THE GOOSE IS SAUCE FOR THE GANDER.

[61099.]—**A Rule of Grammar.**—I think the views of "Doctor Medicinæ" must be admitted by reflecting persons to be absolutely true. Horace, who was certainly a man of sense, said, "usus quem penes arbitrium est, et jus, et norma loquendi." Language is like a world, and the so-called rules of grammar are, at best, like lines of latitude and longitude drawn across the face of it. When a pedant wants to regulate our speech to suit his views of what ought to be, he is like a man who would shift the position of towns to suit the convenience of geographers. Rome, for instance, is in lat. 41° 54′ N.; lon. 12° 28′ E. How much nicer it would be to move it to lat. 42 and lon. 12. When questions are in dispute, however, the votes of those who have studied grammar may fairly count for a little more, *ceteris paribus*, than the votes of those who have not. "It is me," "it is him," is still sub-judice. The only reason for the usual rule about the verb "to be" is that it is so in Latin and some other languages; but surely if we reflect we shall admit that there is no need for the word following "to be" to be in any "case" at all. If there were an absolute form of the word, a "stem," then surely that "absolute form" would follow the verb "to be." Where there is no absolute form there is no particular reason for taking any case but that which is the simplest and easiest to pronounce. In English the accusative case is that which comes most naturally at the end of a sentence; hence we might naturally expect people to say, "it is me," and "it is him." To say "it is I," is like galloping your horse to a precipice and pulling it up sharp at the edge; a feat (if you could perform it) well calculated to show off your horsemanship, and therefore "it is I" is highly favoured by those who despise the ignorant herd. I am of opinion that in some cases the multitude will prevail, and in some the few. As to votes, I am for "it is me," but I cannot vote for "it is him." Logic has very little to do with such matters. I stoutly stand up for "than him," though "than he" is not exactly wrong: this is a question of the same class.—X. Y. Z.

[61099.]—**A Rule of Grammar.**—As "Weald" and S. Bottone practically agree with me, I need only refer to the reply of W. C. Hall. As he surmises, I am tolerably familiar with the grammar of our Anglo-Saxon forefathers, having as an undergraduate gone in for honours in English literature, and I am also tolerably conversant with modern English grammar; but that does not blind me to the fact that such a thing as a hard and fast rule of grammar does not exist—in other words, there is no law of grammar. Custom makes it, and if custom changes, grammar must accommodate itself to the change, or become obsolete and pedantic. My reason for inserting my query was to ascertain, through the medium of probably the most widely-circulated scientific paper in the world, whether custom has, or has not, yet sanctioned any exceptions to the rule of syntax I quoted, and which I "thoroughly grasped" (W. C. Hall to the contrary notwithstanding) twenty-five or thirty years ago. The only authority I have ever seen mention this matter is Dean Alford, in "A Plea for the Queen's English." He says: "*It is me.* Now, this is an expression which everyone uses. Grammarians (of the smaller order) protest; schoolmasters (of the lower kind) prohibit and chastise; but English men, women, and children go on saying it, and will go on saying it as long as the English language is spoken. Here is a phenomenon worth accounting for. 'Not at all so,' say our censors, 'don't trouble yourself about it; it is a mere vulgarism. Leave it off yourself, and try to persuade everyone else to leave it off. But, my good censors, I cannot. I did what I could. I wrote a letter inviting the chief of you to come to Canterbury and hear my third lecture. I wrote in some fear and trembling. All my adverbs were (what I should call) misplaced, that I might not offend him. But at last I was obliged to transgress, in spite of my good resolutions. I was promising to meet him at the station, and I was going to write, 'If you see on the platform an old party in a shovel hat, that will be I.' But my pen refused to sanction (to 'indorse,' I believe I ought to say, but I cannot) the construction. '*That will be me*' came from it, in spite, as I said, of my resolve of the best possible behaviour." Further on he quotes Dr. Latham's "History of the English Language"—a book I have not by me—who says: "We may call the word *me* a secondary nominative, inasmuch as such phrases as *it is me* = *it is I* are common. To call such expressions incorrect English is to assume the point. However, Dr. Latham, though approving of "*it is me*" as good English, and asking "Is there any real custom in favour of '*it is I*,' except so far as the grammarians have made one," sticks at "*it is him, it is her*," though why he should accept the one and reject the other, which is equally customary, is not apparent. In my first communication I did not mention the French form "*C'est moi*," because I did not consider it an equivalent expression, and what we have to do with is what is, or is not, good English, irrespective of the idioms of any other languages or the idiosyncrasies of grammarians, who, in respect of the rule of syntax in question, appear to have been mere plagiarists copying blindly the rules laid down by their predecessors, without the smallest consideration for the usages of society at large.—DOCTOR MEDICINÆ.

[61100.]—**Thin Steel Pipes.**—I cannot say whether they are used to any great extent, but have seen some hundreds made. They are riveted up lengthways, the steel being about $\frac{1}{16}$in. thick, caulked with a caulking iron, and connected by means of flanges and bolts as shown in sketch. A,



steel pipe; B, male flange; C, female ditto; D, eyebolt; E, indiarubber ring washer. The flanges embrace the steel pipes, and are riveted circumferentially. To detach the lengths of pipe, the eye bolts are thrown back, the lugs being open to allow the bolts to clear in the direction of the dotted line F.—J. H.

[61100.]—**Thin Steel Pipes.**—I got a beautiful sample some years ago, I think from the Weldless Steel Tube Company, Icknield Pool-road, Birmingham. No doubt they could give the information "F. H. S." wants.—T. F. S. T.

[61101.]—**Stars Visible from Bottom of Well.**—Will "R. E. F." explain why the "only star likely to be visible in the daytime in the latitude of London is Gamma Draconis"? "R. E. F." seems to have an idea that 8½° of latitude is an enormous distance viewed from the stars. I suppose if a star could peep down a well, it would also be possible to see the star from the well. To the querist I would recommend a study of some of the star maps, which will show him what stars come overhead in the course of the year.—E. D.

[61101.]—**Stars Visible from Bottom of Well.**—Any bright star whose Northern Declination approximates to the observer's latitude so as to approach his zenith would be visible during part of the year at a certain, though of course not constant, hour in the daytime. So far as I am aware, no catalogue of the actual stars visible in such a position as "Faciebat" puts, has ever been compiled. There are, however, many lists of stars visible during an eclipse. Sir G. B. Airy, observing the solar eclipse of 1860 in Spain, records the following nine stars as seen by his assistants during totality—viz., Regulus, Saturn, Mercury, Procyon, Jupiter, Venus, Castor or Pollux (not accurately ascertained), Capella, and Arcturus. Clouds obscured Sirius and α Orionis, which otherwise would doubtless have been visible. Halley records of the eclipse of 1715 that there were no fewer than 22 stars visible in a particular direction where the sky was darkest. This number, however, would seem to be exceptional. In general stars only of the first magnitude are actually seen, though the obscurity is often such that second and third magnitude stars should theoretically be visible. The explanation of this fact given by M. Belli seems to be the most plausible, though others have been offered. He says that during the short interval of totality the eye has not sufficient time to recover from the dazzling effects of the sun's rays, and so take advantage of the actual darkness which prevails.—B.A., Handsworth.

[61105.]—**Exhaust Pipe.**—Replace bend into chimney by a T-piece, and run a pipe down to outside over a gully, and govern the exit of condensed steam by a valve.—S. M. S.

[61108.]—**Oil for Cycles.**—A very old hand in the machine shop has more than once declared there is no better lubricant for cycles than Neat's-foot oil. Personally, I use Avilla Tringham's oil.—GAMMA SIGMA.

[61108.]—**Oil for Cycles.**—Some time ago I saw a suggestion to use vaseline dissolved by heat, and having 10 to 12 parts of petroleum added. I have used it on my machine ever since, and find it superior to any oil.—DOCTOR MEDICINÆ.

[61108.]—**Oil for Cycles.**—I don't know how to remove the disgusting smell from sperm oil; but I got "machine oil" from Messrs. Johnson's, Church-street, Liverpool, two years ago, almost odourless, and what is left in the bottom of a gallon tin is sweet yet, and perfectly good for use. I don't know its composition, but it is far better than any "odorous" sperm or any other kind I ever saw. I understand it is a mixture.—T. F. S. T.

[61108.]—**Oil for Cycles.**—Why not try a mixture of equal parts of washed lard and finely-powdered blacklead? In cycles it sticks longer *in situ* than oil, and on most of the bearings you can fit a little reservoir with a screw cap so as to force a supply down to the journal or axle from time to time. No gumming, no odour, no mess, while the plumbago keeps a beautiful surface on all the wearing parts. Try it and report results for the benefit of others. If you must have oil, use neatsfoot which has been kept in a glass bottle exposed to the light in contact with strips of clean lead; and if you object to odours that are not perfumes, put a bit of camphor in, or, if you prefer, a little otto of roses.—ESSAR.

[61111.]—**Hand Saw.**—The difference is as you say, that Englishmen *thrust* their saws, Orientals *pull* them for the cutting strokes. Bending and buckling are not so likely to occur when pulling as when thrusting, hence Oriental saws are also thinner than those of English make, and less material is wasted in sawdust. The Japanese sit when sawing, and place their feet against the wood.—J. H.

[61111.]—**Hand Saw.**—Some years ago three was a discussion in these pages about using keyhole saws with the teeth reversed so as to make the cut with a pulling stroke—a method which at least avoids all risk of buckling the saw. A little time ago, wanting to cut out a lot of thick wood from an old vine, and not having a keyhole saw-blade, I inserted a metal or "hack" saw in the handle with the teeth reversed, and accomplished the work with ease and despatch. Any attempt to thrust such a saw through damp wood, unless it was held taut in a proper frame, would have inevitably produced buckling or breakage. I should prefer a saw with a thrust action if I had to take a cut through a 12ft. plank; but there are circumstances in which a saw with the teeth reversed is an advantage, especially when you have no more suitable tool.—SAML. RAY.

[61113.]—**White Enamel Paint.**—Some time ago I was in a similar difficulty; but overcame it by rubbing with a smooth block of the whitest pumice-stone procurable.—W. C. HALL, Newport, Mon.

[61115.]—**Gas Engine.**—The valve actions of a gas-engine are rather complicated, as it is not a case of one single action like steam, but a triple combination of gas, air, and flame. I do not know that a verbal description would convey much information, so will send you drawings of the valves, &c., next week (Dec. 24). I shall not have time to get them out for the next number (Dec. 17).—EDWARD CONRY.

[61116.]—**Iron Boot Used in Junod's Vacuum Treatment** (Hæmospasia).—"J. H. M." will require to get this apparatus made to order; it is so little used that I am afraid no surgical instrument-maker keeps it in stock. Underneath is Junod's description: "Moyen thérapeutique qui consiste à faire le vide sur de larges surfaces sur un ou deux membres, même sur la moitié du corps à l'aide d'appareils particulier. L'hémospasie a pour but d'attirer en peu d'instants une masse de sang et de fluides plus ou moins considerable sur une partie saine et de soulager d'autant les organes qui sont le siège d'une congestion morbide."—B.SC., Plymouth.

[61118.]—**Electro-Magnet.**—Have two limbs ½in. in diameter, 3in. long. Wind with No. 24 s.c. wire until their diameter becomes 1½in. Thus wound, you will be easily able to pull the ounce with 1 cell Daniell or Leclanché.—S. BOTTONE.

[61120.]—**Ferrous Oxalate Developer.**—The result is a perfect developer, and requires no further addition.—S. BOTTONE.

[61120.]—**Ferrous Oxalate Developer.**—The developer is ready for use after exposure, and if not energetic enough, a few crystals of clean $FeSO_4$ may be added at the same time; carefully observing the precautions necessary when preparing the strong developer.—A. TREYER EVANS, Newport, Mon.

[61121.]—**Wax or Paraffin Stains.**—Use benzole or methylated chloroform.—DOCTOR MEDICINÆ.

[61121.]—**Wax or Paraffin Stains.**—Benzole, commonly known as benzine or benzoline, may be used.—A. TREYER EVANS, Newport, Mon.

[61121.]—**Wax or Paraffin Stains.**—The droppings from wax or paraffin candles are very easy of removal from carpet or cloth. Place a piece of thick blotting-paper over the spot, and pass a hot iron over it; this repeated two or three times, all trace of grease disappears.—W. H. C.

[61121.]—**Wax or Paraffin Stains.**—Place a sheet of blotting-paper over the stain, make a common sad-iron pretty hot, lay it on the paper, and replace the paper from time to time, until it has sopped up all the wax. If any mark remains, a few drops of benzine collas will remove it.—S. BOTTONE.

[61121.]—**Wax or Paraffin Stains.**—(1) Lay a piece of blotting-paper on the stain and then press on it a flat iron, as hot as possible, without scorching the paper or the material under it; (2) wet the material all round the stain with benzine (which you can get at a druggist's, or perhaps at an oilship) so as to prevent the stain from spreading, and then rub with benzine.—EDWARD CONRY.

[61122.]—**Magic Lantern Slides for Boys' Lantern.**—Buy a small bottle of liquid Indian ink from any vendor of drawing materials; use a fine pen, and draw or write what you like on the glass. I have made many lantern slides in this way. See that the glass is clean, dry, and free from grease.—UMBRA.

[61122.]—**Magic Lantern Slides.**—Dissolve a bit of Indian or China ink in water, and use one of the lithographic steel pens (sold by most stationers). Any of the outlines which may be too thick thin down by scraping on either side with the sharp point of a penknife blade. The outline of high-class pictures may be done this way by those who have not the ability to draw and paint with the brushes as they go along.—DENS.

[61122.]—**Magic Lantern Slides.**—I have used the ordinary moist black paint sold in tins, mixed with water and a little bichromate of potash. This latter body prevents the paint from being tacky after being exposed to light, and only a small portion of it is necessary. An ordinary fine steel pen, a clean glass plate, and the (thick) solution is all I use. Walter Woodbury invented a varnish, prepared by the mixing of a few drops of a solution of indiarubber with a solution of gum dammar in benzole, which he previously coated the plate with, and traced the design in Indian ink.—A. TREYER EVANS, Newport, Mon.

[61123.]—**Analysis of Kainit.**—Water, 2¾ parts in a hundred by weight (at boiling point); sulphuric acid, 23¾ parts in a hundred by weight (at boiling point); chlorine, $32\frac{1}{10}$ parts in a hundred by weight (at boiling point).—A. TREYER EVANS, Newport, Mon.

[61129.]—**"Loeb" Battery for Electric Light.**—This query seems to be identical with 61039 which appeared on p. 293, and the querist, having seen these wonderful batteries, ought to know more about them than any one except those who showed them. Will any one guarantee 70 hours with once charging? If the querist will take the trouble to look in Mr. Sprague's book or search the indices, he will find abundant information, and can then make his choice of understanding for himself or accepting what he is told.—NUN. DOR.

[61131.]—**Electric Cautery.**—This query cannot possibly be answered from the data given. Current is the only thing required in heating a cautery, and the heat = $C^2 \times R$; but ·06 ohm may mean anything as regards length and sectional area of conductor. Please say what diameter your cautery is, and is the ·06 ohm R when cold; it will, of course, be very different when hot. We presume you use platinum wire. The easiest way you could measure the current flowing would, of course, be with an ampère-meter; but you could perhaps more easily arrange a large surface voltameter, and collect the mixed gases liberated. An ampère flowing for one hour liberates about 40 cubic inches of mixed gases; or if a copper voltameter is used, the same current would in one hour deposit about 18¼ grains of copper.—OHM.

[61131.]—**Electric Cautery.**—TO MR. E. CONRY.—The most economic and satisfactory way that I know of would be by two or three single-fluid bichromate of potash cells. The agency required to raise any conductor (i.e., the piece of cauterising wire) to red or white heat is a certain amount of current forced through it, and this forcing requires a certain E.M.F. directly proportional to the resistance of the conductor, i.e., the greater the resistance the greater the E.M.F. required. There are, I think, tables published in some book of the amount of current required to raise wires of various gauges and conductivity to particular heats; but I have not got them by me, so will look up the matter and write you next week. To exactly measure the small amount of current required for the resistance you mentioned, you would require a very delicate ammeter—like Sir Wm. Thomson's, or Mr. Sprague's differential galvanometer—something that will measure from about the $\frac{1}{100}$th of an ampère to 4 or 5 ampères. I do not think you could yourself make a neat and permanent instrument of sufficient delicacy unless you have good tools and appliances, and some skill in instrument-making.—EDWARD CONRY.

[61133.]—**Adiabatic Curve.**—"A. J. W." does not seem to know what an adiabatic curve is. It is a curve showing the expansion of gases under varying temperatures due to expansion. These curves are obtained by ordinates, which are calculated by a formula having a different coefficient for each gas, according to its specific heat. I am sorry I cannot give "A. J. W." the formula, as all my books have been destroyed by fire; but I will try to obtain it by next issue. It is given in Rankine.—NEMO.

[61133.]—**Adiabatic Curve.**—If a gas be kept at a constant temperature while the pressure on it is varied, the volume will vary according to the well-known law of Gay Lussac. If volumes are taken for abscissæ and pressures for ordinates, then the resulting curve is termed an isothermal curve, and in the case of a perfect gas such a curve is a rectangular hyperbola. If, however, the gas be inclosed in a vessel perfectly impervious to heat, then the volume for a given pressure will no longer obey the law of Gay Lussac, and the curve in this case is called an adiabatic curve. I do not think such a curve could be described mechanically; but it is possible to draw one from their equation, which is $p v^x = R$, where p = pressure, v = volume, x = ratio of specific heat at constant pressure to specific heat at constant volume, and R = some constant.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[61133.]—**Adiabatic Curve.**—To "A. J. W."—I know of no method of describing this curve; but its ordinates can be calculated by the formula $\frac{P}{P_1} = \left(\frac{V}{V_1}\right)^r$ where PP_1 are the pressures, VV_1 the volumes, and r the ratio of the specific heats for constant pressure and constant volume of the gas he is dealing with.—GFYUNG.

[61136.]—**Screw Cutting.**—If "One in a Fix" will only think, he will find that for every four threads of his leading screw, there will be eleven threads on the one he is cutting, and will gear only every four threads. You can only gear at every thread of the leading screw, when the thread to be cut is a multiple of the pitch of the leading screw.—HELIX.

[61136.]—**Screw-Cutting.**—I do not quite understand your difficulty. If you bring your saddle back to starting mark, and also have marks on face-plate, and change-wheel in same starting position, the saddle will, of course, gear with screw, and you can put the cut on before starting, if you take notice of position of handle of cross-slide before you draw slide back. The nut of saddle will drop in at every inch, if face-plate and change-

wheel marks are in starting position. Is this what you require?—T. C., Bristol.

[61136.]—**Screw-Cutting.**—"One in a Fix" can scarcely have followed exactly the directions given, or he would succeed with a screw of four threads as easily as with one of two threads. Let him see that his marks are correctly made when the carriage is in gear with the leading screw and all ready for first cut. And in setting for second cut be sure that all the marks are exactly followed, and that the leading screw wheel is not one-eleventh too early or too late. If it is, turn till the marks are exactly right, when the nut drops into the screw-thread at once. If the leading screw wheel is one-eleventh too forward, eight turns will bring it right. If one-eleventh behind, three turns of mandrel are needed.—NEPHESH.

[61136.] — **Screw-Cutting.**—If the pitch of leading screw is equal to, or a multiple of, pitch of screw being cut, its pitch (leading screw) is the least distance. If pitch of screw being cut is a multiple of pitch of leading screw, its pitch (screw being cut) is least distance; and if the one is not a multiple of the other, their least common multiple is the least distance carriage must be traversed for succeeding cuts. Taking 11 threads, the least common multiple of $\frac{1}{4}$in. and $\frac{1}{11}$in. is 1in., so that 1in. is least distance in this case; but "J. H.'s" plan is quite correct so long as the pitch of leading screw is a measure of 1in., and the carriage is to be traversed 1in. or some multiple thereof. In the foregoing, pitch must not be confounded with number of threads per inch.—WORKMAN.

[61136.]—**Screw-Cutting.**—Whether you have two threads or four in your leading screw matters not in this case, since each are aliquot divisions of the inch, and if your pitch is $\frac{1}{11}$ of an inch your nut must gear at every inch with either two or four threads in the leading screw. This is self-evident, since $\frac{1}{11}$ pitch simply means that the space of 1in. is divided into 11 equal parts. The nut once set could not gear at anything less than 1in., because you could not divide two or four threads into 11 without a remainder. But every 11th thread will coincide with 1in. of the leading screw, and therefore whether you have two or four threads, the nut should gear at every successive inch, *beginning* at the point from which you started. That is really the important matter—to commence at one spot for each successive cut: hence the chalking of the bed and wheels. If the nut will not fall into gear at each successive inch, the lathe must be at fault, probably slack screws causing backlash, which in that case you must take up. Let us go through the process. The change wheels are on, nut in gear, and saddle in a certain position relatively to the headstock or poppet, or bed, as you may choose to take. Before starting the cut, mark two teeth of any pair of change wheels which are in actual contact, flank to flank, preferably starting from the one in the leading screw, and on the side facing the rest, so as to be seen from the rest. Mark the position of saddle on bed, or measure or gauge its distance from headstock or poppet, and then enter your thread. When at the end of cut run back the tool-holder slide, release the clasp nut, and rack the saddle back to its previous position, as shown by the chalk-mark on bed, or by measurement from headstock to poppet. The lathe continues running the while, and now set the tool a trifle forwards for next cut, and watch the change wheels revolve until the chalk marks on the teeth come round towards each other. When they coincide, throw in the clasp nut instantly, and allow the cut to go on again. Repeat this until the thread is of the proper depth.—J. H.

[61137.]—**Regulating Current.**—Run your dynamo a little slower, or, if that be not possible, put an adjustable resistance into the F.M. circuit, or a similar resistance in the lamp circuit, so adjusted as to raise the lamp circuit when a 10c.p. lamp is on to the same resistance as when a 20c.p. lamp is on. This you can find quickest and easiest by actual experiment, starting with, say, 10 ohms—e.g., a field of arc lamp carbon. The first, however, is the proper way. See my answer, No. 61110, in the current number (Dec. 10). —EDWARD CONRY.

[61139.]—**Chromic Acid v. Bichromate.**— "W. W. N." is mistaken on two points. Chromic acid is not a better depolariser than potassic bichromate; but it is cheaper to use, inasmuch as 201 parts CrO_3 at $7\frac{1}{2}$d. per lb. do the work of 295 $K_2Cr_2O_7$ at 6d. per lb. I have recently concluded a series of experiments upon this very subject, and my results will be published in next month's *Analyst*. I find that a solution containing 8 per cent. CrO_3 gives the same resistance, E.M.F., and galvanometer gradient, whether it be made from the anhydride or the salt. In the latter case more sulphuric acid is used up, thus:—

(1.) $Zn + 4H_2SO_3 + 2\,CrO_3 = Zn\,SO_4 + Cr_23SO_4 + 4H_2O + O_2$

(2.) $Zn + 5H_2SO_4 + K_2Cr_2O_7 = Zn\,SO_4 + KCr2SO_4 + 5H_2O + O_2$.

It is true that CrO_3 is ten times more soluble than $K_2Cr_2O_7$ in diluted acid; but it must be remembered that, as you increase the amount of CrO_3, so likewise must you increase the amount of acid. For 8 per cent. CrO_3, 15·7 per cent. (by weight) H_2SO_4 is required by theory. I use generally 20 per cent. I consider that more than this is unwise. I have myself entirely discarded the use of $K_2Cr_2O_7$, as the CrO_3 is cheaper and handier to use, and does not deposit crystals of chrome alum. Further, the reduced solution being bright green, it is easier to see when it is used up than when $K_2Cr_2O_7$ is employed.—H. PERCY SMITH.

[61140.]—**Grey Stains on Black Marble.**— If you have a method of polishing black marble, you certainly have also a method of removing stains. To what are the stains due? Some are removed by means of a cloth wetted with paraffin oil; but a useful recipe for most stains is one I noticed given in the Answers to Correspondents on p. 334.—OBERHOF.

[61141.]—**Screw-Cutting.**—You can see what you require in the "E. M." of October 15th, pages 146-7.—WALLACE NEWLAND.

[61141.]—**Leading Screw.**—Set down 2 for mandrel (being number of threads per inch leading-screw) and 13 (threads required) on leading-screw. Intermediates, 10 each. Now multiply first pair by 10 and second pair by 5, and we have

Mandrel
20 — 100
‖
50 — 65 leading-screw.

For threads of 15 or 19 to inch, use 75 or 95 on leading-screw.—NEPHESH.

[61141.]—**Screw-Cutting.**—The ratio of gearing in the cases you give are $\frac{2}{13}$, $\frac{2}{15}$, $\frac{2}{19}$, and so on, for any number of threads—viz., thread of leading screw at top, and of required screw of bottom. You can now split up as you please, if you remember to multiply both numbers by the same number you choose (which should be some multiple of 5)—thus $\frac{20}{130}$, $\frac{20}{150}$, $\frac{20}{190}$. You could use following double trains, say, $\frac{20}{65} \times \frac{30}{60}$, $\frac{20}{50} \times \frac{30}{90}$, $\frac{20}{95} \times \frac{30}{60}$; the only difficulty being in the last, as you may not have a 95 wheel.—T. C., Bristol.

[61141.]—**Screw-Cutting.**—To cut screws with four wheels or compound gear—

Lathe spindle wheel	A
Gearing with stud wheel	B
Second stud wheel	C
Gearing with screw wheel	D

Example: Required set of compound wheels to cut 13 threads to the inch. Chalk down the number of threads on your leading screw 2, and the number you want to cut 13. Annex cipher to each, and we have 20 and 130; divide 130 by 2 gives 65. Now suppose a number, and multiply by the same. You divide by, say, $30 \times 2 = 60$; this will give—

	A	B	C	D
13 Threads	20 ...	60 ...	30 ...	65
15 "	20 ...	60 ...	30 ...	75
19 "	20 ...	60 ...	30 ...	95

—H. H.

[61141.]—**Screw-cutting.**—Place the number of threads in the guide-screw for a numerator, and that in the screw to be cut for a denominator; add ciphers to obtain the wheels for a simple train, find suitable factors, and add ciphers to these for a compound train. Thus, guide-screw two threads per inch, and threads to be cut 13, 15, 19 per inch—

(1) $\frac{\text{Guide screw}}{\text{Screw to be cut}}\ \frac{2}{13} = \frac{20}{130}$ for single train; for double train say $\frac{2}{13} \times 5 = \frac{10}{65} = \frac{2 \times 5}{10 \times 6{\cdot}5} \times 10 = \frac{20 \times 50 \text{ drivers}}{100 \times 65 \text{ driven.}}$

(2) $\frac{\text{Guide screw}}{\text{Screw to be cut}}\ \frac{2}{15} \times 4 = \frac{8}{60} = \frac{2 \times 4}{5 \times 12} \times 10 = \frac{20 \times 40 \text{ drivers}}{50 \times 120 \text{ driven.}}$

(3) $\frac{\text{Guide screw}}{\text{Screw to be cut}}\ \frac{2}{19} = \frac{2 \times 1}{19 \times 1}$ say $\frac{20 \times 100}{190 \times 100}$ substituting $\frac{20 \times 50 \text{ drivers}}{95 \times 100 \text{ driven.}}$

By a process of halving, doubling, or taking aliquot parts, you can obtain a vast number of changes, only remembering to preserve the ratio between the drivers and driven.—J. H.

[61141.]—**Screw Cutting.**—If "Chaser" will divide the nnmber per inch of the threads of his leading screw by the number of threads to be cut, he will obtain the ratio of the driving to the driven wheels. Taking his examples $\frac{\text{Driving wheels}}{\text{Driven wheels}} = \frac{2}{13} = \frac{20}{130}$. If we have these two wheels, we can cut the thread for a double train, then, $\frac{20}{130} = \frac{20 \times 1}{65 \times 2}$. Now we want two wheels; one twice the other. Take a wheel of 30 teeth, then the second must have 60 teeth. Now we have $\frac{\text{driving wheels}}{\text{driven wheels}} = \frac{20 \times 30}{65 \times 60}$ The other examples will be $\frac{20 \times 30}{75 \times 60}$ and $\frac{20 \times 30}{95 \times 60}$.—HELIX.

[61141.]—**Screw-Cutting.** — The product of numbers of teeth in driving-wheels must be to product of numbers in driven wheels as the number of threads per inch in leading-screw is to number to be cut. Write down number of threads per inch in leading-screw, below it number to be cut, and alongside each write down number of teeth of wheel of which you have two in your set (for the lathe I run they are forties) with the multiplication sign between, thus— $\frac{2 \times 40 \text{ drivers}}{13 \times 40 \text{ drivens}}$. Now these are in the proper ratio; but you don't have wheels of 2 and 13 teeth, so you must multiply or divide until you get four numbers corresponding to four of your wheels, always bearing in mind you must multiply or divide a driven by the same number, to preserve the proportion; thus multiplying the 2 and 13 by 5 you get the train $\frac{10 \times 40}{65 \times 40}$; but you don't have a 10; but multiply the 10 and driven 40 by 2, you have $\frac{20 \times 40}{65 \times 80}$, wheels you will likely have, and which will cut 13 per inch. Precisely the same method will give $\frac{20 \times 40}{75 \times 80}$ to cut 15, and $\frac{20 \times 40}{95 \times 80}$ to cut 19 per inch.—WORKMAN.

[61142.]—**The Wimshurst Machine.**—"Shock Spark" is probably working with his Leyden jars not coated with shellac varnish, hence the free surface of the glass has a thin film of moisture upon it, up which the electricity creeps in the form of thin tree-like sparks when the jars are highly charged. The shortness of spark is, no doubt, due to some pointed surface, or other imperfection in the machine, from which the electricity leaks off. Examine it when working in a dark room, and see if it is so. Remedy any defect, and coat the Leyden jars with varnish, and you will most likely get better results; 17in. glasses suitably mounted are capable of giving sparks 8in. length.—J. W.

[61144.] — **Lathe.** — One-sixteenth of feed is heavy for a foot lathe, and it would, therefore, be preferable to take off two cuts of $\frac{1}{32}$ each.—J. H.

[61144.]—**Lathe Feed.**—The feed is not too much if it is a short length, or if well supported by a travelling stay. At the same time, if the piece is much out of truth, it is far better, and will make truer work, if the $\frac{1}{8}$in. is removed in two roughing cuts.—T. C., Bristol.

[61145.] — **Does it Boil?** — Dictionaries are cheap nowadays, and I believe they all contain definitions of the word "boil." I think our friend "Weald" will find that all liquids, even liquid metals, give off vapour long before they begin to boil, which is simply the state of ebullition, and can occur at considerable differences of temperature according to the air pressure on the liquids. Even a cup of comparatively cold water held in the hand and taken out into the frosty air, will "steam" as he puts it, because the vapours then become visible. Is the question put quite bonâ fide? I ask because there seems some hint that answers are not to urge that visible steam is not gaseous water. Steam is certainly not a gas in the true sense of the term, although superheated steam may approach very near to the conditions of a true gas; but then that requires temperatures very much higher than that of boiling water, whatever that may be.—NUN. DOR.

[61145.]—**Does it Boil?**—It seems to me you are making a slight confusion between vaporisation and ebullition. Water will vaporise at all sorts of temperatures, even below freezing point, this vaporisation depending directly on the dryness of the atmosphere, and only indirectly on its heat. The boiling point of water is a certain point on the thermometer at which, when the pressure of the atmosphere is at a certain figure, water will begin to assume the state of complete ebullition, and this point varies with atmospheric conditions, being very different at the top of a mountain from what it is in the valley below. 212° F. or 100° C. are the recognised boiling points, a certain atmospheric pressure being inferred. I believe 15lb. on the square inch, and at or about the sea level (i.e., under all ordinary circumstances), the boiling point will not vary very much above or below this, probably not more than one or two degrees either way; but it is possible to have water boiling at 180° F. on the one hand, or not boiling at 300° F. on the other.—EDWARD CONRY.

[61146.] — **Battery.** — TO MR. BOTTONE. — I have just tried one of Mr. Shippey's 5c.p. lamps marked 7 volts with the battery described at p. 561, Vol. XLIII., with the following results:—

2 cells, 1c.p.; 3 cells, 3c.p.; 4 cells, over 5c.p. Thickness of wire required will depend on distance: anything under 10 yards, No. 16 will do; over 10 up to 20, No. 14; over 20 up to 40, No. 12; over 40 up to 80, No. 10, &c.—S. BOTTONE.

[61147.]—**Red Steam.**—The red hue in this steam is "very like a tinge of angry sunset sky preceding rain," from exactly the same cause—aqueous particles in the air. The "rainbow colours" are easily seen in a spray of water produced by an atomiser. "Weald" saw the red because the watery vapour allows only the red rays to pass. Looking on a spray brightly illuminated, he would see the rainbow colours from diffraction, which may possibly also have some effect on the steam from his cup of hot boiling coffee. Mem. for the 'Xmas dinner table: to take special notice of the colour of the steam from the turkey and the goose, and the pudding.—NUN. DOR.

[61148.]—**Screw-Cutting.**—One turn moves 5-20ths, or $\frac{1}{4}$ of 3in., pitch is therefore $\frac{3}{4}$in., other screw $\frac{3}{5}$in. If leading screw is $\frac{1}{4}$in. pitch, write $\frac{3}{4}$ for mandrel, 1 for intermediate $\frac{1}{4}$ for leading screw, multiply first pair by 40, second by 80. Thus, mandrel, $\frac{3}{4}$ of 40; intermediates, 40 and 80; leading screw, $\frac{1}{4}$ of 80 (*i.e.*, 30—40, 80—20); for second screw, 30—50, 80—20; or, single gearing, 60—20 for one, 60—25 for another.—NEPHESH.

[61148.]—**Screw-Cutting.**—To cut a screw that will traverse a nut the 20th part of 3in. at the 5th of a revolution. Assuming that your leading screw is $\frac{1}{2}$ pitch, the wheels will be: lathe spindle, 60; leading screw, 40; the intermediate wheel may be any convenient size. The pitch will be $\frac{3}{4}$, 2nd 20th part of 3in. at 4th of revolution; lathe spindle, 60; leading screw, 50. Pitch will be $\frac{3}{5}$.—H. H.

[61148.]—**Screw-Cutting.**—If the screw traverses $\frac{3}{20}$in. in $\frac{1}{5}$th of a turn, then we have $\frac{15}{20}$ in one turn = $\frac{3}{4}$in., and the threads per inch will will be $\frac{4}{3}$; if the leading screw has two per inch, then $\frac{\text{driving wheels}}{\text{driven wheels}} = 2 \div \frac{4}{3} = \frac{3}{2}$ and $\frac{30}{20}$, or any two wheels having these proportions. In the other example, $\frac{3}{20} \times 4 = \frac{3}{5}$, and the rev. per inch be $\frac{5}{3}$, then $\frac{6}{5} = \frac{\text{driving wheels}}{\text{driven wheels}}$; $\therefore \frac{60}{50}$ or $\frac{30}{25}$ will cut the thread.—HELIX.

[61148.]—**Screw-Cutting.**—The first nut moves $\frac{5}{20}$ of 3, $\frac{3}{4}$in. per revolution, that is $\frac{3}{4}$ pitch, and the second nut $\frac{4}{20}$ of $3 = \frac{12}{20} = \frac{3}{5}$in. pitch. You do not give thread of leading screw, so I will suppose 2. The wheels must be $2 \times \frac{3}{4} = \frac{6}{4}$ or $\frac{60}{40}$ for first, and $2 \times \frac{3}{5} = \frac{60}{50}$ for second. You can use double train $\frac{30}{20} \times \frac{40}{40}$ for first, and $\frac{30}{25} \times \frac{40}{40}$ for second. If leading screw 4 to inch, use 60 for 40 wheel at top.—T. C., Bristol.

[61148.]—**Screw-Cutting.**—The following is the method for finding the pitch of screw you require to cut: $\frac{1}{20}$ of $\frac{3}{1} = \frac{3}{20}$ = what it travels in $\frac{1}{5}$ of a revolution. Therefore, if it travels $\frac{3}{20}$ of an inch in $\frac{1}{5}$ of a revolution, what would it travel in $\frac{5}{5}$ revolution? $\frac{1}{5} :: \frac{5}{5} : \frac{3}{20}$.

$$\frac{3}{\underset{4}{20^*}} \times \frac{5^*}{5^*} \times \frac{5^*}{1} = \frac{3}{4}$$

$\frac{3}{4}$ being the pitch of screw wanted to be cut, and exactly the same with the other $\frac{1}{20}$ of $\frac{3}{1} = \frac{3}{20}$ what it travels in $\frac{1}{4}$ of a revolution. Therefore, if it travels $\frac{3}{20}$ of an inch in $\frac{1}{4}$ of a revolution, what would it travel in $\frac{4}{4}$ revolution $\frac{1}{4} :: \frac{4}{4} : \frac{3}{20}$

$$\frac{3}{\underset{5}{20^*}} \times \frac{4^*}{4^*} \times \frac{4^*}{1} = \frac{3}{5}$$

$\frac{3}{5}$ being the pitch of screw wanted to be cut. You cannot expect to know what wheels to put on when you do not give the pitch of your leading screw.—WALLACE NEWLAND.

[* Cancelled figures.]

[61148.]—**Screw-Cutting.**—$\frac{1}{20}$ of 3in. is $\frac{3}{20}$in., which multiplied by 5 gives traverse for one revolution, which is, of course, the pitch. Now, $\frac{3}{20}$in. $\times 5 = \frac{3}{4}$in. pitch of first mentioned screw; and $\frac{3}{20}$in. $\times 4 = \frac{3}{5}$in. pitch of other. Now, the driving-wheel or wheels must be to the driven wheel or wheels as the pitch to be cut is to pitch of leading-screw (don't confound the pitch spoken of here with the number per inch); hence, supposing your leading-screw to have two threads per inch, then $\frac{\frac{3}{4}}{\frac{1}{2}} = \frac{30 \text{ driver}}{20 \text{ driven}}$ or $\frac{60}{40}$ or $\frac{120}{80}$ any of which gears will cut $\frac{3}{4}$in. pitch. Again—

$\frac{\frac{3}{5}}{\frac{1}{2}} = \frac{30 \text{ driver}}{25 \text{ driven}}$ or $\frac{60}{50}$ or $\frac{120}{100}$ any of which will cut $\frac{3}{5}$in. pitch.—WORKMAN.

[61148.]—**Screw-Cutting.**—Traversing one-twentieth part of 3in. in the fifth of a revolution, in one revolution the traverse will be five-twentieths, or $\frac{1}{4}$ of 3in. = $\frac{3}{4}$in. = $\frac{3}{4}$in. pitch, or four threads in 3in. In the second case a traverse of one-twentieth part of 3in. in the fourth of a revolution means that in one revolution the traverse will be four-twentieths, or one-fifth of 3in. = five threads in 3in. In each case 3in. contains a complete number of threads. Taking the first case, and assuming a leading screw of two threads per inch (you do not state the number), you have the ratio—

Leading screw = 6 threads in 3in.
Screw to be cut = 4 " "

Hence, $\frac{6}{4} = \frac{60}{40}$ or $\frac{30}{20}$ or $\frac{120}{80}$ drivers. driven.

In the second case—

Leading screw = 6 threads in 3in.
Screw to be cut = 5 " "

Hence, $\frac{6}{5} = \frac{60}{50}$ or $\frac{120}{100}$ or $\frac{30}{25}$ drivers. driven.

—J. H.

[61148.]—**Screw-Cutting.**—To cut a screw that will traverse the 20th part of 3in. in one-fifth of a revolution:

20th part of 3in.
5th part of 1 revolution.
3in.
5 whole revolution
—
20)15
4 = $\frac{1}{4}$
—
60($\frac{3}{4}$in.
$\frac{3}{4}$ pitch $4 \times \frac{3}{4} = 3$in.
Leading-screw 4 to 1in. × 3 = 12.

$$\frac{4}{12} = \frac{40}{120} = \frac{5 \times 8}{10 \times 12} = \frac{50 \times 80}{100 \times 120} = \frac{50 \quad 40}{100 \quad 60}$$

To cut a screw that will traverse the 20th part of 3in. in one-fourth of a revolution:

20th part of 3in.
4th part of 1 revolution.
3in.
4 whole revolution.
—
20th)12
5 rev.
—
60(3in. long 5 rev.
5 threads in 3in.
Leading-screw 4 threads to 1in. × 3 = 12.

$$\frac{5}{12} = \frac{50}{120}$$

$$\frac{5 \times 10}{10 \times 12} = \frac{50 \quad 100}{100 \quad 120} = \frac{25 \quad 100}{50 \quad 120}$$

$$\frac{5}{12} = \frac{5 \times 5}{5 \times 12} = \frac{25}{60} = \frac{\overset{25}{50^*} \quad 50}{\underset{30}{60^*} \quad 100}$$

* Cancelled figures.

—WESTWOOD.

[61149.]—**Dynamo.**—Detach the coil that heats from its neighbour, if a Gramme ring armature, and join these two by a short bit of wire of larger gauge than that of the armature wire. If the armature be drum-wound—i.e., each coil separate from the rest—separate the offending coil from its sections of the commutator at each end, and run without it. If this causes the machine to spark too much (which depend greatly on the current and E.M.F. it was giving), join the two commutator bars to which the coil was attached by a piece of wire of larger gauge, as in the Gramme ring case. A piece of the armature gauge, doubled, will do very well. If you have leisure, you might design a couple of little plug connections, so as to plug the coil in or out at pleasure, or else do it by connecting through a ferrule joint with screws at each end, one end of the wire to be connected always and the other at pleasure.—EDWARD CONRY.

[61156.]—**Battery for Lamps.**—I should suggest your continuing the double fluid, with sulphuric acid and water in outer, and saturated solution of bichromate of potash in inner cell. I have used this cell greatly, and have found it clean and convenient, and not wasting to any material extent by the solutions being left standing. In this respect I prefer it to chromic acid solutions. Have a look at the cells now and again to see that the sulphuric solution is never lower than the other, as, if this happens, the bichromate may leak through the porous pot and soil the zincs, which last should always be amalgamated, otherwise the cells will waste their strength in local action. I will send you next week a datum from which you will be able to calculate pretty nearly how much you would get out of any sized cell as above.—EDWARD CONRY.

[61157.]—**Condensing and Non-Condensing.**—If you have 10lb. pressure in exhaust-pipe you are crippling engine very much indeed. But I suppose this is purely a coal question with you; if so, an experiment will suit you best. You could, for example, notice nearly exactly how much fuel it takes to keep steam and fires exactly in same state for one or two hours, and then how much it takes in same time when engine is running. Again, it is dependent on number of hours engine and heating apparatus are working per week. Some five years ago I had a similar case, and it was rather a nice point as to whether it should be a new condensing or non-condensing engine, and I decided under the special circumstances on non-condensing. There is nearly the same heating power in steam at 5lb. as at 10lb.—T. C., Bristol.

[61158.]—**White Enamel or Paint.**—Use the white glazed tiles where you can, and cover other parts with zinc oxide paint ground in best stoving copal.—NUN. DOR.

[61159.]—**Electrical.**—"Elm" will find the Nicholson's revolving doubler fully described in the *Phil. Trans.*, Vol. LXXVIII., page 405. Bennet had the electrophorus only, and so used them by hand as to increase the charge.—J. W.

[61160.]—**Herbs.**—There is no tisane in the "Formulaire Magistral" called "tisane aux quatre herbes." Probably "Uranos" means the very common "tisane aux quatre fleurs," which is much used for cough soothing. Here is a recipe:—Fleurs de guimauve (flowers of marsh mallow), fleurs de pied de chat (flowers of catsfoot or everlasting), fleurs de pas d'âne (flowers of coltsfoot), fleurs de coquelicot (flowers of wild poppy). Take equal quantities, dry, mix, break up small, and infuse as we do common tea, using about the same quantity; the proportion given in the Pharmacopœia is 12 to 1,000 of boiling water.—B.SC., Plymouth.

[61162.]—**Sewing Machine.**—Is the "Pestered Man" using same tensions for thick work as for thin? It seems (by his query) that the hook takes fresh thread from the reel instead of pulling up the old loop. His thread should be well oiled, and the work slightly soaped. Then tighten up the tension till the loops disappear, and the bottom thread pulls well up into the work.—NEPHESH.

[61162.]—**Sewing Machine.**—Probably the loop is left because the spring box or thread check through which the cotton passes prior to tension pulley has become clogged, and does not put sufficient strain on cotton to prevent it slipping round tension pulley instead of turning the pulley. If by turning the thread three times round tension the machine works, this the cause certain. Remedy—clean out thread check, take out screw in end spring, and two discs, clean and replace. It must put enough strain on the thread to prevent it slipping over the tension pulley without turning said pulley.—ROBERT ROYCE.

[61163.]—**Faulty Dynamo.**—TO MR. BOTTONE.—The proportions of your wire on armature and F.M.'s are wrong, hence your partial failure. Put about $\frac{3}{4}$lb. No. 20 on the armature and 5lb. No. 18 on the field, or 7lb. No. 16, and you will be nearer the mark. As it stands at present, the resistance of your single Swan lamps is too high. Try two or three in parallel; or get one of one-third the resistance; or look at the last page of my book, "The Dynamo," as to the mode of coupling up in shunt.—S. BOTTONE.

[61164.]—**Observatory.**—A "gun-tackle purchase" is generally composed of two single blocks. If "Observer's" roof is not too heavy, I don't see where he will need them, if his sash rollers are large enough. My own Berthon roof is 12ft. diameter; it is fitted with 2in. sash rollers and stout galvanised plate, and can be easily turned by thumb and forefinger; it has been up more than two years. Keep all rollers well oiled at bearings. "Observer" should have stated size of his roof, as much depends upon this. If he and "C. T." will write to 28, East Claremont-street, Edinburgh, I shall be pleased to help them in any way I can. It is difficult at times to reply to queries from lack of knowing what is really required.—H. A.

[61165.]—**Diffraction.**—I cannot do better than refer F. Bennett to Prof. Tyndall's most useful little book, "Notes on Light." Its price is only a shilling, yet I think it contains all that an ordinary reader requires. Here he will find the phenomenon of diffraction fully explained.—H. A.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, Jas. A. Campbell has replied to 60530.

QUERIES.

[61171.]—**Electric Railway Signals.**—Wanted, some account of the new electric block system that is being fitted up through the Severn Tunnel.—ELECTRIC.

[61172.]—**Engines.**—Will any reader favour us with details of one of the Midland heavy mineral train engines with the small wheels?—LOCO.

[61173.]—**Varnishing Fishing-rods.**—I am trying to varnish some fishing rods, but I cannot succeed to my satisfaction. After applying the varnish, which is made of rectified spirit and best shellac, I find that a multitude of very small bubbles breaks out all over the rod, and instead of feeling smooth there is an unpleasant roughness. Will a kind reader help me out of my difficulty?—SHELLAC.

[61174.]—**Cane-Splitting Machine.**—I shall feel obliged if any of your readers will give a description of a machine for splitting cane.—R. G. M.

[61175.]—**Sugar for Removing Boiler Scale.**—A short time ago, there appeared in your columns a paragraph describing some experiments made (I think by an Italian engineer) with sugar as a means of removing and preventing the formation of scale in steam-boilers, and asking subscribers who might try it to give the results of their experience. I have charge of a 4-horse vertical boiler which, through neglect, had become badly scaled. During the last four or five weeks I have put in about $\frac{1}{2}$lb. of common brewer's sugar at intervals of seven days, and blown off a couple of gallons or so of water twice a day while working. On breaking man-lid and mud-door joints last Saturday, I was agreeably surprised to find that a considerable detachment of scale had taken place, so much so that I had some difficulty in removing mud doors, pieces of scale as large as my hand having been loosened and fallen into the narrow space between boiler shell and firebox. We use only town (Birmingham) water, which is hard. If I continue the use of sugar to the effectual removal of all scale (which I anticipate), would some of our scientific contributors say if it would be safe to use it as a detergent, or whether it would be likely to injure the plates? I had hoped to see some experiences on this question in "Ours" before now, as it is of considerable importance.—OMPAX.

[61176.]—**The Wimshurst Machine.**—I have nearly completed my 12in. influence machine, and have met with an unfortunate mishap. I mounted the plates about a week ago by cementing them to ordinary deal bosses with Prout's elastic glue, then varnished and placed on the sectors, and put away in a cupboard to dry. On taking them out, I found a large crack on one from the boss to the edge, and the other was cracked wedge shape. Though the glass did not cost much, I do not wish to do away with them, as it has cost me time and trouble by varnishing, placing on the sectors, and mounting. Would they do if I cemented the edges with Prout's glue? This will hold them firmly, as well as the bosses. In the next plates I mount, would cementing a thin washer between the boss and glass prevent cracking? Does one always get the same sign of electricity from each terminal, or does it vary? In the Voss, the sign of electricity we get depends which paper disc on the stationary plate has the greatest initial charge, and so the increasing quantity of the charge starts from this disc. Does the Wimshurst machine act like this by starting its charge from the plate whose sectors have the greatest residual charge, and so get electricity of various signs at different times, or is it constant whenever used? What is the theory and advantage of two different-size discharging balls? Are large or small Leyden jars the best for good sparks? Will the machine work if the plates are $\frac{3}{8}$in. apart?—ELECTRICITY STUDENT.

[61177.]—**Plate Machine.**—Can I make a good small frictional machine with a 5-16in. plate-glass disc 8in. in diam? Also the proper sizes for the combs, rubbers, bosses, conductors? Also a simple way of mounting a plate machine disc with and without a central aperture?—ELECTRICITY STUDENT.

[61178.]—**Electric Lamp.**—Will someone kindly advise me as to whether small lamps, say of 5c.p., can be repaired when the platinum terminals are broken off flush with the glass, and, if so, how?—S. M. S.

[61179.]—**Concrete and Cement Plastering.**—Will some engineering reader who has a knowledge of the above kindly state if it is a fact that salt (or sea) water is not suitable for mixing with cement, sand, gravel, &c., to form concrete or cement plaster? It is stated by many that it is not, and I should like to know why, if it is so?—IRISH CONTRACTOR.

[61180.]—**Dynamo.**—I have a small set of castings, which I have made. I want to make them into a dynamo to supply six lamps 45 volts. Please give me size and weight of wire for magnets and armature for series winding—that is, if castings are large enough: Armature, $3\frac{3}{8}$in. diam., 2in. wide; magnets, 3in. long, 1in. diam.; four limbs to magnets.—AMATEUR.

[61181.]—**To Mr. Bottone.**—Is this the proper proportion of resistances for a compound Gramme machine, E type, to maintain 120 lamps, 110 volts: R. armature, 1-20 ohm; R. magnet, series coil, 1-30 ohm; R. shuntcoil, 50 ohms. If not right, please put me right.—AMATEUR.

[61182.]—**Lead Hammers.**—Can any reader inform me how to mix antimony with lead for the purpose of hardening the lead for making lead hammers? I have tried melting the antimony with the lead; but it appears to burn on the top of the molten lead and will not mix with it.—W. M.

[61183.]—**Engine Details.**—Would any of our fellow-readers please give me size of slide-valve and throw of eccentric to cut steam off at half-stroke for cylinder, diam., $3\frac{1}{2}$; length of stroke, 5in.; size of ports, steam 5-16 by $1\frac{3}{4}$, exhaust $\frac{5}{8}$ by $1\frac{3}{4}$; bars between, 5-16? Also, please show how to get size of slide valves and eccentrics for any cylinder, or recommend book on same?—GREEN LAD.

[61184.]—**Sheep Dip.**—I understand that undiluted oil made from coal-tar is used for this purpose, although sold under some fancy name. Could any reader of "Ours" inform me as to this, and if not used without the addition of water, hot or cold—how many gallons is used per 100 sheep? The oil contains carbolic acid.—WOOL.

[61185.]—**Twin Screw and Paddle Engines.**—Will any of your correspondents kindly give me information (as fully as possible) as to the advantage possessed by twin screw and paddle engines (disconnecting or otherwise) over the ordinary type?—TWIN SCREW.

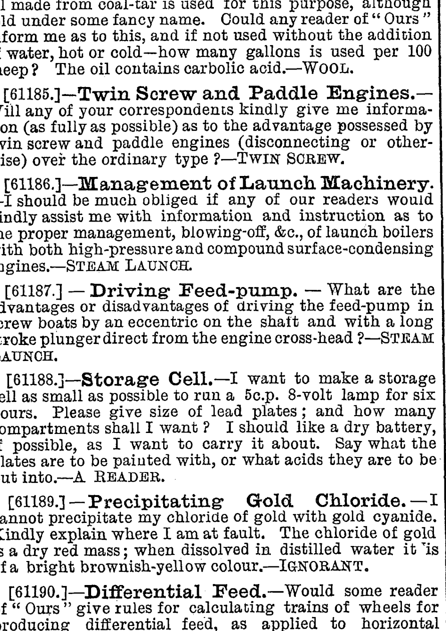
[61186.]—**Management of Launch Machinery.**—I should be much obliged if any of our readers would kindly assist me with information and instruction as to the proper management, blowing-off, &c., of launch boilers with both high-pressure and compound surface-condensing engines.—STEAM LAUNCH.

[61187.]—**Driving Feed-pump.**—What are the advantages or disadvantages of driving the feed-pump in screw boats by an eccentric on the shaft and with a long stroke plunger direct from the engine cross-head?—STEAM LAUNCH.

[61188.]—**Storage Cell.**—I want to make a storage cell as small as possible to run a 5c.p. 8-volt lamp for six hours. Please give size of lead plates; and how many compartments shall I want? I should like a dry battery, if possible, as I want to carry it about. Say what the plates are to be painted with, or what acids they are to be put into.—A READER.

[61189.]—**Precipitating Gold Chloride.**—I cannot precipitate my chloride of gold with gold cyanide. Kindly explain where I am at fault. The chloride of gold is a dry red mass; when dissolved in distilled water it is of a bright brownish-yellow colour.—IGNORANT.

[61190.]—**Differential Feed.**—Would some reader of "Ours" give rules for calculating trains of wheels for producing differential feed, as applied to horizontal boring machines? A is wheel keyed on mandrel driving B (B and G are keyed on a sleeve, which revolves on spindle C), G drives D, which is keyed on screw S. If



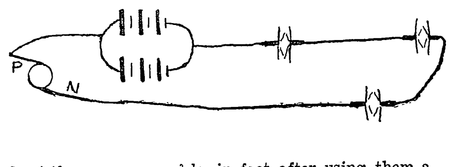
pitch of screw = 3 threads per inch, what trains of wheels would produce 35·8 and 3 threads per inch respectively? Will the introduction of intermediate wheels produce different results? As "Goodeve's" and other textbooks are in no way exhaustive on this subject, perhaps some of our able correspondents will oblige—A BELATED FOREMAN.

[61191.]—**To Mr. Wimshurst.**—I have a 12in. plate machine, with combs on glass tubes and 12 brass sectors, 2 3-16 by 7-16 by $\frac{1}{8}$, on each plate; but I cannot get it to excite itself, though if a charge is given to it, it gives a brush discharge about 3in. long. What size of jars should I also use for same?—LES DENTS.

[61192.]—**Colouring Stock Fittings.**—To "ARMOURER."—Many thanks for your kindness in answering my query. I shall be glad to avail myself of your kind offer of lending me the tool; and now there is one thing more I should like to know: How to colour the stock fittings. I have tried two or three ways, but cannot manage it properly.—J. BEARDSHALL.

[61193.]—**Poisonous Alkaloids.**—Balland about two years ago recorded in *Jour. de Pharm. et de Chem.* that poisonous alkaloids existed in old flour. Has this been verified, and to what extent? Mr. Allen would probably oblige—ARMY HOSPITAL COMPOUNDER.

[61194.]—**E.P.S. Secondary Batteries.**—Will some reader of our journal inform me the best plan of recharging the above batteries from a series-wound dynamo, running three arc lights in series, with a C of 15 ampères at 185 volts? The batteries are 8in. by 10in. by $2\frac{1}{2}$in. I have tried to charge them repeatedly by connecting them in multiple arc with lights, as per sketch,



and yet they are very weak—in fact, after using them a few seconds they appear to lose all traces of charge. Should I charge them by connecting them in series with the lamps? I don't think the cells are in any way defective, and they are comparatively new. Does the solution require changing, or how am I to know when to do this?—OWEDA.

[61195.]—**Damage by Woodworms.**—Certain pieces of my furniture in daily use have been attacked by woodworms, and it appears to be spreading over the rest, new and old. In some instances the wood has been riddled to the consistence of sponge. Could any correspondent tell me what will stop this, and whether a bad piece of wood will infect another? I have tried rubbing cayenne pepper into the holes and flooding them with turpentine, but without avail.—F. K.

[61196.]—**Staining Leather.**—What will stain new sheep skin leather to the various shades of dark-brown and dark olive, so as to match old calf binding, as I wish to re-back certain old volumes? Also how to stain light-coloured leather into scarlet suitable for labels? Any hints would greatly oblige—F. K.

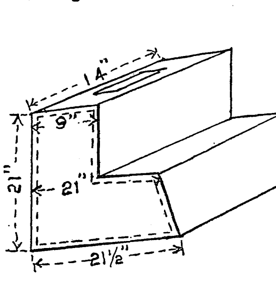
[61197.]—**Motor and Coil.**—Kindly inform me what is the average cost of working motor and electric motors from $\frac{1}{4}$ to 3H.P. Will No. 26 s.c. wire do for induction coil, secondary, and what quantity to get 1in. spark? What are the advantages of coils made in section, and details to make one? What size platinum points are best for contact breaker, and if it requires more primary than an ordinary one?—J. L.

[61198.]—**Induction Coil.**—What length of spark will an induction coil (with condenser) give of the following dimensions? It measures 3 by $1\frac{3}{4}$, is wound with two layers of No. 18 cotton-covered wire for primary, and 6oz. of No. 40 silk-covered for secondary (in sections).—F. DAWSON.

[61199.]—**Fan.**—Would "Rouge Gorge" kindly send description of fan mentioned by him in his reply to query 61019?—H. E. SMITH.

[61200.]—**The Work of the Heart.**—Can any of our readers tell me (1) the average weight of food consumed by an adult, and its heat value, (2) and average work done by one man in 24 hours? It seems to me the food consumed must give an extraordinary duty if the heart does work = raising 125 tons 1ft. in 24 hours, to which I suppose must be added the work done by the man himself.—H. E. SMITH.

[61201.]—**Range Boiler.**—Will someone kindly give a sketch how range boilers are moulded in greensand?



No chaplets are to be used for steadying the cores. This sketch will show what is wanted to have only one opening on the top, 8in. by 6in.—H. S. H.

[61202.]—**Fret Saws Breaking.**—I have a fretarm fitted to my 3in. lathe, driven as usual by a pin in the face-plate. The saw is held between one arm of wood and a vertical sliding bar, working in guides below the platform. The action is easy, and apparently all is as it should be; but I break saws, sometimes every few minutes, and even in a straight cut in $\frac{1}{4}$ stuff. Can any reader suggest the reason? I am a novice; but I take great care, and endeavour only to press the wood straight forward. I strain the saw fairly tight, till it just twangs if tried like a harp string. I fancy it is better to strain the saw between two arms like a Roger fret machine, as there is no sliding bar needing lubrication, and the driving power is not communicated to the oscillating arm by making a connecting link of the saw itself; but hundreds are made as mine is, and I suppose they are found to answer. One of Churchill's machines is advertised to cut 3in. stuff, so that a fret saw must be capable of standing a deal more strain than $\frac{1}{4}$ stuff can bring upon it. The saws appear to be fairly tough if tried by bending and purposely breaking one. Someone please assist.—O. J. L.

[61203.] — **Porous Pots.** — To "EVELINE, NEWPORT," OR OTHERS.—In the "E.M." for April 16th last, p. 154, you say it makes porous pots act better to bake them over a clear coke fire. Would a clear coal (or anthracite, perhaps) do as well? Also how to bake them? Am I to cover entirely with coal, or merely rest them on the top and turn them? Is there any other method?—LONDINIENSIS.

[61204.]—**Photographic.**—What distance should the stop be placed in front of a view lens? Also, is the Rectilinear the quickest for instantaneous work?—LENS.

[61205.]—**Mechanics.**—Would any of our mechanical friends kindly help in the following questions? A vertical bar, moving in guides, is driven by a circular cam plate, having a centre of motion in the line of direction of the bar. The distance from the centre of motion to the centre of plate is 2in., and the bar exerts a pressure of 10lb. when rising, but falls by its own weight. What would be the work done in 100 revs. of the plate? (2) A horse drawing a cart along a level road at the rate of two miles per hour performs 29,216 foot-pounds of work in three minutes. Would anyone tell me what pull in pounds the horse exerts in drawing the cart?—NOVICE.

[61206.]—**Clothing.**—Would some kind fellow English Mechanic, or his wife, help a mother who likes to keep her boys and girls well clothed? I can manage to make up the garments; but it is such a puzzle to me to cut them out. Father and the boys are able to measure and draw all the various parts of their work, and it goes together the first time. Isn't there some method whereby I could measure them up, take the dimensions of the young "urchins," and then develop it on paper, so that I could feel that I was going to work scientific? "Draw a correct line and then work to it," as Ned says. A little instruction on the above would greatly oblige many a mother, as well as—JANE CONSARCINATION.

[61207.]—**Paper Doors.**—Will any of our readers kindly inform me if they know of paper doors and mantel pieces being made? If so, how?—JOINER.

[61208.]—**Watch.**—(1) What do watch-makers use to restore the dull crystallised appearance on the works of watches that have been handled with hot fingers? (2) Does a slightly bent balance wheel make any difference to the time-keeping qualities of a watch?—A. C. J.

[61209.] — **Psychological.** — To "GARRISON GUNNER."—I have a friend wholly given up to "drink." He is the father of a respectable family, and is very anxious to reform, but has lost all control over himself. I have just been reading an account of a case of mesmeric treatment of a desperate criminal, thoroughly bad and unmanageable in prison, who had it impressed upon her while in the mesmeric sleep that on recovering her normal state she was to become a reformed character. A course of this treatment had the desired effect, and she is now a hospital nurse. When I read the above, I could not help but wish that my friend could be treated in a similar way. Does "Garrison Gunner" know of any similar case, and would he advise my friend to try it?—T. EDGE.

[61210.] — **Mean Pressure.** — Referring to the ENGLISH MECHANIC, dated April 23, I should be much obliged to "Fizgers, Belfast," if he would kindly explain a little matter in his description of "Rankine's diagram for mean pressure" on page 173, and the 35th line from the bottom in the third column, it states: "take $BM_3 = \frac{1}{2}$ BM + the back pressure." The question is: How is the back pressure to be taken into account, as BM_3 is, of course, larger than $\frac{1}{2}$ BM by itself, and $\frac{1}{2}$ BM alone would bring that point inside the triangle instead of in the sector of the circular arc? I also notice in Rankine that the length of AX is decided by taking CI as a radius, and describing the arc from the centre C and cutting the line AX.—ASAPH.

[61211.]—**Planing Machine.**—To "T. C., Bristol," AND OTHERS.—I am making a small planing machine. Could you give information of how to drive it with one pulley or by treadle to get a quick return motion? There is one (The Eureka) that does this. Any information on this subject will oblige—PLANING.

[61212.]—**Oilcloth.**—Would any kind reader inform me what the blocks are made of for printing oilcloth, and what kind of paint is used for same, and kindly state if there is a book published on the above subject?—NOVICE.

[61213.]—**Engine Query.**—To "T. C., BRISTOL."—Kindly let me know this: We have a winding engine here. When she is working in back gear, if we will put a drop of oil on bottom bars, it won't be touched until steam is shut off. The blocks keep up to the top bars, and keep to the bottom bars when working in forward gear. It is a double engine, working first motion—slide valves.—ENGINEMAN.

[61214.]—**Pumping Set.**—Would any reader give me any information about a set hanging her column? I understand it is a quantity of air between the bucket and clack, and cannot get rid of it. Is a bad clack the cause of it?—CLACK PIECE.

[61215.]—**To Mr. Bottone.**—(26559, No. 1132.) Can you supply more lamps like the one you describe as only requiring 4·7 of an ampère, or tell me where I could procure them? Any information would oblige. What was the c.p. of the lamp, and how many volts did it require?—HARRY FRIVOLI.

[61216.]—**A Good Battery.**—Can anyone tell me where "Cato" has answered "Peregrinus" (60889)? I have looked very carefully, but have seen nothing as yet. If he has not answered, is it not rather cruel to keep many (no doubt) in suspense after raising our expectations as he did? If this comes under "Cato's" notice, I hope he will, at any rate, satisfy my curiosity, which has been fully aroused.—HARRY FRIVOLI.

[61217.]—**Pocket Barometer.**—In your issue of Dec. 4th is a diagram of an aneroid barometer, which, on the face of it, appears to give an immense amount of information; but which, nevertheless, in principle appears to me to answer a want I have felt, but which I had not the ingenuity or speculation to overcome. I have been living near Sydenham-hill, and come to the City every day to satisfy the stern necessities of life, and I carry a small aneroid in my pocket. I take the readings of barometer at home each evening and morning, and during the day generally inspect it also; but the result of these mid-day inspections is frequently to mislead me. My barometer hand points where it did when I left home. I say "Yes, steady—promises fair;—arrange accordingly for the evening's pastimes; but to my annoyance the instrument plays me false at the moment I have forgotten the change of altitude, and the apparently unmoved hand really means a fall of, say, 1-10in. in a few hours, which is a very different warning to steady. I know the difference of height; but it is not convenient to go into an elaborate calculation of three points of decimals at any moment one may desire to look at the barometer before you can tell what it means. Now, with the plan described by your correspondent "Montmartre," it appears to me we have only to set one of the motions, say A, for the diurnal change, and another, say B, with the altitude on it just 75ft., 100ft., or whatever may be necessary below it; then I know that in the City I always read changes from B, at home from A. Now, there are one or two points I would like to ask your correspondent "Montmartre"—viz., are these motions independent of each other. Also, to a person who has no intention of travelling on the continent of Europe, and therefore would only require English measurements, whether it would be necessary to have more than two of the motions? The size shown is excellent for reading; but your correspondent does not say anything about thickness. All the aneroid barometers I have seen of such a size seem to have been designed more to fix in one's hat than to carry in the waistcoat pocket.—TOWERS.

[61218.] — **Lighting Lantern.** — Will any reader kindly help me with the following? I want to light up my magic-lantern with the most powerful incandescent light possible; space about 4in. sq. Can I get one lamp of 40 or more c.p, or must I have, say, three 25c.p.? If so, how many cells shall I want, and will ordinary bichromate arrangement with chromic acid be most efficient and economical? Also, how many hours such a battery will run with one charge, say two hours each night?—MAHMOUDIE.

[61219.]—**Gold Solutions.**—Will any of "ours" kindly tell me what is the cause of my gold solutions only acting for a short time? I have made up solutions from the "E.M.," and from "Watt's" and other sources, and have managed to get the right colour at first; but after four or five times using I can get nothing but a very very pale deposit, and only that after the article has been in the solution for some time. I know a little about electricity, and am perfectly sure my battery is right, and know how to regulate the current accoring to articles, &c. I have tried all ways to get solutions to act right, but cannot succeed, and am rather discouraged thereby. I only want to gild small articles, such as gold and silver brooches, bangles, &c., and it is rather too expensive a process to make up solutions every few weeks for the small number of articles I want to do. The solutions are kept securely corked up in bottles when out of use, and are quite free from organic matter of any kind, and only use them about twice a week.—PUZZLED JEWELLER.

[61220.]—**Boxwood.**—Can any reader of the ENGLISH MECHANIC give me the following information? Approximate annual importation to Great Britain, in pounds, of boxwood? Where imported from, and average wholesale price? Principal uses, or any further information.—J. P. R.

[61221.]—**Cutters.**—Could any of your readers inform me how wire nails are cut to form the square points? A small drawing, showing how the cutters work, would oblige—VERNON.

[61222.]—**Electric Indicator.**—Would Mr. Conry kindly give the amount and gauge of the wire he would employ to wind the electro-magnets figured in his sketch? Also the length of the cores of the same? What should be the distance between the points N and S of the permanent magnets shown?—H. F. C., Liverpool.

[61223.]—**Balancing Millstones.**—I am working a pair of 4ft. 4in. French millstones, grinding wheat for flour. While standing they are a true balance, when running they are not on a balance, but drag on one side. The spindle is quite upright. The stone is driven by over drift. The foot of driving spindle takes equal bearing. The centre bar bites equal upon the driver. The cock-head is in good order. All irons are free and easy. Bed stone is quite true and level; yet the stone is not on balance when running. I have four other pairs in the mill all run well. Will any of our milling friends help me a little in this important matter?—CHATTERIS.

[61224.]—**White Metal.**—Can any reader tell me if white metal, such as is used for the cranks of many traction engines, would be suitable for stone spindles to run upon? Would it be better than brass; also cheaper (I am told it would be), and what is it made from? I should be much obliged for any practical advice upon the matter.—CHATTERIS.

[61225.]—**Ironing Machines.**—Will any kind reader tell me if there are any domestic ironing machines patented? We have read of one that was exhibited in London this year that was driven by steam.—MECHANIC.

[61226.]—**Barometer.**—Could any of our numerous readers tell an anxious amateur the cause of the glass weight of a mercurial barometer refusing to float back the weight, although the mercury comes up the tube. It comes up the side of the glass rod, and when it is floated up does not follow the mercury back easily, but spasmodically. The glass rod does not seem too thick for the tube. I wonder sometimes if the mercury is dirty, or the tube is greasy, and, if so, how must I proceed to make right?—A CONSTANT SUBSCRIBER.

[61227.]—**Model Boiler.**—To "T. C., BRISTOL," AND OTHERS.—I should be very pleased to be instructed how to make an engine boiler of an 8-gallon copper pot. The sides are nearly 1-16in. thick; the middle of the bottom $\frac{1}{8}$in. I should particularly like to know what pressure of steam it will stand with safety, if well made. The pot weighs 12lb. now the handle and other irons are taken off.—J. K.

[61228.]—**Lantern Transparencies.**—Can any of your readers tell me the best composition for stopping out transparencies for lantern? Have tried Bate's black varnish, but not sufficiently opaque.—DENSITY.

[61229.]—**To Mr. Striffler.**—I am making a battery as described by you on p. 240 of Vol. XLIV. Will you kindly say what you mean by preparing the porous cells with paraffin and tallow, and if it is often necessary to remove the sulphate of zinc from the porous pots?—HOLLAND.

[61230.] — **Watch Conversion.** — Can "Watchmaker," or any of our readers, tell me what size lever escapement I shall require for above purpose? The top plate measures $1\frac{1}{2}$in. and 3-16.—WATCH CHAIN.

[61231.] — **Dynamo (Ten 20c.p.)** — To MR. BOTTONE.—Wanted to know what pattern of dynamo is best for the above? Size of magnets and armature, quantity and size of wire for F.M.'s, and for armature. I have Mr. Bottone's book, and sincerely hope he will soon do for the "ring" armature what he did for the Siemens H armature.—BRIAN BORU.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

CHRISTMAS DAY.

THE ENGLISH MECHANIC will go to press some hours earlier than usual next week, in order to complete publication before the Christmas holidays. All advertisements must, therefore, reach the office by 5 p.m. on TUESDAY, Dec. 21, instead of by 1 p.m. on Wednesday, as usual.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 15, and unacknowledged elsewhere:—

W. H. BAILEY AND CO.—C. Richardson.—T. E. Espin.—Rev. Edw. Harte.—H. Thorpe.—John Clarke.—W. Rammage.—M. Glover and Co.—Miller.—Woodworker.—P.—Arinas.—H—H. O., Glasgow.—One out of Work.—A. F. Shakespear.—J. J. S.—R. T.—Micky Dooley.—W. W.—F. M. E.—S. Bottone.

JAS. WRIGHT. (Referring to the article in Vol. XXXVI., it appears that a description of the galvanometer was given in the *Journal Universel d'Electricité*, while the illustrations in No. 911 represent improvements. In these circumstances, it does not appear necessary or advisable to reproduce the earlier description, which is, however, available in the journal mentioned.)—BLACK. (Methods of ebonising furniture and woodwork generally have been frequently given. See No. 1078, p. 246; No. 979, p. 371, and the indices generally.)—GEMINORUM. (For cleaning old books, see p. 120, last volume, where there is an article on the subject.)—G. CORRELL. (There is no truth in the statement that fruit stains in a table-cloth can be taken out by the sun's rays only at the time the fruit-trees are in blossom. The sun's rays act as a powerful bleaching agent at all times. Most fruit stains yield readily when the cotton or linen is well soaped, and a little powdered potash or common salt is sprinkled on the spot, which is kept moist and exposed to the sun.)—AN OBSERVER. (The "scientific reason" is the other way. The sun's rays do not put a fire out, as can be demonstrated by a simple experiment, which is the scientific way of treating such a question.)—MAGISTER. (You are suffering from progressive myopia, and just as your sight became shorter as you approached manhood so it will grow shorter still, unless you wear suitable spectacles. Friends who tell you that when you get stouter your former good sight will return, express a common belief; but you are short-sighted because your eyeballs have lost their normal form and are now longer from back to front than they should be. Mr. R. B. Carter, in his work on "Eyesight, Good and Bad," says: "When myopia is once established, and unless its influence is speedily counteracted, it provides for its own increase by the effect of convergence effort." Therefore, let an oculist provide you with suitable spectacles at once.)—A CONSTANT READER. (Yes, we believe petroleum is useful in the case; but see a paper on the subject in No. 1061, p. 456.)—J. H. ARTHUR. (We do not know of a book in which such directions are given. You will find directions in back volumes—e.g., p. 311, Vol. XXXIV. There are some directions for mounting crystals in Martin's "Manual," published by Churchill.)—AGRICOLA. (Is there such a book? You will find information about rams in Vol. XLII.; but we know of no work specially devoted to the subject.)—G. H. SUTCLIFFE. (There is a "Practical Carver and Gilder's Guide and Picture-frame Maker's Companion," price 2s. 6d., Savory, Cirencester. They are usually held in the vice. See index to Vol. XXXV.)—EXHIBITOR. (Yes, "something similar," with a considerable difference. There is no doubt about it, if the attachments are springs or elastic; but nothing is said about elastic strands on p. 195.)—OLDHAM CHAP. (In No. 1115.)—BLACKSMITH. (See indices of recent volumes—the last, for instance.)—E. DAVID. (Polish with rottenstone and oil, after removing all scratches with water of Ayr stone.)—T. REKSAT. (Mineral oil lamps can explode only when the reservoir is filled with a mixture of air and vapour of the oil. The majority of the lamp accidents are not explosions, but "falls." See p. 48, No. 1043, and a discussion in subsequent numbers. The real explosions are caused by moving the lamps rapidly or by blowing down chimneys to extinguish them.)—YOUNG MACANIC. (About half a dozen. Why use small carbons? See back numbers for many

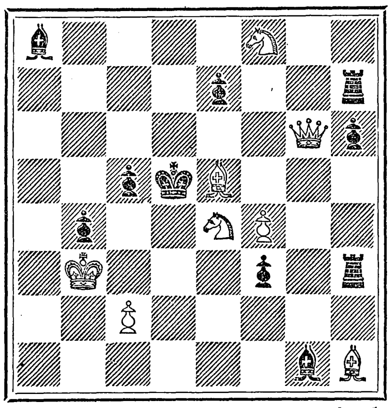
answers to such a question.)—SPENCER. (Do you not understand that the duration of any battery depends entirely on the amount of work it is called upon to do? The Leclanché lasts a long time when called upon to work at intervals only; but it is not really suited for electric lighting. See a number of replies on this question in No. 1082, p. 325.)—J. W., Manchester. (Perhaps it is a weak solution of acetic acid; but we do not know the composition mentioned.)—J. E. (See Hints Nos. 4 and 5 above. We gave the address. See No. 1118, p. 568. The other is a pocket machine.)—J. T. (The moulds are made of gelatine or glue, to which a little tannic acid or bichromate of potash is added. They become insoluble after exposure to light. The model is oiled, and the melted gelatine poured over it. When dry the gelatine mould is removed, and after exposure to light is ready to receive the plaster.)—TANGO. (The method of taking buckles out of saws, or saw hammering, was illustrated in No. 902, p. 407. There is a long article, also illustrated, on straightening saws in No. 635, p. 251.)—F. GIBSON. (Either of the preparations mentioned ought to answer; but fire-engine hose is made water-tight by impregnating the leather with glycerine to which three per cent. of carbolic acid has been added. Paraffin wax dissolved in benzoline ought to answer all purposes.)—CALDBECK. (Scarcely of sufficient interest to our readers. The expense will vary with the circumstances, and a barrister's course would be the lowest. The doctor and the accountant involve the passing of examinations, and much depends on whether the aspirant is an articled pupil or not.)—C. H. W. (Several preparations are given in back volumes; but one of the best is Leroy's, which has stood the test of years. See p. 445, No. 930; but of late years fossil meal, asbestos, and other materials have been utilised.)—C. A. W. C. (We do not know whether any steamship owners take apprentices in the engine-room. Apply direct to some of the companies.)—JOSEPH WHITE. (Quite true. The photographic charts of MM. Henry show more stars than have been seen with telescopes. Whether the "most powerful telescope" will show them is another matter. You will find all about the matter in the last volume, and in recent back numbers. 2. The absurdity of the other statement has been pointed out in our columns. Reference to almanacs or a little calculation will show that the 21st of June and the 21st of December cannot possibly fall on the same day of the week.)—HOUSEKEEPER. (Inadmissible as put, because the replies must of necessity be advertisements. See indices and advertisements. 2. For the stains try a solution of chloride of lime, and rinse the part through several waters after the colour is discharged.)—J. MCGLOUGHLIN. (Add a little white wax to the starch, and use a glossing or polishing iron—that is, an iron the nose of which turns up slightly so as to present on the ironing face an edge forming a sort of burnisher. The special iron is not necessary, but it is used at the best laundries.)—A SUBSCRIBER. (Answered many times. Clean the iron thoroughly, dip in a bath of hot oil or melted grease, and then immerse in molten tin. Wipe off superfluous tin with a wisp of greasy tow.)—W. W. RAMAGE, Colorado. (Thanks. Several devices of the kind have been on the market here for many years.)—WEIGHTS AND MEASURES. (We should understand the weights to refer to avoirdupois, unless otherwise mentioned.)—P. P. C. (If you cannot see any popular works on astronomy look in back volumes, or see the index to Vol. XXXV.)—JACK. (Soft iron is necessary—the softer the better.)—WESTWOOD. (It could be used; but if it is only for zinc, that is better done by dipping the articles in molten zinc.)—A READER. (You can get them from any warehouse which deals in such materials, and find a table in such a work as Molesworth's Pocket-Book.)—J. W. TOWNSEND. (Lithia is the oxide of lithium. Lithia water is made by adding carbonate of lithia to water in the proportion of 5 grains of the carbonate to 10 fl. oz., and then charging the water with carbonic acid.)—T. J. O'CONNOR. (The "History of the Invention of the Locomotive" is published by T. West, North-road, Darlington. See first page, Nos. 1119 and 1120.)—E. L. P. (We must refer you to back numbers. It is only those machines which have an electromotive force sufficiently high to overcome the resistance of the human body that are dangerous in the sense you mean)—W. J (You have no circulation at all. Carry the pipe from the top of the boiler to the top of the cistern, and it will work all right. See indices of back volumes.)—PERPLEXED. (Thorough ventilation is the only remedy; but see what has been said in back volumes. Steaming shop windows are often very difficult to cure.)—D.B. (Flood Rock, the last part of the work in clearing Hell Gate, was blown up on Oct. 10, 1885. You will find a detailed account of the works carried out at Hell Gate, New York, with a diagram of the galleries, &c. made in Flood Rock on p. 203, No. 1076, Nov. 6 1885)—C. W. W. (Pewtress and Co., Little Queen-street, Holborn, W.C., as stated on p. 193, and elsewhere.)—C. O. N. (Almost all the large musical instrument warehouses. Try Withers, St. Martin's-lane, W.C., or Dawkins, Charterhouse-street, E.C.)—J. A. (By means of polishing buffs, wooden wheels covered with leather.)—BOOK. (Nothing. They must be mixed together by a masticator, and subjected to heat and pressure. We believe the book published by the Society of Arts, John-street, Adelphi, W.C., is out of print. 2. They are out of print. 3. Electrical cement is made of rosin 5oz., beeswax 1oz., red ochre or Venetian red in powder 1oz. Dry the last thoroughly, melt the wax and rosin together, and stir in the powder by degrees.)—EXAM. (If you cannot refer to back volumes, you should procure a copy of the "University Calendar," in which you will find all particulars.)—NEEDY MECHANIC. (If you have all but the corners done, surely you can cut a paper pattern and see how that fits before cutting the leather. They are made on a former, which takes to pieces and releases the bellows when finished. 2. No one can tell the cause without examining. The water may dissolve the pipe, or may come over as water instead of steam.)

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXII.—BY BLACK PAWN.

Black.



White. [8 + 10

White to play and mate in two moves.

SOLUTION TO 1,020.

White.	*Black.*
1. Kt-K 7 (ch).	1. K takes R.
2. B-R 5.	2. Kt-B 3.
3. P takes Kt, mate.	

We understand that this Problem is really by R. B. Wormald (No. 39) in "Chess Openings," 1875. It has also been published in "Chess Gems." It was sent us by a correspondent on whose good faith we thought we could rely.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,020, by J. Krasser, Link, White Pawn, and J. Mackenzie; to 1,019, by Hampstead Heath, J. A. M. (fine and deceptive), G. A. A. Walker (key move); to 1,021, by Black Pawn (very pretty) and A. Bolus.

BLACK PAWN.—We are obliged for the three-mover; it shall have attention.

LINK entered for A and B; J. Palmer and J. W. Hamill for B.

J. P. T.—Thanks for problem.

G. A. A. W.—We simply referred to Game Tourney by way of comparison of duration of time—two years to six months—and yet there is no difficulty in meeting with competitors, though the entrance fee is forty times as much. We are sorry for two or three reasons that we are unable to entertain your proposal.

J. A. M.—Thanks for the information.

J. MACKENZIE.—How do you proceed in 1,018, if 1. $\frac{\qquad}{\text{B-Q B 6}}$? If 2. $\frac{\text{Q takes P}}{\text{R-Q 3}}$, and we fail to see mate next move, if 2. $\frac{\text{Kt-Q 7 (ch)}}{\text{K-K 3}}$, and if 3. Q takes P (ch), B covers.

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OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, **Photo Apparatus**, wet or dry, cameras, sundries, &c., in exchange for Microscopic or Magic Lantern Slides. —Apply, PIGGOTT, Chemist, Huddersfield.

Gas-Engine (Bisschop), 1 man power, cost £25; Water Engine, 1 horse, by Ramsbottom, working order; 2,000c.p. Arc Lamp. Offers.—W. HUTCHINSON, Liversedge.

Dynamos, four, two by British Electric Light Coy.; 3 Serrin Arc Lamps, switch boards, brushes, carbon, speed indicator, coil, &c. Offers.—W. HUTCHINSON, Liversedge.

One dozen pure nickel silver **Teaspoons**. Will exchange for anything to value of 3s. 6d.; sample, 4½d.—GILBERT, Oxford-road, Sheffield.

What offers for 52in. **Bicycle**, in good condition, with lamp, bell, spanner, &c., strong, and suitable for a beginner. Can be seen by appointment. Wanted good air-gun, and part cash. For value see Sale Col. advt.—C. E. K., Lady Cross, Gayton-road, Harrow.

Horizontal **Steam Engine**, 6in. stroke, 3in. bore, 24in. flywheel, new. Exchange for a small lathe, complete, to the value of £3.—Stamped addressed envelope to P. PITMAN, Mellor, Marple, near Stockport.

Chest of **Mechanic's Tools**; book, "Every Man His Own Mechanic," Spon's "Mechanic's Own Book," Engine-making, finished Parts of Engines, Musical Box, Exchange.—Above.

Splendid **Magic Lantern**, with 60 slides, all complete, in fine mahogany case. What offers?—J. GREIG, Rock-road Cottage, Killarney.

Vertical **Boiler**, 2ft. high, new water gauges, safety-valve, small steam gauge, ⅞ pump. Offers. Sketch, 2 stamps. —Letters, W. SMITH, Bilston-road, Wolverhampton.

Four **Electric Bells**, one invalid set, four room indicators, wires, batteries, new, unused; small Screw Steamer, perfect; Model Paddle Engine and Boiler, sundries. For exchange. Wanted, Electro Motor for sewing machine or pair Lanterns, &c.— Box 1, Mallow.

Two 3-light **Gas Dry Meters**, by Glover, gunmetal, 1in. steam cock, Devrince and Mullinson's patent, and 31 ls. copies "Pictorial Family Bible," published Sangster and Co. Dynamo, electric scarf pin, battery, or books containing recipes, small printing press in exchange.—BUSY BEE, Green-street, Upton Park, E.

Photographic Camera wanted, ¼ or ½-plate, double swing back; also Ross' Symmetrical, Dallmeyer's Rectilinear Lens; particulars. Exchange Browning's Lantern Microscope.—CHRISTIE, Cathcart, Glasgow.

Wanted, two 10 candle-power **Incandescent Lamps**, with batteries complete, for gent's silver English lever, capped, warranted.—31, South Quay, Yarmouth.

Wanted, **Electrical Apparatus** in exchange for model engine and boiler, 1½in. bore.—H. RODGERS, 127, Abbey-street, Bermondsey.

Vertical Engine, 1½-H.P., on cast-iron platform, which makes water tank complete, fitted with pump by James Davis, Millwall, London. Offers to value of £9; quite new, never had steam in.—W., 12, Church-street, Fulham, S.W.

4in. **Leg Vice**, in good condition, 10s. Pair Brass Standards, 4in. high, new, 3s. Wanted, smaller vice, also strong boiler for model engine.—CARN, 54, Dieppe-street, West Kensington, S.W.

Best make **Bellows Camera**, half-plate lens, with stops, in leather case, 3 double dark slides, folding stand, dry plates, baths, &c. worth £8. What offers in exchange? All letters answered. —M. ALLISON, Howwood, Paisley, N.B.

Wanted, **Electro Motor**, Cuttriss or Griscom preferred. Exchange six-cell Fuller's battery, half gallons, worth 30s.—C. G., 50, Graham-road, Dalston.

Exchange, **Lathe**, back-geared, 5in. centre, slide-rest, &c., and Humber tricycle, for screw-cutting lathe, 5½in. or 6in. centre.—H. G. W., Farley Lodge, Farley-road, Catford, Kent.

One **Opera or Field Glass**, cost 21s., for anything in cutlery or household requisites.—W. SMITH, 146, Otley-road, Bradford, Yorks.

Berri's Machine **Printing Press**, Type, &c. Want Safety Bicycle or Harmonium for same.—*Eagle* Office, Daventry.

Will exchange splendid Double **Combination** 8¼ by 6½ portrait lens, dia. 3¼, by Cox, of London, cost £12; for litho press, tricycle, or lathe.—Offers to F. FRAINE, 1, Lorn-villas, Priory-road, South Lambeth.

Organ, old, 2 manuals, pedals, 2 couplers, 12 stops, knobs, action, all complete except pipes and bellows. What offers? —Rev JAMES, Walberswick Vicarage, Southwold.

20 **Incandescent Lamps**, 20c.p.; 18lb. of double cotton-covered wire, 12 W.G., 50lb. 18 W.G. Offers.—HUDDLESTON, 40, Samuel-street, Woolwich.

Guitar, date 1827, condition good as new. Exchange anything useful. Offers.—J. H. MENHINICK, Egloshagle-road, Sladesbridge, Cornwall.

2in. centre **Lathe Heads**, steel spindles. Will exchange for good opera glass.—CARTWRIGHT, 15, Joseph-street, Hunslet, Leeds, Yorkshire.

Vertical Engine and **Boiler** combined; boiler 2ft. long by 14in., pressure 70lb.; first-class lot. Seen by appointment.— ALLMARK, Garden-lane, Chester.

Small **Lathe**, flywheel, crank, two driving pulleys, small dynamo, electromotor, battery, incandescent lamps, &c. Offers.—CHARCOAL WORKS, Hodson-street, Liverpool.

Wanted, a small **Saw Bench** and **Saws**, complete. Will give lady's gold watch and long gold chain, cost £13 10s., nearly new; will give small sum for a good bench, &c.—Apply at once, J. N. KNIGHT, 29, James-street, Barrow-in-Furness.

Fans, 4½ by 1⅞, compound motion, of brass, nearly new. Exchange for magneto machine in working order.—J. RAE, 33, Arden-street, New Brompton, Kent.

A bargain, small partly finished **Magneto-Electric Machine**, wrought iron armature. What offers, 36 silk?—B., 19, Milkwood-road, Brixton.

Oppen's **Stamp Album**, with 370 assorted rare stamps, in good condition. Exchange for anything.—H. BUDD, Stoke-road, Gosport.

324 Rare **Coins** and **Tokens**. Gent's Gold Watch and Chain. Exchange for slide-rest lathe or recent-make tricycle.—H. BUDD, Stoke-road, Gosport.

Automatic Knitting Machine offered in exchange, slide saddle, 3 crutch. What offers?—Wellesley House, Colchester.

9in. centre compound **Slide-Rest**, nearly new. Exchange to the value of £2 2s. Stamp for particulars.—SEDGLEY, Ryding-square, West Bromwich.

Lathe Heads, 5½ centre, face-plate, hand rest, ornamental slide-rest, wood and iron turning tools, worth 50s. Exchange. Offers.—F. POYNTER, Eton College.

Lathe, on iron standards, treadle, &c., 3ft. long. What offers? Exchange.—166, Siddals-road, Derby.

Quadrant, Singer's S.S., or Cripper type Tricycle wanted. Condition no consequence. Exchange capital Dynamo and Electrical Instruments; cost over £18.—A. J. S., 194a, Marc-street, N.E.

Wanted to exchange, "**English Mechanic**," 325 consecutive numbers, indices, clean, unbound; present date; for anything useful in Lathe Appliances.—FINCH, 47, Paul's-street, Cheltenham.

"**Elements of Natural Philosophy**," Golding Bird; 4th edition, 12s. 6d.; perfect; for "Microscope and its Revelations," by Carpenter, same value.—DENNE, Christchurch-road, Eastbourne.

Will exchange a Portable Circular **Fan Forge**, new, for an Air Pump or Lead Burner's Apparatus, in good condition.— TURNER, 1, Gainsboro'-cottages, South Hackney.

36in. **Facile Bicycle**, ball bearings, Hancock's tyres, in good condition; saddle, dropped handle bars, mud guard, bell. What offers?—TURNER, Gainsboro'-cottages, South Hackney.

Bicycle, 50in., Rudge's ball bearings back and front, half plated, nearly new. Also a 3in. Amateur Lathe, complete. Exchange for a 5in. Slide-rest Lathe.—H. TYSOE, 1, Clive-street, Grangetown, Cardiff.

Scientific Books. What offers? "Natural Philosophy" (Tyndall), published 2s. 6d. "Notes on Electricity" (Tyndall), published 1s. "Notes on Light" (Tyndall), published 1s. 6d. "Magnetism" (Harris), published 2s.

Books.—"Mind and Body" (Bain), published 4s.; "Art of Invigorating and Prolonging Life" (Dr. Kitchener), published 7s. 6d. "Dr. Paris on Diet," published 10s. 6d.

Books.—"Templeton's Engineer and Millwright's Companion," published 6s. "Steam-Engine" (Northcott), published 7s. 6d. "Elements of Mechanism" (Goodeve), published 3s. 6d. "Principles of Mechanics" (Goodeve), published 3s. 6d.

Books.—"Hydrostatics and Pneumatics" (Larder and Lowe), 5s. "Pneumatics and Acoustics" (Pepper), 2s. What offers? See last week's advertisement. Some left.—Mr. ANDREWS, 35, St. Martin's-street, London, W.C.

Lathe Bed and Parts of 5in. lathe for round smith's Bellows.—RIGBY SMITH, Fazackerley-street, Chorley, Lancs.

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Ammoniaphone, 42s., half-charged, antiseptic, new. What offers?—6, St. Mark's-grove, Fulham-road.

Gramme Dynamo, 120 c.p., mounted on oak base, nearly finished. Also Hand Dynamo. Exchange good half-plate Lens or offers.—CAMP, William-street, Norwich.

Beautiful pearl-handled **Knife**, contains 6 blades, exchange for any of Miss M. C. Hay's novels.—GILBERT, Oxford-road, Sheffield.

S. R. Bottone's new book on the "**Dynamo**: How made and How Used." Exchange for 10 c.p. Lamp.—WALTER, 146, High-street, Peckham.

Coil, on polished mahogany stand, dovetailed, ebony ends to coil, with condenser, 100 sheets, 1in. spark; quite new; exchange for Microscope or anything in the mechanical line.—H. J. LONEY, Post Office, Gosport.

"**Knight's Practical Dictionary of Mechanics**," 30 numbers, new. Exchange for Twist Drills, Stocks and Dies, or Cutter Frame.—H., 36, Camden-road.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Economic Cookery.—Patent Heat Conductors for roasting, 2s. 6d., baking, 2s. 3d.; boiling, 2s. per pair, carriage paid. See ENGLISH MECHANIC, Oct. 15, 1886, page 147.

The Patent Heat Conductors save a family pounds a year.—Agent, TALLACK, 28, Hatton-garden, London.

New Illustrated Price List of **Screws, Bolts, and Nuts** for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Fretwork.—Catalogue of every requisite, with 600 illustrations, free for 6 stamps.—HARGER BROS., Settle, Yorks.

"**Beginner's Guide to Photography**," one shilling. Wholesale of the publishers, LEJEUNE and PERKEN Hatton-garden, London.

"**Beginner's Guide to Photography**," one shilling. Free from abstruse technicalities. Retail of Opticians and Booksellers.

Electric Depot, 10, Deansgate, Manchester. Handiest shop in the trade. Largest stock. Greatest variety. Lowest prices.

Leclanche Batteries, 14s., 16s., 24s. per dozen. Sample, 1s. 9d., free.—SEDDON, 5, Queen's-road, Chadderton, Oldham.

Soda Water Machine, bargain. Engraving free post.—NATHANIEL SAINT GEORGE WILCOCKS, Bath.

Wimshurst Influence Machine.—Sole manufacturers of new and improved pattern. 12in. from 30s.—KING MENDHAM, and Co., Bristol.

Deposition of Smoke.—Complete Apparatus to perform this never failing experiment, with static electricity, 5s. 6d and 10s. 6d.—As above.

Standard Ohm, in boxwood cylinder, guaranteed correct to ten thousandth of ohm, 18s. 6d., with copper poles, 21s.— As above.

Galvanometer Cards for tangent and ordinary combined, vertical, astatic, reflecting, and unmounted compass cards.—As above.

Variable Resistance Incandescent Lamp Stand, invaluable for battery power, vide ENGLISH MECHANIC, Oct. 16, 1885, price 3s. 6d.—As above.

Write for **King, Mendham, and Co.'s** large new and reduced Price List, post free, 4 stamps.

Wheel-Cutting to 12 inches diameter in brass only. —CLEGG, 18, Belinda-street, Hunslet, Leeds.

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Aerated Water Machinery.—Repairs, Renewal, Additions, &c., skilfully executed.—N. St. G. WILCOCKS, 45, Avon-street, Bath.

Mica or Talc cut for all purposes by C. JOHNSON 7, New Oxford-street, W.C. Mica chimney covers, &c.

Grease Making without rosin oil.—Sample and particulars from J. M., 6, Hamlet-street, Bootle, Liverpool.

Mica or Talc.—RICHARD BAKER and Co., 9, Mincing-lane, London.

Lathes for every trade and every fancy. We make upwards of 250 varieties.—BRITANNIA CO.

Catalogue of Lathes and Parts, finished or rough, also of other Tools, six stamps.—BRITANNIA CO.

List of Second-hand Lathes and Fret Saws, one stamp.—BRITANNIA CO., Colchester.

London Showrooms.—Britannia Co., 99, Fenchurch-street. All correspondence Britannia Works, Colchester.

Lathes, Files, Steel, Saws. Cheap, good. List, 2 stamps. Cash or hire.—ROBINSON, Catherine-street, Sheffield.

Turning Woods for Amateurs.—Box, Cocus, Lignum Vitæ, Snake, from 3d. per lb.—HARGER BROS., Settle.

Skates (Acme), highly recommended, good value, steel plates, 4s. 3d. pair, free.—HARGER BROS., Settle.

Wood Planing.—Hand power 120, steam-power 1,200ft. per minute. Illustrated circulars free.—G. HAZELAND, Par, Cornwall.

"**The Wilcocks Eclipse**" turnover bottler for patent stopper bottles.—Maker, N. St. G. WILCOCKS, Bath.

"**The Wilcocks Power Cork Bottler**" for soda water, lemonade, &c.—N. St. G. WILCOCKS, Bath.

Lathe Castings, &c.—See T. Taylor's advertisement in ENGLISH MECHANIC every other week. Established 1847.

Carving Tools.—Set of 22, warranted, handled, well assorted, by post, 11s. 6d. See illustrated catalogue.—LUNT'S.

Saws, Disston's American, agent for same. Planes, new, London, malleable iron and gunmetal, every description.— LUNT'S.

Vices, bench, parallel steel jaws, to open 3½, 9s. 6d.; ditto 4, 15s.; ditto 4¾, 21s.—LUNT'S.

Taps (Engineers), warranted Whitworth, plug or taper, 3-16, ¼, 5-16, each 6d.; ⅜, 7-16, 8d.; ½, 10d.; ⅝, 1s.; ¾, 1s. 3d. Postage extra.—LUNT.

Tools, every description. See illustrated catalogue. 90 pages. Send 4 stamps.—A. S. LUNT, 297, Hackney-road, E.

Corundum for Aluminium or other purposes.— RICHARD BAKER and Co., Mica Brokers, 9, Mincing-lane, London.

Electrical Stock.—Clearing surplus under cost. Medical Coils, plated, with slide, 15s. Invalid Bell Sets, 8s. 6d.

Terminals, 20 per cent. off list. Wire, Electro-Motors, Batteries. Write for list.—759, Old Kent-road, S.E.

Brass **Model Engine Castings**, rough and finished, best quality. List, stamp.—WOOD, Dalley-street, Broughton, Manchester.

"**Sheet metal Workers' Instructor**" (Warne's) —Few copies cheap, covers slightly soiled.—94, St. Augustine's-road, N.W.

Two built **Wooden Booms**, about 60 feet lengths, by about 30in. diameter, with 16 and 18 strong iron hoops, also rings on each. Used for ballasting light ships during removal.—42 Box, Post Office, Newcastle-on-Tyne.

An **Overhead Traveller**, with winch attached, to lift 2 tons.—42 Box, Post Office, Newcastle-on-Tyne.

A heavy **Circular Saw Bench**, in good condition, with about 15 8½in. metal rollers, in strong metal standards.—42 Box, Post Office, Newcastle-on-Tyne.

Electric Bell Sets, comprising bell, battery, push, and 25 yards of wire, 7s. 6d. Catalogues of apparatus free on application to HUNTER and Co., 56, Wincheap, Canterbury.

Boilers, Vertical, Portable, and Cornish, one horse-power upwards.—GRANTHAM CRANK and IRON COMPANY (Limited), Grantham.

Lead Electric Accumulators made up and burned. Any class of of chemical work done. Soldering superseded. —HOWELL and BRIGGS, Practical Plumbers, 58, Rokeby-street, Stratford.

Marlborough **Tricycle**, quite new, to be drawn for, tickets 1s.—SMITH, 40, Calverley-road, Tunbridge Wells.

Self-feeding and Hand-feeding **Drilling Machines** for fine work. Write for list.—F. GREENAWAY, Maker, Slough, Bucks.

First-class **Lathe** (equal to new), with compound geometric, eccentric, and spherical chucks.—GEO. PLANT, Alsager, Cheshire.

Selection of interesting **Microscopic Slides** for Sale, from 6s. doz.—S. HARRISON, Dalmain-road, Forest Hill.

Powerful **Hydraulic Press**, to 500 tons, steel cylinder, 18in. ram, to be Sold, a sacrifice.—CAM.

Splendid **Launch Engine**, two 3in. single-acting cylinders, £25.—CAM and SON, Excelsior Works, Worcester.

Wood Planing.—Hand-power 120, steam-power 1,200ft. per minute. Illustrated circulars free.—G. HAZELAND, Par, Cornwall.

Metallic **Violin Strings**, acknowledged success, six Firsts, post free, 1s.—JOHN ELARCO, 24, Fern-grove, Liverpool, S.

Soda Water Machine, gas-work, turn-over bottler, recipes, &c., for working, £20; particulars free.—WILCOCKS, Bath.

Bentley's Electrical Stores.—The cheapest house for bells, batteries, wires, and fittings.—7, Newton-street, Manchester.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 24, 1886.

NOTES ON THE CHURCH ORGAN.
II.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

IT is, perhaps, unnecessary to remark that in approaching the subject of the Church Organ, one enters on the consideration of a problem widely different in its general bearings to that presented by the chamber organ. Between the Church Organ and the chamber instrument there are few points in common beyond those which are connected with general excellence of manufacture and purity of tone. As the two instruments are designed for entirely different spheres of usefulness, so must they, if properly schemed and appointed, be widely different in their tonal structures and musical resources. While the maximum powers of expression (even at the risk of some loss of brilliancy), and the greatest possible delicacy and variety of tone are necessary for the chamber organ, less powers of expression and the greatest richness and dignity of tone are requisite in the true Church Organ. Excellence of workmanship, perfection of voicing, and general refinement of tone are required alike in both classes of instrument.

A Church Organ should be designed throughout on the simplest and most thorough principles: there should be no ambition on the part of its founders to make a display in the shape of a great number of speaking stops; but, on the contrary, a determination to have, in every possible way, a work of art—true and perfect in materials and workmanship, and developed on the soundest lines of organ building. The tonal structure of the instrument, be it small or large, should be characterised by gravity, dignity, and softness—gravity, secured by an adequate and properly-balanced Pedal department; dignity, by volume of foundation tone in all departments; and softness, by skilful voicing under a copious windage at a moderate pressure. Those who desire to realise what I mean by dignity combined with softness may listen to the Schulze *Diapason* in the Great department of the Leeds Parish Church organ. Such a *Diapason* is a Great organ in itself. Dignity combined with softness cannot be secured by small-scaled foundation work, numerous incomplete stops, and many ranks of acute pipes, blown by high pressure wind until they literally scream a coarse apology for their serious shortcomings. Gravity combined with softness cannot be arrived at by one master-of-all-work pedal stop—a "deep booming" 16ft. *Open Diapason*; and much less by an apology in the shape of a *Bourdon*, in which the fundamental tone and its second upper partial seem to be perpetually struggling for the mastery.

A properly appointed Church Organ, containing nothing but whole stops of full scale, and adequate Pedal department, and constructed, by a conscientious builder, with the best materials, must of necessity be a somewhat costly affair; but it will fully represent the money expended, and prove a lasting satisfaction to all concerned in its fabrication and use.

Just a few words addressed to those who may be interested, at any time of their lives, in the procural of a Church Organ, and I shall proceed with matters of detail. When an organ is required, and the funds, immediately available, are limited, there are two straightforward and sensible modes of procedure with reference to its construction.

Firstly, if the church is small, do not aim at having an instrument out of all reasonable proportion with it; but be satisfied with one which, containing a moderate number of thoroughly useful and well-balanced stops, will sustain the voices of the choir and congregation on all occasions in a perfectly satisfactory manner. Adopt this simple course, entrust the work to a builder known for his skill, taste, and probity, and remain persistently deaf to the allurements of the tradesmen, who, with fascinating lengthy list of stops and specious promises, offers tempting and *apparently* substantial advantages.

Secondly, if the church is large, and the funds are insufficient for the purchase of an organ of the necessary size and character, do not aim at having a complete instrument all at once. The best mode of procedure is as follows:—Select a builder with the before-mentioned high qualifications, and instruct him to submit a specification for a true Church Organ of just sufficient power and variety of tone for the church, and the extreme requirements of the highest service held, or likely to be held, therein. Then state the present limit of the funds, and consult with him as to the best way of expending them on the suggested instrument. Let the scheme, so far as the bellows, windchests, and all the mechanism are concerned, be carried out in its entirety, and preparation be made for all the stops contemplated. The balance of the funds, after paying for all this, carried out in the most workmanlike manner, should then be devoted to the procural of the foundation stops or those most necessary for the accompaniment of the service. The remaining stops may be added at subsequent intervals as money is obtained. Private generosity is ever at work in church matters, and an unfinished organ is a favourable field for its operation. When it is known that the organ has, so far, been constructed on the most perfect lines possible, and that provision has been made for the reception of further stops, one may calculate on the completion of the instrument at an early period. It will be a great and lasting satisfaction to all parties concerned to know that nothing has been done in a cheap and careless manner, and that all the work has been constructed of the proper materials. The beginning has been wisely and well essayed, and the ending, albeit somewhat delayed, cannot but be entirely satisfactory.

Of course, when funds are ample, all the difficulties hinted at above have no existence; but, in the name of art and common sense, let the money be expended in procuring an organ of the best materials and workmanship, with the requisite number of properly-balanced and well-voiced stops, suited for the highest class of accompanimental music, rather than a large instrument of inferior manufacture, which will eventually prove a huge disappointment to everyone connected with its construction and use, and which will entail a continual expenditure to keep it in working order. *The better an organ is built the cheaper it will prove to be in the end.* This is an important fact to be added to the great advantages, in a musical direction, secured by careful and skilful construction.

Claviers and Couplers.

Following the arrangement adopted in my previous articles on the chamber organ, I have now to consider the question of the number of manual claviers necessary for the Church Organ. The true Church Organ should never have less than two, whilst it need never have more than three manuals. When two are adopted, they should respectively command the Great and Swell departments; when three are introduced, they should command the Great, Swell, and Choir departments. The compass of all should be from C C to a^3, 58 notes. A higher compass is unnecessary in accompanimental music and the desirable class of voluntary playing. In the case of two claviers, the Great should occupy the lower and the Swell the higher position; when three are introduced, the lowest should be the Great, the middle the Swell, and the highest the Choir clavier. This is the arrangement I strongly advocate, although I am perfectly aware there are many who prefer the old-fashioned arrangement, which places the Choir clavier lowest. The matter is not one of very great importance, however, and need not be dwelt upon.

I know, in limiting the claviers to three, I shall be condemned by numerous ambitious church organists who desire organs of the first magnitude, or having the appliances strictly belonging to them, whereon they can display, not their self-restrained powers in the dignified and refined style of playing suited to the music of the Church, but the full extent of their powers as organists in *all classes* of music. I cannot help, and do not desire to escape, such condemnation: I simply adhere to my views that a Church Organ is not a concert-room instrument; and should not be impaired by any attempts to make it one, and, accordingly, rendered insufficient for its chief, and, indeed, only proper use. In an instrument of moderate size, schemed on the many-manualled concert-room type, an enormous loss of grandeur or volume of tone will be sacrificed to secure numerous solo or "fancy stops" of insufficient mixing and building-up powers. The organ, in such a form, becomes merely an "ear-tickler" instead of a noble element in the hymns and chants of praise. I preach no stupid crusade against solo or "fancy stops"; let the foundation-work of the organ be first adequately represented both in pedal and manual departments, and it matters little what is superadded to it, the Church Organ will at least be safe.

It must be borne in mind that the multiplication of keyboards does not affect the general tone of the organ; it merely gives the performer facilities for making rapid changes of tone—changes by no means indispensable or desirable in accompanimental music of ordinary character. In English organs of the first magnitude there are only four manual claviers, and very few of our Church Organs have more than three. In France, however, the largest church instruments have no fewer than five manuals; for instance, the grand organs of the cathedral of Notre Dame and the church of Saint Sulpice, at Paris. Such instruments invariably occupy the west end position, and are seldom, if ever, used for accompanimental music. Another smaller and strictly accompanimental organ is provided in the choir in each case. In the church of the Madelaine, at Paris, the grand organ is elevated over the entrance door, while the accompanimental organ is placed at the opposite end of the church, behind the high altar. The celebrated organ at Haarlem has only three manuals. In Germany, although several church organs which have been built or altered during the last quarter of a century have four manuals, the generality of the fine old instruments have only three.

Every Church Organ, whatever number of manuals it may have, must have a pedal clavier, compass CCC to F, 30 notes.

It is desirable that a Church Organ with two manual claviers should have all the following couplers, especially if the stops in the manual departments do not exceed twenty in number.

1. Swell to Great, unison coupler.
2. Swell to Great, sub-octave coupler.
3. Swell to Great, octave coupler.
4. Great to Pedal.
5. Swell to Pedal.

In larger instruments, which may have stops of 16ft. tone in both manual depart-

ments, the Swell to Great sub-octave coupler may be omitted. Some organists prefer the Octave coupler to affect the Great manual only; but I am satisfied, in organs of the true church type, the Swell to Great octave coupler will be found to be generally more useful. This coupler question, so far as the Church Organ is concerned, is not, however, one of paramount importance. A carefully appointed and well-balanced instrument will meet all legitimate demands made upon its musical resources, even if it has but one manual coupler—the Swell to Great unison coupler.

In Church Organs with three manual claviers, the following couplers are to be recommended:—

1. Swell to Great, unison coupler.
2. Swell to Great, octave coupler.
3. Choir to Great, unison coupler.
4. Choir to Great, sub-octave coupler.
5. Swell to Choir, unison coupler.
6. Great to Pedal.
7. Swell to Pedal.
8. Choir to Pedal.

It is not advisable to omit any of the above-named couplers. The best position for the coupler-knobs is, as in the chamber organ, immediately above the upper keyboard, arranged in three divisions—namely, four belonging to the Great, one to the choir, three to Pedal.

Draw-Stop Knobs and Combination Appliances.

The draw-stop knobs, belonging to the speaking stops should be conveniently and compactly arranged, in groups, close to the right and left cheeks of the manual claviers. In all cases, when no insuperable objections obtain, the draw-stop jambs should be placed at an angle, so that the knobs can be drawn towards the performer, and be more easily reached by his hands. This arrangement entails some additional mechanism; but the cost of the same is well represented in the greater convenience secured. M. Cavaillé-Coll carries this principle to its extreme development in the consoles of his large organs. The draw-stop jambs assume the form of a quarter of a circle, and are carried in tiers from the cheeks of the different claviers. This arrangement allows a large number of knobs to be placed within easy reach of the organist, without the necessity of placing any knob above the level of the upper clavier.

Whatever the arrangement of the draw-stop knobs may be, I strongly advise their being very distinctly grouped, so that those belonging to each department may be readily distinguished. The use of knobs of differently coloured wood or ivory, faced with white for the inscriptions, is much to be recommended. There are several minor matters connected with the draw-stop knobs which I should like to dwell upon; but space is too limited to permit more being said here.

It is highly desirable in a Church Organ to have a full complement of combination levers operating on the stops of different departments and couplers. Small foot levers, double action, should be supplied to bring on and put off the manual unison and pedal couplers.

In organs with pneumatic action, combination pistons should be provided under the respective manuals; these render the cumbrous system of foot combination levers unnecessary. I am afraid it will be some time yet before the beautiful invention known as the "Roosevelt patent adjustable combination action" comes into use in this country; but I feel sure that the day is not far distant when no organ of importance will be complete without it or some appliance doing the same work. As I shall have to speak particularly of this invention in my "Notes on the Concert-room Organ," I need not say more about it in this place.

Expression Levers and Tremulant.

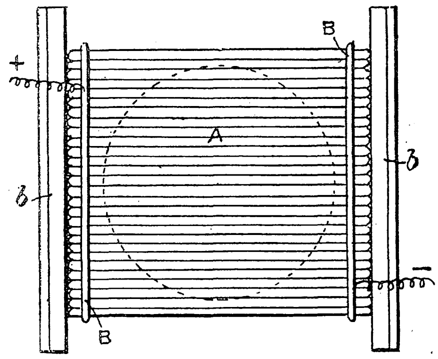
In a Church Organ of two manual departments there will in all cases be one swell-box, and in some instances two, as will be pointed out hereafter. In either case, the form of the Expression lever should be that already commented on in connection with the chamber organ—namely, the balanced lever. Its position, or their position when two are required, should be central, immediately above the pedal clavier. Two Expression levers will be required in an organ of three manual departments, and these should occupy the position recommended above.

As I have gone at some length into all matters connected with the Tremulant in the second article of "Notes on the Chamber Organ," it is unnecessary for me now to do more than direct the reader's attention to that article. All remarks there made are perfectly applicable to the Tremulant for the Church Organ. I may direct special attention to the particulars given respecting the methods of "bringing on" the Tremulant.

(*To be continued.*)

ANDERS' IMPROVED TRANSMITTER.

An improved transmitting telephone, which is apparently devised to overcome the difficulty in connection with the legal definition of a "diaphragm," has been patented by Mr. G. L. Anders, of Worship-street, Finsbury. The patentee says that the improved instruments which constitute his invention belong to that class of telephonic transmitters wherein is no diaphragm or tympanum to transmit the vibrations to the electrodes, but wherein the air-waves of the voice act directly upon the electrodes or contact pieces themselves. The electrodes are made extremely light, so that they are easily moved by the sound-waves, and they are also constructed so as to be loose and unconfined in those planes in which they are required to move in order to vary the contact when the sound-waves act on them. Rods or



thin tubes of coke, carbon, or other suitable material are particularly adapted for use as electrodes. These electrodes rest upon suitable supports, and against each other, in a free manner by their own weight, having no adjustment, but are prevented from falling by suitable framework or supports, or they may be supported by pivots thrust loosely into their ends through suitable supports. They may lie all in one plane, or they may lie in many planes, but always so that the sound-waves shall tend to act on them, as nearly as possible, simultaneously. They may be thickened at the ends if desired, and may be of any suitable form in cross section. The sound-waves may be directed upon or amongst them by means of a suitable mouth-piece or tube, and a sheet of oiled silk or other waterproof fabric may be interposed between the speaker's voice and the mouth-piece or tube, simply arranging it so that it serves to cut off the moisture of the breath from the rods or the like without acting as a diaphragm or tympanum. The figure represents the new telephone in plan. A are carbon rods or tubes arranged loosely in supporting loops or bars of metal or conducting material (B) fixed in the underside of the mouth-piece C, or in or to other suitable support. The battery wires are attached as shown; *b* are ribs to keep the rods in place. The transmitter may be mounted in any suitable way; but the patentee prefers to mount it desk fashion, and he also prefers to face the supports B with platinum foil for the contact of the carbon rods or tubes.

ELECTRICITY IN THE SERVICE OF MAN.*

Although "electricity" is often credited with the production of phenomena which it cannot possibly cause, there can be no doubt that it does form an important part of modern civilised life, and the reason is found in a sentence which the author of this work places in his preface or Vorrede—"In its power to assume always that form of energy which happens to be the most useful, lies the great importance of electricity." That statement is true, as has been abundantly shown in many recent exhibitions, but although there are textbooks almost innumerable (more or less useful), and an enormous number of papers in ephemeral publications, and the more lasting *Transactions* of societies learned or otherwise, there are few, if any, works which deal with electricity in the comprehensive manner indicated by the title of Dr. Urbanitzky's treatise. In its English dress it has been edited with copious additions by Dr. Wormell, who has not hesitated to alter the method of the author with great freedom, when he has conceived it to be out of accord with English modes of thought or reasoning, and has added much matter of interest which was not to be found in the German edition. Prof. Perry, who has indited an introduction to this volume, says pertinently that the history of electrical engineering differs from that of any other application of the principles of natural philosophy in this important respect: that long after practical men had developed elaborate mathematical investigations, the results of which were absolutely necessary to them, nearly all the teachers of the science of electricity in colleges and schools remained in a state of ignorance of everything except what may be called a list of "electrical tricks." Those who are old enough to remember the lectures of a quarter of a century ago will recognise the truth of that statement; but since 1870, when some of the more useful textbooks began to appear, the great value of "electricity in the service of man" has gradually made itself felt outside the telegraph office and the metallurgist's laboratory. The study of the few, aided by the intelligent observation of the many, brought about numerous discoveries, and every year electricity is mixing more and more with the daily life of civilised people. It must be confessed, however, that we owe more to the practical men who went, blundering it may be, from mistake to mistake until they discovered facts which ultimately became the staple data of the textbooks. With some few exceptions—notably the work issued by Mr. Sprague in 1875, which we may perhaps say first appeared in these columns—textbooks on electricity are misleading, and fail to convey to the reader any definite ideas of the subject. The author of the present volume, no doubt, wished to make his work complete, and accordingly Part I. deals with the principles of electricity; but a considerable portion of the matter in these 224 pages might have been left out to the improvement of the work. Part II. treats of the Technology of Electricity, and commences with a history of electric machines, which is freely illustrated—in fact, the illustrations are an important feature of the work, for there are nearly 850 which portray the progress of electricity as applied in the service of man. Thus, in the division relating to the generation and conduction of electricity, we commence with diagrams showing the principle of Pixii's machine, followed by illustrations of that machine, Clarke's, and Stöhrer's. Thenceforward, most of the historically-noted machines are illustrated and described, and in some cases the principle on which they worked is explained by a diagram. The famous Pacinotti machine, the forerunner of all the ring armatures, is described by a translation of the original paper written by Dr.

* Electricity in the Service of Man. From the German of Dr. ALFRED RITTER VON URBANITZKY. Edited by Dr. WORMELL. London, Paris, New York, and Melbourne: Cassell and Co., Limited.

Antonio Pacinotti. The diagrams in which methods of winding and other details are shown will be of special interest to the reader, as will such minor matters as Edison's tubes for the leads or conductors, his regulator, and meters. In the sections devoted to batteries there is an illustration and description of Pulvermacher's chain, which is said to be "used in medicine," and in connection with the Leclanché cell we are told that the zinc rod should be neither cast nor wrought, but drawn out. Details of similar character are mentioned in connection with other batteries, of which a considerable variety are illustrated, including the Grenet-Jarriant which is used for lighting the Comptoir d'Escomte in Paris. This is a zinc-carbon arrangement, the zincs dipping into mercury and surrounded to a certain height by a solution of sodium bichromate (1), sulphuric acid (3), and water (10 parts). The Grenet-Jarriant battery, however, is chiefly noticeable for the arrangements for lifting the zincs out of the solution, for supplying the latter and withdrawing it, and for rinsing the cells out after use. Some of the other constructions illustrated and described may be of use, and at any rate will have the effect of showing would-be inventors something of what has been already done. The descriptions of secondary batteries are not quite so complete; but a full explanation of the Planté is given. The history of the electric light is briefly written, and regulators and lamps are described at some length, including the details of manufacture of incandescent lamps, the mercury air-pumps, and the glass-blowing machine being illustrated; but more modern results of trials with incandescent lamps might have been given than those made at the exhibitions of Paris and Munich. Arc lamps and regulators are illustrated in a great variety of design, and the applications of the light and the current are shown in forms as numerous as could be desired—at all events sufficient to give an idea of the manifold uses of the electric light, for there are many illustrations of its application to railway stations, mines, lighthouses, navigation, and even the surgical appliances, including Leiter's gastroscope. Electrotyping is described with many important details, and the sections on electromotive power are exceptionally full and almost historically complete. The telephone and microphone naturally receive much attention, and all the best known instruments, with many others, are illustrated, together with the devices employed at central stations for communicating by telephone. The photophone, pherope, and phonograph, though they have at present done little in the service of man, are illustrated and described, and the electric telegraph, of course, has many pages devoted to it—in fact, nearly every useful invention in connection with electricity will be found in Dr. Urbanitzky's pages, the only notable exception being the at present undeveloped system of signalling from trains in motion, known as the "air line" telegraph—an invention which has only recently passed its preliminary trial, but which is already a sufficient indication of further wonders in the application of electricity to the service of man. Probably neither the author nor the editor would claim what may be termed critical accuracy for this work; but it is undoubtedly a useful and valuable volume, if only from the fact that practically all the useful applications of electricity are described in its pages. In that respect it has no rival.

THE AMATEUR WORKSHOP.—XXXI.

Brass Foundry.

It is cheaper to buy castings in small quantity than to make them, and those which are purchased are also mostly free from the defects of blow-holes and scabs, which amateurs are seldom able wholly to keep out of castings of home manufacture. Nevertheless, I think it well to devote an article or two to the subject of foundry work, because the series could hardly be deemed complete without it, and also because it is often desirable to be able to make sundry little castings at home for immediate use or for experiment, without the trouble and delay of going to a foundry for them. Often in rural districts there is no foundry within reasonable distance. Sometimes, also, when a foundry is handy, the men are so accustomed to rough or heavy work, chiefly in iron, that they cannot, or will not, take the pains required for many amateur jobs whose ultimate value may not be more than a shilling or two, but over which the amateur himself would be willing to spend hours of careful finishing and touching up. These jobs are not cared for in shops whose staple trade is of a more paying character, and so they are hurried through or else allowed to be shelved until a convenient season. If the amateur is an experimentalist also, he will, perhaps, find his occupation in the mixing of metals for the making of various alloys, in the reduction of metals from their salts or ores, &c., and in numerous studies besides, his melting furnace being his hobby, like another man's lathe or bench. Iron in small quantity also can be melted in a brass furnace, and, indeed, all the common metals and alloys. For these reasons, therefore, I shall now note in detail the construction of the furnace itself and the various appliances and tools used in connection therewith, adding a few hints relative to the practice of brass moulding itself, remarking, however, that success in that art, as in every other class of work, can only come after much practice.

The style and size of furnace is not arbitrary, and may be chosen according to the nature and quality of work to be done. A properly-constructed brass furnace is rather a cumbersome affair in a small shop; but it is the most suitable for the work, and can be made to such dimensions as are most convenient. But an iron stove, made open-topped with a movable cover, if furnished with a good draught and lined with firebrick, is efficient for light casting, so that choice may lie between the two.

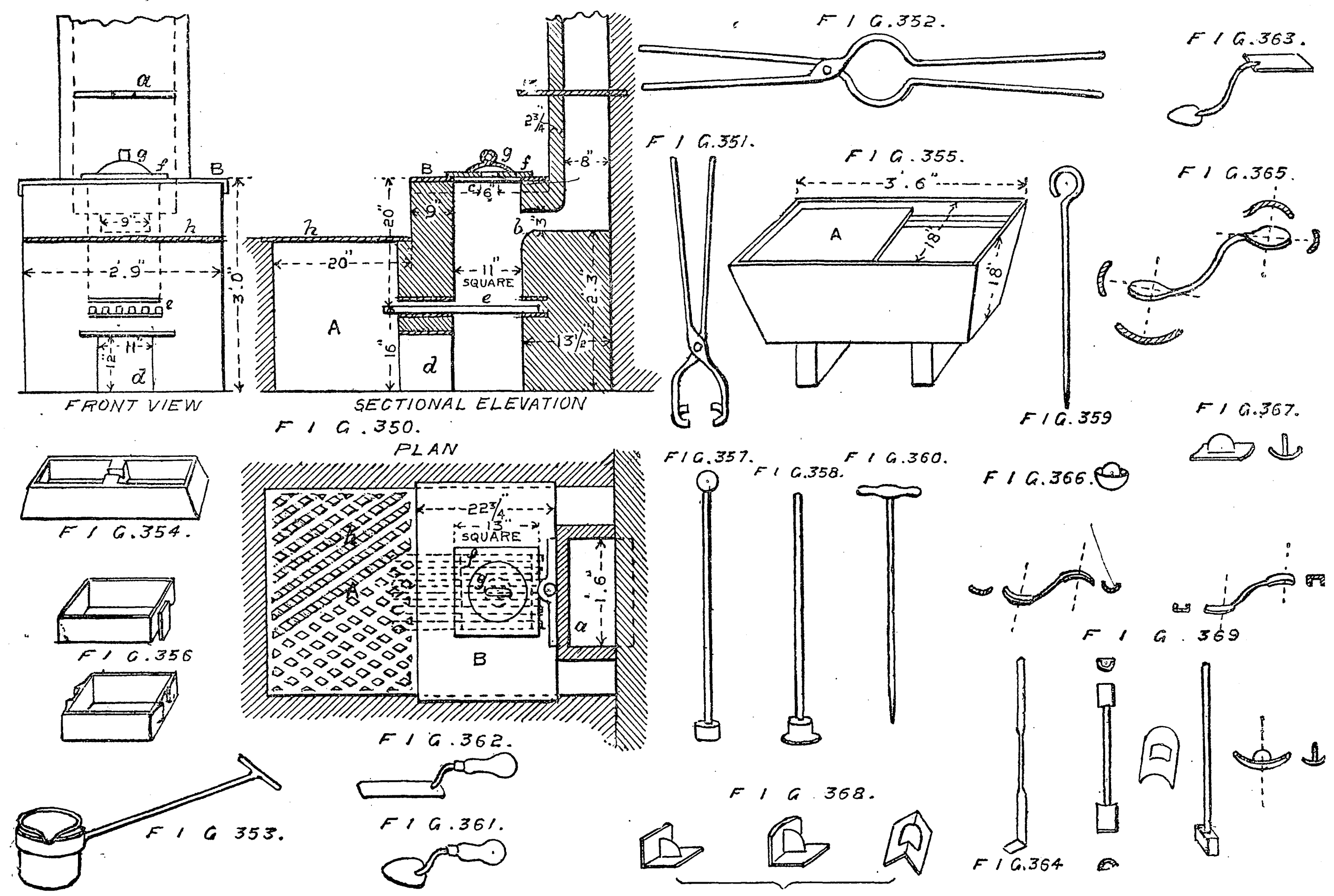
A proper brass melting furnace is shown in Fig. 350, and dimensioned for small crucibles. It is built wholly of firebrick set in fireclay. If a long chimney is available in the wall of the building against which the furnace is to be erected, a piece of pipe lined with firebrick can be led from the stove into it; but if not, the chimney must be built as shown, to a height of 20ft., or from that to 25ft. In the absence of the chimney, it would be necessary to use an artificial blast, and such was the practice among the early founders. The blast then should be heated, or fed in circuitously, since a current of cold air would be apt to crack the crucibles. A sliding damper, consisting of a plate of sheet iron, must be inserted in the chimney (shown at *a*) for the regulation of the draught. The smoke and fumes pass away through the opening *b*, into the chimney. Through the hole *c*, in the top of the furnace, the crucibles are lifted in and out. The ashes are raked from underneath the grate bars through the hole *d*, communicating with the ash-pit A, in front. The fire-bars rest upon bearers, and are arranged for convenience of removal when the grate has to be emptied of clinkers. A common method, simple and effective, is that shown in the figure where the bars *e* consist only of square rods of wrought iron, passing through an opening in the front brickwork across the bottom of the furnace to a similar opening at the back, and resting on sheets of iron built into the bricks. The bars stand out a few inches into the ash-pit, and when it is desired to put out the furnace they are drawn out with the tongs, and the fire falls down below.

The arrangements for the fixing of the furnace may be modified as happens to be most convenient. I have shown the type usually employed in brass foundries. Two or three such furnaces precisely alike, except that their capacities usually differ, are ranged side by side, and communicate with a common chimney. From the figure it is seen that the top of the furnace stands a few inches only above the level of the floor, and the reason of this is that the workman shall stand right over the crucible when lifting it in and out. This is desirable in any furnace, and is essential when heavy crucibles have to be manipulated. But a small furnace can, like a stove, be erected on a stone, or properly protected floor, and the making of an ash-pit be avoided. The top of the mouth *c* is covered over with a plate *f*, perforated with a circular sight-hole, and this again is closed with a second iron plate called a tile, *g*, and so named because an earthenware tile was originally used. The removal of this light tile is more convenient than having to move the cover itself whenever a sight needs to be taken for the purpose of noting the progress of the melting operations. It is desirable also that the top of the furnace should be protected from injury by means of a covering plate of cast iron, B, which may be made in open sand and perforated with a square hole to clear the furnace mouth, and also furnished with a shallow flange around the bottom edges of the two ends to embrace the upper edges of the bricks, when the furnace is built as shown in the figure. The ash-pit in front is covered over with a perforated grating *h*, or gratings, so that the floor is made good, at the same time that air for draught is allowed free admission. These plates are cast in convenient lengths (in this case one only) and dropped into rebated recesses prepared for their reception in the floor, and only lifted for the cleaning out of the ashes.

If an iron furnace is preferred, some kind of plain stove can be utilised by being lined with firebrick, the draught being derived from an ordinary chimney. The stove may consist of flat plates bolted together in a rectangular form, or it may be circular. Small crucibles can be withdrawn through a door in the front, but as this is an inconvenient arrangement, the better plan is to make a special cover perforated with a hole of sufficient diameter to take the largest-sized crucible and tongs which are likely to be used. Over this hole a cover of sheet or of cast iron can be slid. The particular type of stove is not of so much importance as the obtaining of a sufficient draught, together with the means of its regulation by an efficient damper, and convenience for working the crucibles, and watching the fire and the melting process, if possible, from above. When these conditions are satisfied, details can be modified. Regard must be had to the fixing of the furnace clear of all woodwork. Bricks, stone, sand, iron plates should alone be permitted around the immediate vicinity of the furnace, and these conditions are easily fulfilled in foundries. An amateur might in some instances utilise an outhouse for the purpose. But in towns small furnaces must often be put into boarded rooms. Then the furnace must be kept clear of floor and walls by proper non-conductors, such as bricks resting on sheet-iron plates, so that the risk of conflagration shall be prevented.

The best crucibles, or "pots," as they are shortly called, are those made of plumbago—i.e., they contain only so much clay as will serve to bind the plumbago together, or about one of clay to two of plumbago. They are smoother than the clay crucibles, and therefore retain less of the metal adhering to them. They cost roughly 1d. per lb. capacity, or a trifle over that. Thus, one of 20lb. capacity would cost about 1s. 10d., of 24lb. 2s. 3d., of 28lb. 2s. 7d., and so on in about the same proportion. They are marked for pounds or kilogrammes, the number being stamped on the crucible, according as they are ordered. A new pot requires annealing, effected by being turned mouth downwards over the fire for awhile. When uniformly heated it is turned mouth upwards, its bottom resting on a bed of coke; hard coke (i.e., "foundry" or "furnace" coke, not gas coke)* broken into small lumps is then put all round it, and up level with the mouth; the metal is charged, either now or before the pot is put in; the lid put on, then a few large lumps of coke are put above the lid; and, lastly, the tile is put over the mouth of the furnace. Nothing is now disturbed until the metal is melted, the average duration of this period soon being known by experience, and, if necessary, its progress being noted by removal of the tile and cover. When the metal is melted, the pot is lifted from the fire by means of the tongs (Fig. 351), a flux added if there is much impurity, and either poured direct by means of these tongs into the mould, or transferred therefrom to the double shank (Fig. 352), if the charge is a heavy one, or to

* The essential difference between "gas coke" and "hard coke" is that the former is only a by-product of the gas retorts, from which the illuminating hydrocarbons have been removed as far as possible, while the latter is the main product, in which the bulk of the hydrocarbons are retained, having been subjected to such a degree of destructive distillation in close ovens that their carbon is deposited in the coke, rendering it hard and dense, and therefore able to resist the weight of the contents of the furnace and the action of the blast, whilst its heat-giving value is much increased. Gas coke is dark and dull in colour, furnace coke is comparatively light and silvery in appearance, consisting almost entirely of pure carbon, with but a small proportion of ash. Gas coke is light, hard coke heavy. Its cost is more than twice that of gas coke, or about 25s. per ton.



the single shank (Fig. 353), if of less than 30 or 35lb. weight.

The proper mixing of alloys is an art of which we engineers know little in comparison with the professional brass founders of Birmingham and other centres. Gun-metal, hard brass, and some fusible alloys are the chief mixtures we have occasion to use; hence I must be content to state a few main principles connected with the mixing of these alloys only.

For general work, much the readiest way is to buy metal of required quality already cast into ingots, and remelt. Where this is not done it is the usual practice among brassfounders to mix their metal, and ingot it before using it for casting purposes. An ingot mould is shown in Fig. 354. The metal poured gently in at one end fills up the first division, and passes on through the notch into the second. The mould is warmed previous to pouring, and a little oil sometimes run over the bottom, since a very slight degree of moisture will cause the metal to fly. The second melting is believed to have the effect of more thoroughly amalgamating the alloy. But where special mixtures are wanted for special work, founders make their own alloys in preference to buying, as being more reliable, and also usually ingot them. When mixing alloys, the less fusible is melted first. When melting copper and tin, for example, the copper is first melted, and afterwards the tin added in lumps; the whole is then either covered down, or stirred only for a few minutes until the fusion is complete, when a bit of yellow soap or other suitable flux is added, and the moulds or the ingot poured. There is no difficulty in melting the alloys of gunmetal, neither is there in the case of brass containing copper with moderate proportions of tin and lead. But the mixing of zinc sometimes causes considerable difficulty in obtaining the proper amalgamation without excessive loss by volatilisation. Everyone knows that if zinc is put into an uncovered pot it will go off in bluish white fumes of oxide (ZnO), and since this occurs at a low temperature, it is difficult to prevent the volatilisation before the proper union of the metals has taken place. Under any circumstances, there is an unavoidable loss of zinc, much larger in proportion than that of the other constituents. There are two common methods practised for diminishing this loss. The one which is usually followed in engineers' oundries is to melt the copper first, then add he tin or lead, and last of all the zinc in small lumps, taking care that they are free from moisture, thrusting them below the surface, and stirring the while to promote amalgamation. When all are mixed, the surface is covered with a flux, a piece of borax, charcoal dust, or broken glass, the cover put on for a few seconds, and then removed, the alloy skimmed, stirred, and poured. The second method, and one which is more employed by the ornamental brassfounders, is to make two separate mixtures of metal before finally adding them together in the proportions to form the required alloy. The most volatilisable metal is added in a certain quantity to the more infusible, advantage being taken of the fact that the melting points of alloys are lower than those of their constituents. Thus, a portion of tin or antimony would be added to copper in the proportion of two or three of the former to one of the latter, and these when fused, added in small quantities to the softer metals or alloys. The first portion of the alloy is called "temper," and the amalgamation is more perfect than if all were mixed at once.

When iron and brass are turned, planed, or shaped at the same machines, the iron borings, filings, and chips become mixed with those of brass, and unless removed before remelting, spoil the castings by making them pinny—that is, they form aggregations of hard globules which stress the cutting tools greatly. Hence previous to remelting these, a magnet must be employed for the removal of the particles of iron and steel.

When pouring the molten metal, regard must be had to the temperature at which it is run. The chilling influence of small moulds causes the metal in these to set very quickly; therefore in such cases it should be poured as hot and fluid as possible. The amount of fume which metal gives off is a test of its high temperature: as it becomes dead the fumes diminish. For the heavier works the metal is required dead, because in the first place hot metal in mass causes the sand to become burned, and so imparts a rough skin to the castings; and second, because in alloys which are imperfectly mixed, or which contain metals of very different specific gravities, there is time for a partial separation due to delay in solidification, so that the different portions of the casting show different degrees of hardness. Lastly, the dross or sullage must be bayed back, or skimmed from the surface at the moment of pouring, to prevent its entry into the mould.

These few hints embrace the essential principles of melting and casting. Our remaining notes will have reference to the appliances, tools, &c., employed by the brass moulder, together with their mode of use. A brassfounder does not, as a rule, kneel on the ground at his work, as is usual with ironfounders, because his moulds are usually small, and therefore suitable for manipulation upon a bench. Either an iron core bench is used, in that case simply a plate of cast iron ⅝in. or ½in. thick, having a shallow flange running round the back and two ends, leaving the front edge clear, the plate resting on trestles, or on brickwork. Or a moulding tub or trough (Fig. 355) answers the double purpose of a bench and a receptacle for sand. The trough is a wooden vessel somewhat like a large washing tub, and furnished for a portion of its length with a movable sliding top, A, upon which the smaller boxes are rammed up. It is conveniently laid against the wall and supported on wood blocking. The boxes or flasks being light, are usually without handles, often also without pins, Fig. 356 being a common type. They are held together during the pouring of the metal either with superimposed weights or with a pair of screw clamps. For special work special boxes are, of course, used—longer, narrower, or deeper, as the case may be—than the example figured. For temporary and amateur use, wooden boxes are usefully employed.

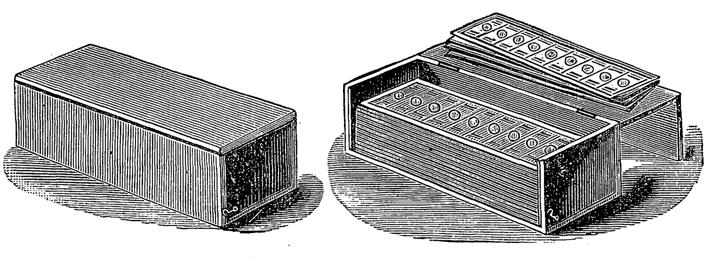
Subsequent figures show the principal types of tools used. The rammers are of three forms: the pegging rammers (Fig. 357) and the flat rammer (Fig. 358), the first being used for punching the sand immediately adjacent to the patterns and in narrow and contracted spaces, the oval end being used first, and the hemispherical end afterwards; the third or flat rammer being for levelling over the top sand, and therefore used only when the latter is about on a level with the edges of the box. A pricker or piercer (Fig. 359) is used for lifting patterns from the sand, or the fingers alone are used for that purpose; a vent wire (Fig. 360) is also employed, but the real function of the latter instrument is the "venting" or honeycombing of the sand with small holes for the escape of the gas generated in casting. The heart (Fig. 361) and square trowels (Fig. 362) are used for sleeking over broad surfaces, scraping and cutting down the sand to form the joints around the patterns, mending up moulds, &c., while the heel of the wooden handle is

improvised as a mallet for driving in stops or chaplets into the sand, and sprigs for sprigging broken moulds; in fact, the trowel is a kind of universal tool, like a shipwright's adze. The heart and square trowels are again combined in Fig. 363, differing only in size from the previous examples. A cleaner and lifter (Fig. 364), spoon tools (Fig. 365), a button sleeker (Fig. 366), pipe sleeker (Fig. 367), square corner sleekers (Fig. 368), are illustrated. The remaining group comprised in Fig. 369 illustrate various forms of bead tools and cleaners, whose uses are obvious from their sectional shapes, being the mending up and finishing of the surfaces of moulds whose outlines correspond more or less therewith; and all are made in various sizes either in brass or iron; lifters, trowels in the latter, while the bead and spoon tools are cast in each, many of the beads and sleekers being made by the moulders themselves to various shapes as occasion for their use arises. A good kit will contain several tools of the shapes given above, but differing in size.

I must defer my remarks on the practice of brass moulding to the next article.

MEDLAND'S PORTABLE CABINET FOR MICROSCOPE SLIDES.

IN the annexed engravings we illustrate a neatly-made portable cabinet for microscope objects, which has been introduced by Mr. J. B. Medland, 12, Borough, S.E. The cabinet is rather smaller than 11in. by 5in., by 3½in., and contains 16 trays, capable of holding nine slides in each. Each glass slip is held at its ends by the projecting side flap of the tray, which is held down by the succeeding tray, and so on, the lid holding the whole firmly down. When open, the lid and front fall back, as shown in the engraving, forming a stand or table to place the trays upon, which are thus less liable to get displaced or upset, as when



placed among other apparatus, or upon the desk or work-table. The designer considers that the advantages of size, compactness, and the improvements over the ordinary case, strongly recommend it to demonstrators of practical physiology, histology, medical students, and all microscopists who may require to carry a number of objects in a small space, with the least possible risk of damage.

NEWALL'S OCCULTER.*

By R. S. Newall, F.R.S., F.R.A.S.

I LATELY designed, and had made by a clever local optician, an addition to the eyepiece of my telescope, which I find of the greatest advantage in examining the satellites of planets and multiple stars. My idea was to produce an instrument exactly the reverse of Dawes's solar eyepiece; that is, to interpose a screen which shall shut off the bright object, and thus allow of the faint companions being more easily seen, and, at the same time, the apparatus must be simple and capable of easy manipulation and adjustment. I had my eyepieces each fitted with a stop, that is, a piece of tube the same diameter as the adapter, into which the eyepiece fits, and the stop is cut of such length that when the eyepiece is pushed in it shall be in the focus suited to my sight, so that I have no trouble in adjusting.

The occulter is a ring of brass, about ¼in. thick and ⅜in. broad. It slips stiffly on to the eyepiece, as shown in the accompanying drawing. The ring is bored with three holes, as in the section, and into each is fitted an ivory sphere, ⅜in. diameter. They are held in place by brass springs, which have a ¼in. hole in each, to admit of the movement in any direction of a small platinum wire, which passes through the sphere. On one end of the

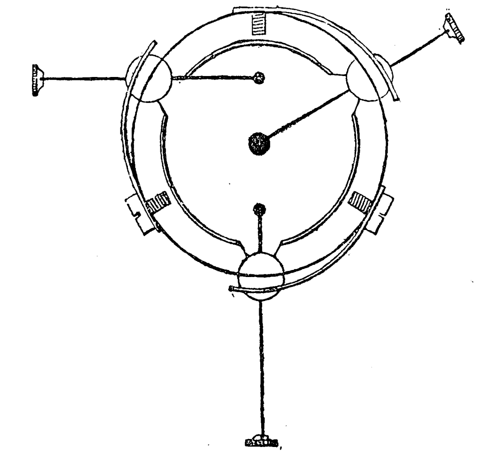


Fig. 1.

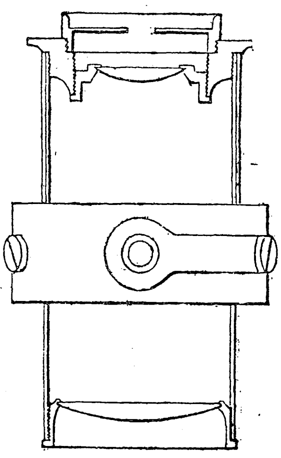


Fig. 2.

wire is a disc, and on the other a small button or handle. By these means the discs may be placed in any required position to eclipse the object, or they may be pushed to one side, so as to be entirely out of view; and when drawn back up to the ivory sphere the ring can be slipped off the tube, and the eyepiece is as it was, having only three holes in it corresponding to those in the ring. The centres of these holes are, of course, in the plane of the focus of the eye-lens, but the spheres allow of the discs being placed out of focus, which is sometimes of advantage. One disc would be quite enough for most work, but a spare one or two may be convenient occasionally, so I made mine with three discs slightly varying in size.

* From the *Monthly Notices* of the R.A.S.

ACTINIC CONTRAST IN PHOTO-MICROGRAPHY.

DR. G. A. PIERSOL considers that successful photo-micrography depends especially upon three conditions: (*a*) having all parts of the object exactly in the same plane; (*b*) having well marked differentiation between the elements of the tissues; and (*c*) having the object so stained and illuminated as to insure sufficient actinic contrast between it and the surrounding field or background.

The successful acquisition of the condition of actinic contrast is not always readily had. While the blue stainings (hæmatoxylin, methyl blue) are, of course, more actinically powerful than the reds and browns, yet so much depends upon the individual specimen, in regard to opacity and thickness, that each case must be determined for itself. While a thick section stained in carmine will yield but a dark mass without detail, a similar section stained in hæmatoxylin may furnish a satisfactory picture. But the days of thick sections are past; the question now is, How shall we stain and illuminate the thinnest possible section so as to yield good photographs?

While a very delicate section well stained with hæmatoxylin is all that can be desired for examination, we shall soon find that actually it is far too transparent to produce a vigorous photograph, there being insufficient actinic contrast between the general blue colour of the field illuminated by the blue monochromatic light from the ammoniacal sulphate of copper cell and the bluish-purple of the section. When the preparation of the section is under control, it will be found advantageous to prepare a few sections, as already suggested, by which the thinnest section in the brown colours always markedly impress the plate.

In many cases, however, it is inexpedient to specially prepare objects for photography. For such cases a very valuable adjunct will be found in the use of different coloured lights produced by tinted glasses carefully adjusted to the intensity and colour of the staining. The use of glass, or of solutions of colours, has long been employed in the arts in reproducing paintings. Koch in his "Traumatic and Infective Diseases" related his experience with this method, but condemns it as impracticable. On account of the length of exposure and vibration "the picture does not have sharpness of outline sufficient to enable it to be of use as a substitute for a drawing, or, indeed, even as evidence, of what one sees." Notwithstanding the unfavourable experience of this skilled investigator, some subsequent results by this methsd have been most encouraging. Defrenne obtained excellent photographs of the *Bacillus tuberculosis* by means of fuchsin staining and green glass; and quite recently the author's own experience with the same bacterium and stain have been very gratifying. Since then a number of modifications have been tried. As a result of the experiments the practical deductions have been reduced that when the staining and thickness of the specimens are insufficient to give the necessary actinic contrast with the colour of the field, we can best succeed by employing a coloured glass whose tint will be such as to give the contrast as well as to afford light to sufficiently impress the plate where not occupied by the object. Such a colour will not be the complementary one in many instances. With blue staining the use of complementary yellow would yield but a faint image, since the weak actinic power of the transmitted rays are insufficient to deeply affect the unoccupied portions of the field. The substitution, however, of a suitable shade of green affords sufficient contrast of the object as well as permits the passage of rays sufficiently actinically powerful to adequately impress the surrounding parts of the plate.

With all these colours the exposure is greatly lengthened; with a medium green it being five to seven times longer than with blue light; as, however, the normal exposure is seldom over one second, the increase has practically little disadvantage. Not only for very minute objects, as bacteria stained with methyl blue, under high powers, but equally for very thin hæmatoxylin or carmine sections under low amplification, has this green glass proved most useful. By its use it is always possible to obtain pictures where all the merits of vigorous negatives with the beautifully sharp details alone, procurable from the thinnest sections, are combined, and where the usual method yirlds but a weak image.

These suggestions apply specially to sunlight. To those engaged in such work who have never employed these means, the shades of green offer themselves as valuable modifications of illumination well worthy of a trial. The exact time required, a matter of importance, must be determined for existing conditions by each manipulator. Mr. J. W. Queen suggests a trial of the stained gelatine plates now coming into use for the purpose of securing contrast. The sensitiveness of the plates is much greater than usual, so that the time of exposure will be diminished instead of lengthened, and by using plates variously stained, suitable contrasts might be obtained with differently stained specimens.

Mr. R. Hitchcock also refers to the so-called ortho-chromatic, or iso-chromatic sensitive plates now sold, which may be found useful in photo-micrography; but it is well to consider that they differ from the plates mainly in their greater sensitiveness to the less refrangible rays, while they are scarcely less sensitive to the blue, which still preponderates. For this reason, in order to obtain strictly uniform results for all colours, coloured screens must be used, particularly when working with sunlight. The great advantsge of such plates rests in the fact that they are sensitive to the red and less refrangible rays, which do not at all, or only slightly, affect the ordinary plates.—*Jour. Roy. Mic. Soc.*

IT is stated by M. H. Dunville that if two glasses of water be placed, one upon the north pole of a powerful magnet, and the other upon the south pole, in four or five minutes the former acquires a slightly alkaline reaction, while that on the south pole becomes slightly acid!

DEPREZ'S GALVANOMETER.*

TO rivet scientific facts in the mind, study and practice must proceed together. This is especially true in electricity, where a multitude of conditions are imposed for every phase of the subject. No one can go very deeply in the study of electricity without reaching the subject of electrical measurements; certainly very little can be done in this direction without a galvanometer of some kind. Among all the galvanometers yet invented, there is, perhaps, none possessing all the good qualities of the one shown in the annexed engraving. It is very simple; the materials are inexpensive, no great mechanical skill is required in its construction; and its sensitiveness and accuracy are sufficient for the requirements of most electricians. Besides all this, it is perfectly "dead beat," so that no time need be wasted in waiting for the instrument to come to rest. This galvanometer is the invention of M. Deprez, of Paris, France. It consists essentially of a rectangular coil of fine wire, suspended on strained torsional wires in a strong magnetic field. To the base is secured, by means of angle plates, a compound U-magnet, 7in. high, formed of three steel magnets, one-quarter inch thick, secured together and to the angle plates by bolts. The distance between the inner faces of the poles of the magnet is $1\frac{7}{16}$in. Two and three-quarter inches behind the centre of the magnet a brass column rises from the base, and is provided near its centre with an adjustable brass arm, supporting at its outer end, and exactly in the centre of the space between the poles of the magnet, a hollow soft iron cylinder, $2\frac{1}{4}$in. long, $1\frac{1}{32}$in. external diameter, $\frac{13}{16}$in. in internal diameter. The top of this cylinder is even with the upper ends of the magnet. To the top of the brass column is secured, at right angles, an arm that extends over the hollow iron cylinder, and is provided with a vertical sleeve, in which is clamped a rod having on its lower end a small silver hook, arranged axially in line with the iron cylinder.

To a block attached to the base, opposite the centre of the magnet, is secured a tapering spring $\frac{1}{16}$in. thick and $3\frac{3}{4}$in. long, carrying at its free end a small silver hook, which is arranged in line with the axis of the iron cylinder. A rectangular coil of No. 40 silk-covered copper wire, large enough to swing freely over the iron cylinder, is suspended a hard-drawn No. 32 (0·008in. in diameter) silver wire from the hook above, and is connected by a similar wire with the hook on the spring below. The upper wire is $2\frac{1}{4}$in. long between its connections, the lower one $2\frac{3}{4}$in.

The sides of the rectangular coil are flat, being about $\frac{1}{8}$in. thick and $\frac{5}{16}$in. wide. The resistance of the coil is 150 ohms. The silver hooks are connected with the opposite ends of the coil, in the manner shown in Figs. 2 and 4. Each hook is provided with a flat head, which is secured between two thick plates of mica, the shank of the hook projecting through a hole in the outer mica plate. Each pair of mica plates is secured in place on the coil by a winding of silk, which is coated with shellac varnish to prevent the plates from slipping. The hooks are arranged exactly in the middle of the ends of the coil, so that when the coil is supported in the position of use by the silver wires it will oscillate freely between the poles of the magnet and the iron cylinder. The terminals of the coil are soldered to the silver hooks. The upper hook is made a little more than a half-inch long, to receive a small concave mirror (as shown in Fig. 4), which is secured in place by cement or wax. The mirror has a focus of 30 or 36in. The relation of the magnet A, the coil C, and the iron cylinder B, are clearly shown in Fig. 3, which is a horizontal section taken through those parts.

A glass shade protects the delicate parts of the instrument. The two binding posts which are outside of the glass shade are connected under the base with the brass column and the spring, so that the current passes from one binding post to the column, thence down the upper silver wire, then through the coil, the lower silver wire, and the spring to the other binding post. The silver wires are placed under considerable tension, and the coil is adjusted to a central position by turning the hooked rod at the top of the instrument.

When an electrical current is sent through the coil, it tends to assume a position at right angles with a line joining the two poles of the magnet, the amount of displacement of the coil from its normal position depending on the strength of the current. As the deflection for a very light current is small, a beam of light reflected from the concave mirror is employed as an index. The scale is arranged as shown in Fig. 1, the light being projected from a lamp, supported at the proper height behind the scale, through a slit below the scale and on to the concave mirror. The mirror reflects the beam on to the scale. The mark at the centre of the scale is 0, and arbitrary numbers, running upwards regularly, are arranged on the marks on opposite sides of 0. The common paper scale used by draughtsmen answers for this purpose.

* By GEO. M. HOPKINS, in the *Scientific American.*

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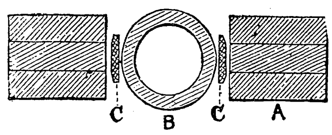
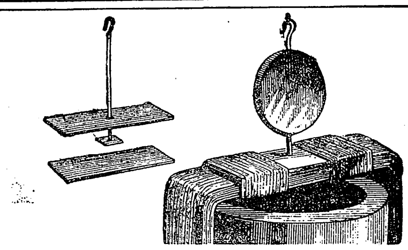
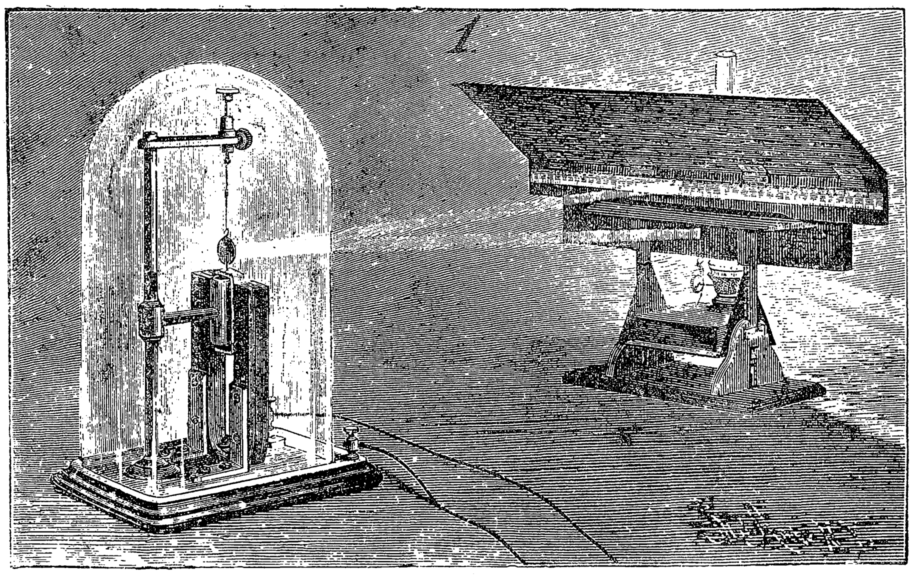






When the coil is at rest, the light spot remains at the centre of the scale; but when a current passes through the coil, the beam moves steadily forward and stops without oscillation, the distance through which it moves depending, of course, on the strength of the current. The coil is returned to its normal position by the spring of the silver wires. By employing shunts in the usual way, heavy currents may be measured by the aid of this instrument. The sensitiveness of the instrument is so great as to indicate a current when the ends of two No. 18 copper wires connected with it are placed on opposite sides of the tongue.

The coil is carefully wound over a form covered with paper, each layer of wire being varnished with shellac varnish as the work of winding progresses. When the coil is complete, the coil, together with the form, is heated in a warm oven until its varnish becomes hard throughout the coil. The concave mirror may be purchased from the optician, or a very fair mirror may be made by cutting a small disc from a double convex spectacle lens of 60 or 70in. focus, and silvering it. A simple and quick way of silvering a small surface consists in scraping from the back of a piece of ordinary looking glass all of the silvering, except a patch of the size of the mirror to be silvered. A small drop of mercury placed on the patch soon loosens it, so that it may be slid from the glass and transferred to the disc. The disc must be perfectly clean. After the patch is in position on the disc a piece of tinfoil is placed on the back of the disc, pressed down firmly, and allowed to remain long enough to absorb all the surplus mercury. It is then removed, and the transferred silver will be found adhering strongly to the disc. The various dimensions above given are taken from an almost exact copy of a Deprez galvanometer made by Carpentier, of Paris. The copy operates admirably. It is probable, however, that a considerable deviation from these dimensions might be made without seriously affecting the value of the instrument.

CASTING ALUMINIUM BRONZE AND OTHER STRONG METALS.*

THE difficulties which beset the casting of aluminium bronze are, in some respects, similar to those which were encountered in perfecting methods for casting steel. There is much small work which can be successfully cast by methods used in the ordinary mouldings of cast-iron; but in peculiarly proportioned, and in large bronze castings, other means and extra display of skill and judgment will be generally required. In strong metals there appears to be a "red shortness" or degree of temperature, after it becomes solidified, at which it may be torn apart, if it meets a very little resistance to its contraction, and the separation may be such as cannot be detected by the eye, but will be made known only when pressure is put upon the casting. To overcome this evil, and to make allowances for sufficient freedom in contraction, much judgment will often be required, and different modes must be adopted to suit varying conditions. One factor often met with is that of the incompressibility of cores or parts forming the interior portion of castings, while another is the resistance which flanges, &c., upon an exterior surface, oppose to freedom of contraction of the mass. An illustrative case, which the writer had to deal with, was the casting of some blast-furnace tuyeres, the dimensions of which were about 12in. diameter at the small end, and 14in. diameter at the large, and 17in. long. These tuyeres were made hollow for the passage of water to keep them cool when the furnace was in blast. The core to form this hollow space was one which foundrymen would term a "mean core" to make and to use, and the stronger it could be made by means of the mixture of the sand, the easier would it be to make and to handle. But it was proved at the hydraulic testing of the first casting that these conditions were the worst for causing leakage. It was found that in order to procure a casting which would not leak, the core must be "rotten" and of a yielding character. This was obtained by using rosin in coarse sand and filling the core as full of cinders and large vent-holes as possible, and by not using any core-rods or irons. The rosin would cause the core, when heated, to become soft, and would make it very nearly as compressible as a "green sand" core, when the pressure of the contraction of the metal would come upon it. It might be well to state that the size of this core was such as would leave 1in. thickness at each end, and one $\frac{1}{2}$in. at the inner and outer sides of the casting, and was all surrounded with metal, excepting four 1in. round openings through which the core delivered its vent or gas. By means of dried resin or green-sand cores we were able to meet almost any difficulties which might arise in ordinary work from the evils of contraction, so far as cores were concerned. For large cylinders or castings which might require large round cores, which could be "swept," a hay-rope wound around a core barrel would often prove an excellent yielding backing, and allow freedom for contraction sufficient to insure no rents or invisible strain in the body of the casting. To provide means for freedom in the contraction of exterior portions of castings which may be supposed to offer resistance sufficient to cause an injury, different methods will have to be employed in almost every new form of such patterns. It may be that conditions will permit the mould to be of a sufficient yielding character, and again it may be necessary to dig away portions of the mould, or loosen bolts, &c., as soon as the liquid metal is thought to have solidified. In any metal there may be invisible rents or

* By THOMAS D. WEST, extracted from a paper read before the New York Meeting of Mechanical Engineers.

strains left in a casting through tension when cooling sufficient to make it fragile or to crack of its own accord, and it is an element which, from its very deceptive nature, should command the closest attention of all interested in the construction of castings.

Like contraction, the element of shrinkage is one often found seriously to impede the attaining of perfect castings from strong metals. In steel castings much labour has to be expended in providing risers sufficient to "feed solid" or prevent "draw-holes" from being formed, and in casting aluminium bronze a similar necessity is found. The only way to insure against the evils of shrinkage in this metal with work requiring "risers" or "feeding heads" was to have them larger than the body or part of the casting which they were intended to "feed." The "feeder" or "riser" being the largest body, it will, of course, remain fluid longer than the casting, and as in cast iron, that part which solidifies first will draw from the nearest uppermost fluid body, and thus leave holes in the part which remains longest fluid. The above principle will be seen to be effective in obtaining the end sought. It is to be remembered that it is not practical to "churn" this bronze, as is done with cast iron. A long cast-iron roll, 1ft. in diameter, can by means of a "feeder" 5in. in diameter and ½in. wrought-iron rod, be made perfectly sound for its full length. To cast such a solid in bronze the feeding head should be at least as large as the diameter of the roll, and in length about one-quarter longer than the length of roll desired. The extra length would contain the shrinkage hole, and when cut off a solid casting would be left. This is a plan often practised in the making of guns, &c., in cast iron, and is done partly to insure against the inability of many moulders to "feed" solid, and to save that labour. There is nothing in the way to prevent obtaining large guns of aluminium bronze as perfect as are made of cast iron. It is simply a question of having enough "riser" or "feeding head," and such guns would surpass in strength any other metal now used in their manufacture.

A method which the writer found to work well in assisting to avoid shrinkage in ordinary castings in aluminium bronze, was to "gate" a mould so that it could be filled or poured as quickly as possible, and to have the metal as dull as it would flow, to warrant a full-run clean casting. By this plan very disproportionate castings were made without "feeders" on the heavier parts, and upon which "draw" or shrinkage holes would surely have appeared, had the metal been poured "hot."

The plan or principle adopted in pouring this bronze is similar to that employed for casting steel, which, as is well known, consists in pouring through a spout controlled by a valve, which lets the metal flow from the bottom of a ladle instead of the top or lip, as practised in pouring cast iron. The exact plan which the writer used for castings weighing over 50lb., was to make the pouring basin sufficiently large to contain all the metal necessary to fill the mould, and give any surplus which might be required for a "flow-off," or to fill up "feeding-heads," &c., and so to prevent any metal from flowing into the mould until it was all in the pouring basin. The entrance of the gate would be stopped by means of an iron plug, and the moment all was ready it would be pulled, and the metal would almost instantly fill the mould, so large would its gates be made. By such a plan it will, of course, be readily seen that there was no danger of any "scum" or oxide entering the mould, an element which would seriously mar the appearance of a casting. Besides the difficulties from difference in the colour which resembles gold, such oxide would be very liable to cause a disunion of the particles of the body, or make an unacceptable surface when the casting was finished up. The metal itself is one that works well in our ordinary moulding sands, and "peels" extra well. As a general thing, disproportionate castings weighing over 100lb. are best made in "dry" instead of "green" sand moulds, as such will permit of cleaner work and a duller pouring of the metal, for in this method there is not that dampness which is given off from green sand mould, and which is so liable to cause "cold shuts." When the position of casting work will permit, many forms which are proportionate in thickness can be well made in green sand by coating the surface of the moulds and gates with silver, lead, or plumbago.

From "blow holes," which are another characteristic element likely to exist in strong metals, it can be said that aluminium bronze is free. Should any exist, it is the fault of the moulder or his mould, as the metal itself runs in iron moulds as sound and close as gold. Sand moulds to procure good work must be well vented, and if of "dry sand," thoroughly open sand mixture should be used and well dried. The sand for "green sand" work is best fine, similar to what will work well for brass castings. For "dry sand" work, the mixture should be as open in nature as possible, and for blacking the mould, use the same mixtures as are found to work well with cast iron.

The different problems for making strong metal castings all present peculiarities which call for special treatment in the manner of moulding, &c.; but the difficulties to be overcome mainly hinge more or less upon one or other of the three elements, oxidation, shrinkage, or contraction. These are being controlled better every day, and progress is made by which almost any kind of casting can be procured as readily as of cast iron. With aluminium bronze, "Mitis," and steel castings to be had, the engineer should not want for strong metals to meet almost any conditions.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday evening, the 15th inst., at the Institution of Civil Engineers, Mr. W. Ellis, F.R.A.S., president, in the chair. Mr. G. R. Fancombe, B.A., Mr. C. E. B. Hewitt, B.A., and Capt. S. Trott were balloted for and duly elected Fellows of the Society.

The following papers were read:—

1. "On the Proceedings of the International Congress of Hydrology and Climatology at Biarritz," by Mr. G. J. Symons, F.R.S. This congress was held in October, and was divided into three sections—viz., scientific hydrology, medical hydrology, and climatology, scientific and medical. The total number of papers read was 109. An exhibition was also held in connection with the congress. The excursions were of primary importance to the medical men, and extended over a period of three weeks. The places visited were—Bayonne, Cambo, Dax, Arcachon, Pau, Eaux-Bonnes, Eaux Chaude, Cauterets, Lourdes, Bagnères de Bigorre, Luchon, Ussat, Ax, Montpellier, Cette, Boulou, Amelie des Bains, La Preste, Banyulo-sur-Mer, and Thues.

2. "Report on the Phenological Observations for 1886," by the Rev. T. A. Preston, M.A., F.R.Met.Soc. The weather was, on the whole, very ungenial, and everything much retarded. It was also very fatal to insect life, so that the complaints on this head have been far less than usual. Bush fruits were very abundant, strawberries and peas were spoilt by drought, in many places, stone fruits, except plums, were not abundant; plums were extraordinarily plentiful, so much so that they realised nothing in the markets, the cost of picking and carrying often being more than they realised. Apples were very poor, from the destruction of the bloom by heavy rain. Hay was good and plentiful, and well harvested. Corn and other grain were not up to an average. Root crops were, as a rule, remarkably good.

3. "A Criticism of Certain Points of Prof. Langley's Researches on Solar Heat," by Prof. S. A. Hill, B.Sc., F.R.Met.Soc. These experiments were carried out at Mount Whitney, in Southern California during 1881.

4. "Account of the hurricane of March 3rd and 4th, 1886, over the Fiji Islands," by Mr. R. L. Holmes, F.R.Met. Soc. This storm was the most destructive that has ever been known to occur in the Fiji group. The lowest barometer reading was 27·54in. at Vuna, in Taviuni. The storm was accompanied by a great wave, from 18ft. to 30ft. in height, which swept over the land, and caused an immense amount of damage. It was reported that 50 vessels were wrecked, and 64 lives lost during this hurricane.

5. "Results of Meteorological Observations made at the Military Cemetery, Scutari, Constantinople, 1866-85," by Mr. W. H. Lyne. The annual mean temperature is 58·4°; the highest temperature registered was 103·6° on June 22nd; and the lowest 13·0° on January 25th, both in 1869. The annual rainfall is 29·29in.; the greatest fall in one day was 4·06in. on Sept. 25th, 1866.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE usual monthly meeting was held on Monday, the 13th December. The chair was taken by Mr. H. Hudson. Thirty-three members were elected and 25 candidates proposed, and Messrs. W. Thynne Lynn, B.A., F.R.A.S., and Herbert Sadler, F.R.A.S., were elected Associates of the Society. Mr. Herbert Sadler, in commenting upon a former paper on the masses and distances of binary stars, complimented Mr. Gore on the care and accuracy of his computations; but took exception to the data on which they were founded. Amateurs were too apt to accept such results as absolutely proved, whereas they were, in reality, matters of much uncertainty. The celebrated star 61 Cygni was a case in point, for, although numerous measures of the orbit had been obtained, they were not at the present time sure that it was a binary at all. The calculations of the Astronomer Royal for Ireland gave a parallax of 0·467″ for 61² Cygni; whilst Prof. Asaph Hall, by precisely the same method, obtained a final result of 0·270″. The former would give a light passage of less than 7 years; but if they accepted the figures of the American astronomer, it would take more than 12 years. He merely gave this as an example of the uncertainty which attended such investigations.

Mr. W. S. Franks, F.R.A.S., commended the study of coloured stars as in every way suited to beginners with small telescopes. To the amateur in astronomy, what could be more pleasing than to contemplate the colours of those gems of the midnight sky? The hidden meaning of the colours was in itself a theme for wonder; since, why should the richest tints of blue, green, and violet be confined to the companions of double stars? That they were not an effect of contrast could easily be proved by occulting the brighter star. The bluest of isolated stars was Vega, which many would not consider blue at all, and the greenest was β Libræ; but it was only when they came to such stars as β Cygni, γ Andromedæ, and others that the most gorgeous colours were obtained.

In a paper on "The Quadrantid Meteors," Mr. T. W. Backhouse said the ensuing shower would occur under fairly favourable circumstances on the 2nd of January, though, as the maximum would take place in daylight, observers in this longitude would not be fortunately situated. Next to the August Perseids the New Year's display of Quadrantids with their billiant, streaked appearance, was the most striking. Their time of maximum was, however, shorter than most periodical displays, and this rendered an exact calculation of their period important. Mr. W. F. Denning, F.R.A.S., attributed a special value to the notes of Mr. Backhouse. His table of results for last January proved the shower to have been decidedly conspicuous, though it could not be seen to any advantage at Bristol. On January the 2nd, he had watched the sky whenever a break in the clouds permitted, and had counted 17 shooting stars, of which only four were Quadrantids. Of course this was under unfavourable conditions; and Mr. Backhouse's results afforded clear evidence that it was a fairly bright display. He had determined the radiant at 228° + 52; but the paths had been too few to obtain a reliable average. The mean point of divergence from a considerable number of radiants by other observers gave 230·5° + 51·3°.

A paper by Mr. J. E. Gore, F.R.A.S., was read on some suspected variables of the Algol type. This class of variable stars was a very rare one, only seven having been detected. They were in order of Right Ascension:—

Star.	D. Period.	Variation.
U Cephei	2·49132	7·2 to 9·1—9·4
β Persei (Algol)	2·86727	2·2 „ 3·7
λ Tauri	3·952	3·4 „ 4·2
S Cancri	9, 11h. 37·75m.	8·2 „ 9·8—11·7
δ Libræ...........	2, 7h. 51m. 20s.	4·9 „ 6·1
U Coronæ.........	3, 10h. 51m. 14s.	7·6 „ 8·8
U Ophiuchi	0, 20h. 7m. 41s.	6·0 „ 6·7

Owing to the fact that in these remarkable variables all the light variations took place in the course of a few hours, whilst for the remainder of the period it remained constant, it would be seen that the discovery of this class was a matter of great difficulty, and this would, he thought, account for the paucity of such stars amongst the many thousands known to astronomers.

Mr. T. G. Elger, F.R.A.S., in a third paper on "The Moon Surveyed in Common Telescopes," dealt with Gassendi and the eastern side of the Mare Humorum, and described in detail the various points of interest which might be observed with very moderate telescopic means. The remarkable peculiarities of Gassendi itself; its low and attenuated state on the south-east, and the degradation of a great portion of its northern wall were well worthy of scrutiny. The complicated structure of the magnificent central mountains—which had been compared by the late Prof. Phillips to an associated group of dolomitic or trachytic rocks—together with points of interest in the neighbourhood, were illustrated by a number of autographed sketches, which the members were advised to compare with the actual appearance in their own telescopes. A paper on the present and future of celestial photography by Monsieur Lihou was also read, and Mr. W. F. Denning contributed the third series of his valuable papers on "Telescopes and Telescopic Work."

ROYAL MICROSCOPICAL SOCIETY.

THE third meeting of the session was held on the 8th inst. at King's College, Dr. Dallinger, F.R.S., the president, in the chair.

Mr. Crisp read a letter received from Mr. Durkee, the designer of the electric lamp which was described and figured in the December number of

the *Journal* (p. 1053), and there stated to have been "received anonymously from America." The letter explained that a full description had been sent by the same mail as the lamp, but it had miscarried, and the letter now to hand unfortunately did not arrive in time for the explanation to be inserted in the *Journal* with the description.

Mr. J. Mayall, jun., said that Mr. Crisp at their last meeting had pointed out that if microscopes were to be made for every special purpose for which they could be used, there would be a large field open, and he had to introduce to their notice that evening another of this class. It had been designed to measure with great accuracy the divisions ruled upon a diffraction plate, which was about the severest test that could be applied to any method of dividing fine lines. The microscope upon the table had been constructed with great care by Mr. Hilger after the designs of Sir Archibald Campbell, and was capable of executing measurements over a space of nearly 6in. The diffraction plates with which they had hitherto been familiar only occupied a space of about 1in.; but he believed Sir Archibald had devised a ruling machine which would be able to rule to 6in. The instrument was extremely firmly made, having a massive stand of iron carrying a heavy bar on which the microscope traversed. Motion was imparted to it by means of a screw cut with 100 threads to the inch, and a series of verniers enabled the observer to read down to the $\frac{1}{100000}$in. For strictly end measurements an application of electricity was employed, so that by means of a weak battery and a galvanometer it could be arranged that a contact should be made when passing every line, such contact being shown instantly by a deflection of the galvanometer needle. In this way end measurements could be made with great accuracy. The first time he saw this apparatus he felt that, as there was no fine adjustment, it was hardly available for high powers, and it seemed to him that if comparatively low powers only were used, the accuracy of the results might be likely to suffer, because a person could hardly tell if he was looking at the middle of a line or not. He pointed out this want to Sir Arch. Campbell, who had since devised a fine adjustment for the purpose, of a somewhat original form, consisting of two tubes one inside the other, fitted with a collar having a thread cut upon it, and moved by a tangent screw. One objection to a tangent screw was that there was always loss of "time" in using it; but in the case before them the work, as carried out by Mr. Hilger, was so true that no objection of this kind was experienced, and the motion obtained was so exceedingly slow that several turns had to be made before any motion could be appreciated under a $\frac{1}{8}$in. objective. He had particularly emphasised the necessity for a very slow motion, because he thought that most of those usually made were too fast, and this new one was the slowest he had ever seen. Another ingenious arrangement, devised by Sir Archibald, was a method of illuminating the object from above by a mirror made of speculum metal, held by a horizontal arm, and fitted with condensers with screw motions to direct the illumination. He felt bound to say that the trials he had made with these gave him the impression that they were rather too coarse for such fine work as it might be required to perform. Certainly, with a power as high as $\frac{1}{12}$in., it would not be possible to manipulate an apparatus of this kind which necessitated having to touch the microscope. All such arrangements should be separate from the instrument, otherwise it would be impossible to prevent very inconvenient tremors. He did not think this method of illumination so good as that devised by the late Mr. Tolles, in which a prism was inserted behind the front lens of the objective, though for low powers it might do very well.

Mr. Mayall also exhibited and described a new form of heliostat, also made by Mr. Hilger, for use in solar photo-micrography, consisting of a plane mirror equatorially mounted and rotated by a clockwork movement; but also having a second mirror mounted upon a universal joint attached to the polar axis so as to admit of motion in any direction. The pencil of sunlight reflected from the first mirror could, by means of the second, be directed in any desired direction, affording to the worker the very great advantage of being able to place his microscope and camera in any position he pleased. When properly adjusted, with the polar axis parallel to that of the earth, the clockwork would enable the reflected beam to preserve the same direction for about six hours.

Mr. F. R. Cheshire exhibited and described an improved form of inoculating-needle for use in connection with bacterium culture tubes. It was well known that the usual plan was to have a platinum wire fused into the end of a piece of glass rod, which served as a handle; needles of this kind had the merit of being easily made, and being also inexpensive. The one he exhibited cost rather more, but possessed sundry advantages which he thought might compensate for the extra outlay. It was mounted in a wooden handle having a square ferrule which prevented it from rolling when placed upon a surface which was not level; in this was inserted a piece of very small silver tube, at the end of which was the platinum wire. On the tube a circular disc of silver was fixed, which, when placed over the flame of a lamp, rapidly became hot, and communicated the heat to the needle—silver being a very good conductor of heat. The silver tube, being very much less thick than the glass rod, could more easily be introduced without coming into contact with the sides of the glass tube; but a much greater advantage than this also arose from its comparatively small size. The diameter of the ordinary culture-tubes was generally about $\frac{1}{2}$in., whilst that of the glass rods was about $\frac{1}{4}$in. On introducing the needle therefore the glass rod displaced a large quantity of air from the tube, and on its withdrawal the in-draught would cause a quantity of outside air to pass in, and in this way impurities might be admitted, whereas, owing to the small size of the silver tube the displacement of air by it was extremely small. He also thought that there might be less danger to the operator in the use of the new pattern, because the needle perhaps charged with anthrax could not come in contact with the table at all if laid down upon it. It would also be found more convenient to use it in cases where it was desired to separate the different forms in a colony. In order to keep these needles intact, they could readily be inserted into small pieces of glass tube, and when thus placed in a case they could be carried about with great facility.

Mr. E. M. Crookshank thought this kind of needle might be found very useful in some cases, but he fancied that most bacteriologists would prefer to have the ordinary kind with the platinum wire simply fixed in the end of a glass rod by holding over a Bunsen burner. As regarded the suggestion that there might be danger from anthrax getting upon the operating table by the use of the ordinary glass rod, he pointed out that in practice it should be made a constant habit always to sterilise a needle after use by passing it at once through the flame without putting it down.

Prof. Bell called attention to some specimens exhibited of *Tænia nana*, the smallest of the human tape-worms, originally found by Bilharz in Egypt in 1850. Though extremely rare, it had the great advantage to the physiologist at least (though perhaps not to the patient) of being found in considerable numbers. In the present instance the worms had been found in quantities in the duodenum of a girl aged seven years, at Bellegarde. The latest specimen met with was only 15mm. long. Prof. Bell further referred to the observations of Leuckhart on the subject.

Mr. J. D. Hardy called attention to a statement by Dr. O. Zacharias in the October number of the *Journal* (p. 799) with reference to the desiccation of rotifers, and in which it was stated that they could never be revived after desiccation. He thought a protest should be entered against this, as it was within his knowledge that "revivification" had taken place over and over again. He had frequently tried the experiment, and had found that when the dried mud was moistened the rotifers constantly revived.

Mr. Crisp, having read the paragraph referred to by Mr. Hardy, and also a paragraph bearing upon the subject from the December number of the *Journal*, p. 989, said that, as intimated in every number, the society did not hold themselves responsible for the views of the authors of the papers noted, the object being to present a summary of them "as actually published." With regard to the merits of the question, if a few minutes after the moistening they found the adult forms moving about, it must be obvious that they could not have come from eggs, as stated by Dr. Zacharias.

Prof. Stewart pointed out that a good deal must turn on what was meant by "desiccation." It was exceedingly difficult, under ordinary circumstances, to produce a condition of complete desiccation, and it was, therefore, very probable that in all cases of revivification there was sufficient moisture retained to preserve life.

Mr. A. D. Michael agreed in Prof. Stewart's view. That rotifers did apparently revive after desiccation was perfectly clear, and if a full-grown rotifer was revived in the manner stated, it was strange how anyone could be found to suppose that it had come direct from the egg. He did not see any great difficulty in freely accepting the idea that the rotifers which revived had not really been absolutely desiccated. It was quite likely that they became covered with a coating of hardened mucus which prevented them from altogether drying up.

Prof. Bell said that this explanation had usually been accepted as the real one when this subject perennially came to the front. The most curious part of Dr. Zacharias' paper, however, was that he did not in any way attempt to criticise the observations of his predecessors on the facts, but simply declared them to be fables, not inquiring at all into the conditions under which the revivals took place, so as to ascertain whether or not they were desiccated in the same sense in which his objects were when dried up in a granite basin. Prof. Bell also read from Dr. Hudson's and Mr. Gosse's "Rotifera" the paragraphs relating to the desiccation of rotifers (pp. 95, 96), in the course of which the observations of Mr. Davis, recorded in a paper read before the society in 1873, were quoted.

Mr. R. T. Lewis said he remembered that on the occasion when Mr. Davis read his paper upon the subject, he brought to the meeting by way of illustration some grapes which he had coated with gelatin, and had afterwards exposed for many hours to the dry heat of a slow oven. On being cut open in the room the fruit was found to be in a perfectly natural condition, showing that a gelatinous coating was competent to preserve the contained moisture from evaporation.

The President said he thought the question was practically settled so far as the judgment of microscopists was concerned.

Col. O'Hara's note on the dissimilarity of appearance of crystals of blood as examined by him and the illustrations in textbooks was read by Prof. Bell.

Mr. P. H. Gosse's paper "On Twenty-Four New Species of Rotifera" was read by Mr. Crisp, and two plates drawn by Mr. Gosse in illustration were handed round for inspection.

The President said that those who had seen the drawings could hardly fail to be struck with the touch of them, especially when they considered the age of Mr. Gosse. In returning their thanks to the author he could only say that they were proud —he used the word advisedly—to have the paper.

Borated Fish.—The question to decide in connection with the employment of boracic acid as a preservative of fish is not the economic or the commercial one. The point is whether the use of boracic acid is calculated to deteriorate the fish as an article of food, or to cause derangement, not to say disease, in the human economy. Nothing short of the experimental method will afford a decisive and accurate conclusion. But we tread on safe ground when we assert that fish perfectly fresh and kept no longer after its removal from the watery element than is absolutely unavoidable, must be considered to be a better article for consumption and less liable to effect harmful changes in the organism than any kind of borated substitute. However, if fish must be preserved, are there any known facts that should recommend the employment of boracic acid? It is a good antiseptic, and will undoubtedly prevent putrefaction if used in sufficient quantity. Does it cause disease when introduced into the healthy human body in minute doses and for long periods? It certainly is of value internally administered in some morbid conditions of the stomach and intestines. For the last question we have no certain data on which to give a satisfactory answer. But we should think that, if used accasionally and in very small quantities, the acid would probably not prove injurious to the health of the animal organism. It may be urged that washing, boiling, or cooking would free the fish from any boracic acid that might have penetrated into its substance; but probably some of the salt would remain in the fish. The salicylage of beer is a more wholesale saturation, both of beer and consumer of beer, but so far as can be judged *a priori*, the use of boracic acid to preserve fish, though not desirable, would, with proper precautions, not prove harmful.—*Lancet*.

"St. Govor's Well," Hyde Park.—Near the bottom of Broad-walk, Kensington Gardens, and about a hundred yards below the Round Pond, is situated a sunken well bearing the inscription "St. Govor's Well, 1856." A few years ago the water, which issued in a considerable stream from a leaden spout, was credited with medicinal virtues and was distributed to children and curious people in many coloured glasses by an old woman who attended daily. We have heard of the beneficial action of the waters on crippled joints. Since the woman disappeared (from over-indulgence in the waters?) a metal cup has been attached to the spout, and the well has been the constant resort of thirsty children and nursery maids. During the past summer, while the Round Pond has been drained St. Govor's Well has run dry, and it is said that some pipes were discovered under the two or three feet of stinking mud at the bottom of the pond which had the appearance of communicating directly with the well, so that it seems probable that the water has been filtered through the mud, and not through the intervening bed of gravel. Can its reputed medicinal virtues be due to the organic impurities of stagnant water? It is to be hoped that the source of the water will be fully investigated, and, if it is found to be the mere drainage of the pond, that the well will be closed, or else that a supply of pure water will be laid on from a known source. The well would be very much missed by the children, as there is no other drinking fountain in the gardens.—*British Medical Journal.*

SCIENTIFIC NEWS.

THE death is announced of Dr. Robert Dyer Lyons, a well-known Irish physician, chief pathological commissioner to the army in the Crimea, and author of several works on medical subjects.

The death of Father Scortechini is announced from Calcutta, his exertions in the botanical exploration of Perak having brought on an attack of dysentery. He had made large and valuable collections, which will be utilised at Kew in perfecting portions of the flora of British India.

Members of the Geologists' Association will recollect that, at the time of his death, Prof. Morris had made considerable progress with a new edition of his "Catalogue of British Fossils," and they will be glad to hear that a relative has made arrangements for the revision and completion of the MS. and guaranteed the expenses of putting it through the press, as the best monument to the memory of the enthusiastic and accomplished geologist. Dr. H. Woodward will act as editor in chief, assisted by a number of specialists, and the syndics of the Cambridge University Press have undertaken the publication of the work, which will probably appear in the course of 1887.

At one of the science lectures recently delivered at the Royal Victoria Hall, Prof. Boyd Dawkins spoke on the subject of the introduction of the arts into Britain. He began by calling attention to the fact that things were not always as they are now, but our surroundings were entirely due to the labours of those who had gone before us; and he carried the audience back through the many intervening ages between us and our primeval ancestors, that he might show them who those ancestors were and for what we were indebted to them. In a number of magic-lantern slides were then successively displayed the implements in use among the men of the neolithic age, the mines they dug, their dwellings, the articles found in their dwellings, the various kinds of grain grown, the domesticated animals, and the tombs and skeletons. Prof. Dawkins explained the history attaching to all these objects, and the results accruing from them, and then proceeded to illustrate by similar views the life of man in the bronze age, showing how it finally led to the iron age, and concluded by asking his hearers to realise that their present life was the direct outcome of those stages of development which had been represented to them, and so to feel that it was the duty of each one to do something which would add to the good of mankind, and raise man even higher than he was at present. The penny science lectures will not be continued until after the Christmas holidays, the next being on January 25, when Mr. Arthur Stradling will lecture upon "Snakes and Snake-Charming," and bring with him 40 living illustrations.

At the distribution of prizes, &c., at the Liverpool Institute last week, Dr. B. W. Richardson gave an address on "Natural Selection for Science or for Art," in the course of which he said that the time had now come when all students should determine by their own investigations into their characters in which direction their studies should go, so as to lead them onwards in the course of life that was best adapted to them. It seems to Dr. Richardson that the block which has been put in the way of human progress by the ignorant transposition of living science into living art, and the reverse, can never be known until the folly of the transposition is seen in the astounding results that will follow upon the reformation of the false and blind system which now exists of letting expediency instead of fitness decide the fate of the student in his early days, and of allowing the sharpness of competitive examinations to drive the student, hopelessly, into a career for which there has been no test whatsoever either of aptitude or affection. Newton, he said, was the greatest man of science who ever lived, and Turner was the greatest painter of his kind; but Newton probably knew as much of art as Turner did of science. Neither of them had time to learn much beyond his own pursuits; and yet he cannot but believe that even those concentrate minds were improved if sometimes they left their own labour to find rest by change into other and kindred spheres. Certainly, in many great works, by the combination of science with art, the noblest results have been obtained.

The Council of the Society of Arts have offered to award two gold medals and four silver medals for prime movers suitable for electric light installations. The conditions, which can be obtained from the secretary, specify that the motors shall be divided into two classes, to each of which one gold and two silver medals will be awarded. These classes are, briefly, "Motors in which the working agent is also produced"; and "Motors to which the working agent must be supplied." The engines and boilers must be fitted up in accordance with the regulations of the Royal Agricultural Society, and an entrance fee of 50s. per H.P. must be paid on entry. Entries must be sent in not later than Feb. 28th next, and the competition will take place in London next May or June.

The statement that an "electrical metronome" has been established at the Paris Opera-House, enabling the leader to conduct choruses at any distance from his chair, appears to be based on the fact that M. Carpentier has exhibited to the Paris Academy of Sciences an appliance which answers the purpose. The instrument is a simple black plate, with grooves in the form of the letter V, in which a small rod is placed and connected with an electric current. The rod is half white and half black. When the conductor presses a button the rod turns regularly round and round, presenting alternately the black and white face, so as to give the optical illusion of a white pendulum, which moves across the black plate in rhythmical measure.

According to the *Times*, a new storage battery has been devised with which "it would appear to be possible and easy to carry out isolated electric lighting efficiently and economically." Each cell is contained in a wood casing measuring 11in. long by 6in. wide and 7in. deep. The whole weighs 20lb. and has a capacity of 115 ampère hours. Each cell contains six anodes and seven cathodes immersed in a solution of sulphuric acid. The negative plates are specially prepared, and are set into a very hard and durable substance possessing great porosity and conductivity. They will not only bear transport, but can be stored dry for use at any time. The conductor is so protected as to prevent its oxidation, thus avoiding loss of capacity by the buckling of the electrodes, and the active material cannot become detached or disintegrated. The cathode is spongy lead, and the whole constitutes a feeble primary battery. The plates are therefore removed from the cells, charged by a dynamo, and replaced for use. It is proposed to charge the plates at the company's works, to deliver them to the consumer, who will use them until they are exhausted and then send them to be recharged. The description rather strangely concludes, "The current produced can be used either for lighting, supplying motive power, working a telephone or electric bells."

A complete set of Prof. Ewing's apparatus for recording earthquakes is now being tested at University College, Dundee, previous to its being sent to the Observatory on Ben Nevis, where it is to be placed.

Electromotors and accumulators are to be tried by the Philadelphia Traction Company, which controls most of the street tramways in that city.

The Municipal Council of Paris has granted to the Committee of the Jubilee of Railways the free use of 900 acres of the most attractive portion of the Bois de Vincennes, including the lakes, and it is stated that the works will be commenced immediately.

Saccharine is stated to possess high antifermentative and antiseptic properties, and is recommended for administration to diabetics, as it passes through the organism unchanged, and can thus be used to render food palatable without itself exercising any deleterious effect. It is an excellent antiseptic in cases of indigestion caused by abnormal fermentation.

The council of an Italian Anti-rabies Society held at Milan, state that their investigations have enabled them to diagnose the presence of the virus of rabies in those bitten by dogs, and that they can apply, and have applied, Pasteur's method with results superior to those attained by the distinguished savant himself.

Cocaine has a rival in an alkaloid obtained in Australia from the juice of Euphorbia Drummondii, which Dr. John Reid, its discoverer, calls Drumine. The new local anæsthetic acts almost entirely by paralysing, and does not excite.

At a meeting of the Royal Scottish Society of Arts last week Dr. Sang read a description of a new mirror level, the invention of Mr. R. B. Pollitt, Manchester. The level consists of a pendulum and frame carrying an arrangement of plane mirrors showing accurately the relative position of the pendulum and the frame. The frame is similar in appearance to the ordinary striding spirit level, and carries an adjustable mirror, while the other mirror is rigidly attached to the pendulum, which is suspended on a knife edge and agate plate. The position of the mirrors is such that when the level stands on a perfectly horizontal plane they are parallel in every direction. In reading, the image of a vertical scale is reflected from the mirrors and read by a telescope. When the level stands on a horizontal plane the scale is reflected perfectly, otherwise the image appears distorted. It was claimed for the level that it gives advantages in reading small angles, and is not liable to deviations, as was the ordinary spirit level. In the discussion which followed, it was objected that the level appeared to be too delicately constructed to be serviceable for ordinary uses.

At the meeting of the San Francisco Microscopical Society on Nov. 10, Mr. Wickson stated that he had recently found insects on some laurel trees in the Experimental Gardens at the State University. At first sight they appeared to belong to the *Amphidæ*; but a closer inspection showed them to be neuropterous insects of the genus *Psocus*, which embraces some sixty species. They are very active in the larval and pupal stages, as well as in the perfect form. They live in groups, usually on the under side of the leaves. A microscopical examination shows them to have free mouthparts. The compound eyes are exquisitely beautiful, and many other points in their anatomy are of great interest.—At the meeting on Nov. 24th Mr. Wickson stated that the *Psocus* would not attack the scale insect. Specimens of an Australian Polyzoan, *Bicellaria ciliata*, were shown by Mr. Howard, who also exhibited an alga (*Trichodesmium* Sp.) found floating in immense quantities in the Pacific. It consists of rod-like filaments transversely striated, and of a light olive-green colour. The average length and diameter are respectively ·015 and ·0003 of an inch. One peculiarity of growth is that the filaments arrange themselves in bundles of about 25 to 50. This minute plant forms a considerable part of the food of the right whale, and it is, in fact, known to many mariners as "whale-feed." The process of spore formation does not seem to have been observed as yet.

THE use of intermittent light to indicate the speed of engines or other moving bodies has been proposed by M. Gustave Hermitte. His plan is to illumine a Giessler tube by the sparks of an induction bobbin, giving a constant and known rate of vibration per second, say, from thirty to forty, each vibration giving a corresponding flash of the Geissler tube. By optically arresting the moving objects at different points of their course, he proposes to obtain their speed. For example, if a disc of cardboard be made to revolve by clockwork at a uniform and known speed, say, one turn per second, and if it be lighted by the Giessler tube giving thirty flashes per second, we shall see the disc thirty times during one second, or, in other words, while it makes one revolution; and if there be a visible spot on its surface, thirty spots will be seen. If the disc turn ten times per second, the succession of images will disappear; owing to the persistence of impressions on the retina, the disc will appear to be immovable, and we shall see three spots on its circumference occupying fixed positions. If the number of turns of the disc is equal to the number of flashes of the tube the disc will be seen to be immovable. A printed page revolved in this way could be read as if it were fixed.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

DOUBLE STARS—U CYGNI—α ARIETIS—COMET f, 1886.

[26612.]—SINCE sending the results of my observations on U Cygni I have received some valuable information respecting this star from Mr. Sadler. By this it would appear that the star has been but seldom observed on the meridian, and therefore no definite statement can be made as to whether it has any proper motion or no.

The principal star of the pair is Arg. DM + 47°, 3077; but it was not observed with the Bonn Circle. From five observations in R.A., and four in Declination, made with the 6·4in. meridian circle at Dunsink, its place for 1875 would be 20h. 15m. 43·750s. + 47° 30′ 2·03″. The companion star, DM + 47° 3078, was called white by Dr. R. Copeland on July 25th, 1875, but blue on August 3rd in that year; it is certainly blue at the present time. The only micrometrical measures with which to compare my own are Sir Robert Ball's in 1880, who found Dist. 63·5″, P.A. 51·7°; a very close agreement in angle.

Barnard's Comet was observed here at 5h. 45m. on the 14th inst. shortly after sunset, with the 10½in. reflector, power 30. The nucleus appeared very bright, and was rated equal to a 3rd mag. star, but was ill defined, and higher powers showed no distinct stellar point; the surrounding nebulosity is nearly circular, and very bright. The two tails were well seen, the shorter being *preceding*, as described by Mr. Hopkins, while the principal tail (if such it can be called) was traced for about 10°, several small stars being visible through it. A rough setting of the position circle of the micrometer gave 43° as the angle contained by the two tails. The colour of the comet appeared greenish. The same evening I observed α Arietis, and rated the star (marked G on Mr. Gaudibert's drawing) at 11·3 Σ; it was readily visible in strong moonlight. I have examined this star with apertures up to 15in., and have never seen the slightest trace of any close companion.

Kenneth J. Tarrant.

Letchford House, Pinner, Dec. 16.

THE LUNAR RAY SYSTEMS.

[26613.]—The "Ray systems" are among the most important and interesting of lunar phenomena, and are far too little studied. They exhibit many peculiarities, and are among the strictly individual features presented to us by the moon. So far as we know they have no terrestrial analogues; and one of the most important branches of a study of them ought to be an inquiry to ascertain if none such can be found. Terrestrial analogues to lunar phenomena are too little sought for, though in point of fact they are among the most suggestive and instructive portions of the research: too many selenographers appear to forget that seleno*graphy* ought to be regarded mainly as a first step to seleno*logy*. These ray systems are among the most extensive of the lunar details, and are very widely distributed. Webb says they "issue, though in widely differing proportions, chiefly from seven different centres." He mentions the systems of Tycho, Proclus, Copernicus, Kepler, Byrgius, Euler, Anaxagoras, and Messier. Besides these, there are systems associated with Tobias Mayer, Thales, Aristarchus, Marius, Aristillus, Alfraganus, and Olbers. It is to be wished that a complete list of all the ray systems could be compiled. I have thought more than once, when libration was favourable, that portions of several great systems curve round from the invisible hemisphere, and can be traced at the edges of the visible disc. It is to be noted, that every opportunity which one gets of seeing the less ordinarily visible portions of the moon's surface—those brought into view by wide libration—indicates that their details and structure are precisely similar in character to those of the portions we usually see. It is not a suggestion altogether unreasonable, therefore, that were we to note these rays on the edges carefully, and observe their angles of divergence, we might be enabled to guess at the probable position of some of the great centres of past activity on the invisible hemisphere.

A little study soon shows that the ray systems differ in character, and Birt grouped them in three classes, and I think it is desirable that this classification should be generally adopted provisionally. No doubt, of course, it is always hazardous, and often inadvisable, to attempt at an early stage to systematise and classify; but the harm is only done when it is not clearly understood, and borne in mind, that such classification can only be regarded as provisional. However, a system founded upon types, rather than upon abstract definitions, has in it much more of a permanent character, and is often of extreme value in suggesting fresh ideas and observations. Birt's classification of the lunar ray systems was into Tychonic, Copernican, and the Messier rays. The last, however, are unique, so far as is definitely known; though I think a careful investigation would bring more instances to light. The "Tychonic" rays are those resembling the rays issuing from Tycho. These are narrow and definite, and quite distinct. The "Copernican," on the other hand, are those resembling the vast cloud of filmy light surrounding Copernicus. Their character is totally different, being that of a cloud-like, delicate, and inextricable, network. The two are generally separate, and the Tychonic is the commoner; but I do not know if Birt observed that they seem *sometimes* to be combined; at least, one of the rays from Proclus seems quite "Copernican" in character.

As to the observations required, they are good maps and accurate descriptions of the separate known systems, and a careful search for such smaller ones as may have escaped detection, and also a scrutiny of the rays referred to as coming round from the invisible hemisphere. It is to be noted, that some of the systems are by no means so conspicuous as they might otherwise be, inasmuch as they cross ground almost as bright as the rays themselves. This is the case, in part, with the Proclus system. A rather low power is best at first. It is, of course, best to observe them under a high illumination; but it is inaccurate to say, as is often said, that the rays disappear under a low one. It would be well to take note of the period of the lunar day when any given system becomes visible, and of the period when it disappears, and to extend the inquiry to individual rays of the system. The base from which each system starts ought also to be carefully studied. In the Tycho system, most, if not all, of the rays start from a bright ring inclosing a dark ring immediately encircling the crater. In that of Proclus, there is no complete concentric dark ring, but only an incomplete one on the western side. The rays here have several points of origin, from each of which issue several rays. In the Anaxagoras system there seems to be a combination of each of these ways. The rays seem in some cases mostly to lie on *one* side of the formation from which they start. Perhaps it would be more correct to say that they seem to avoid certain directions. Thus, in Proclus, the rays run S.W., W., N.W., and N., but none run E. So far as I have observed, the systems of Tycho, Proclus, Anaxagoras, Byrgius, Tobias Mayer, and Thales are "Tychonic"; those of Copernicus and Kepler, "Copernican." The connection between the rays and the lesser light-markings—the spots and the streaks—also deserves inquiry. I believe it will be discovered that the same association as has been found to exist between these latter, will be found to exist to a certain extent between the rays and some spots. Finally, I may point out that the relative brightnesses of the rays of any given system, and of their parts, ought to be watched, as they afford an excellent means of ascertaining data for the determination of the questions relating to the existence of a lunar atmosphere and an obscuring medium.

S. Maitland Baird Gemmill.

Glasgow.

A GOOD BATTERY.

[26614.]—I AM sorry that "Harry Frivoli" is disappointed at my withholding the working details of above, as asked for by "Peregrinus" and others; but he must bear in mind that such a result as I have obtained from my battery was not obtained without much work and expense, and it is only natural I should wish to be repaid for my labours. Although my battery was patented early this year, the crude idea only was claimed, which has during the past year been so much improved and altered that before I publish details other patents may be necessary to secure my rights. I must, therefore, ask all of "ours" who are interested in electrical matters to wait a little longer.

A syndicate is now being formed to undertake the commercial working, and very shortly I hope to exhibit an installation in London which will prove that this is not "another battery puff," full details of which shall be placed at our Editor's disposal as soon as possible; the scepticism created by unwarranted puffs—to use a mild term—having, I can assure you, been felt very forcibly in my efforts to obtain the necessary financial assistance. However, seeing is believing, and as that is the principle upon which I am working, I hope all sceptics will, in the end, be brought to believe in my statements, marvellous as they may appear.

Even "Nun. Dor." (61129) may believe that a battery may run for 70 hours with once charging, when I show him, as I can, a battery which shall, under his own observation, maintain a lamp for 120 hours with once charging, and which term shall be spread over 24 days of five hours per day if he likes.

Cato.

ORGAN SOUNDBOARDS.

[26615.]—YOUR correspondent, "N. H." is quite wrong in supposing that the Roosevelt soundboard requires two pressures of wind. Each motor is closed by a light spring, not by higher wind-pressure, which Roosevelt discarded twelve years ago. The altered position of the auxiliary motor or "buffer" is not peculiar to Mr. Drechsler, and answers equally well with the Roosevelt soundboard, which I prefer for several other reasons than the absence of second wind-pressure.

Denbigh. **Thomas Casson.**

STREET LIGHTING.

[26616.]—IN the last number but one of this paper a letter upon "Street Lighting" came under my notice.

I agree with the writer of the letter upon his arrangement of glass lenses. The majority of street lamps that light up our large towns at the present day are not at all perfect. Some of the older forms of lamps throw as much light upon the clouds as they do upon the ground, simply because they have no reflectors. Others of more modern date have been fitted with reflectors; but in many cases they are of little good, as they are either inclined at too steep an angle, or too flat a one. The lamps are not wide enough, and with a steep inclination of reflectors, the light, instead of being thrown down upon the ground, is just thrown on to the reflector directly opposite it, and in this case they are of little good. Again, in another form of lamp the reflectors are nearly horizontal, so that the light is thrown down at the foot of the lamp instead of being distributed over a large area of ground.

Lamps, or rather reflectors, should be either circular or octagonal, so that the light will be thrown out in every direction.

The opposite reflectors should be a good distance apart, so that, when placed at a steep angle, all the light thrown off one reflector will pass out of the lamp clear of the opposite one, and also will allow the heated gases from the flame to pass up to the top of the lamp without smoking or overheating them.

The reflectors should either be metallic or mirror reflectors—preferably mirror reflectors, as they are not liable to being injured by cleaning as metallic ones are.

A series of subdivided lenses, as the writer of the recent letter advised, are very suitable for "street lighting," and I am of opinion that, before long, a new incandescent or regenerative lamp will be invented, which will, with properly-arranged reflectors, give a light as satisfactory as the "electric" for ordinary street lighting purposes.

J. G. S.

CUTTER BAR.

[26617.]—IN reply to letter 26584 I use Mushet's steel in tool holders or cutter bars. Size of steel $\frac{7}{16}$ by $\frac{3}{16}$, which was rolled specially for my holders. It is used with edge upwards. I find it excellent for roughing and finishing wrought iron and mild steel, and for roughing cast steel, if latter is well annealed. It will not keep a fine edge for finishing, or a fine point for cutting screws in c.s., and is much inferior to a good c.s. tool for cutting any extra-hard stuff, especially if heated in grinding: I break a bit from rod and grind on an emery wheel. I should be glad to send "Evod" a bit of above size or ¼in. square to try for himself if he will advertise his address.

Glasgow. **H. O.**

VESICLES.

[26618.]—IS it asking too much of "F.R.A.S." to give the meaning he attaches to the word "vesicle" in his reply to query 61145? On consulting four dictionaries, Johnson's "Standard Edition" being one, I take the meaning to be "a small bladder inflated, or else filled with a fluid."

My reason for writing is that there is a very common idea, which I am certain "F.R.A.S." does not entertain, that the particles of condensed water which form fog, cloud, or steam (as it appears

when blown off from a boiler) are hollow bubbles or "vesicles," which, from their lightness, keep afloat in the atmosphere. This is, however, a fallacy. All vapour, from the lightest summer-evening fog that lies on the surface of meadow land to the heaviest thundercloud, consists of spheres of solid water, subject as any other body of water to the common laws of gravity, but delayed from reaching the earth's surface by their friction in the atmosphere, this effect being much augmented by the great increase of superficies from subdivision as compared with their weight.

The above does not, of course, include any theory of electrical repulsion or attraction.

Several physicists, including the younger Helmholtz, have apparently proved that visible fog or cloud cannot be formed in air perfectly free from dust, the particle of dust being necessary as a nucleus for the sphere of water.

December 18. **R. J. Lecky.**

THE STRONGEST MOTIVE.

[26619.]—I FEAR we are not likely to settle the long-standing problem of free will in the pages of the ENGLISH MECHANIC. But it appears to me that in this controversy the word "motive" is nearly always used in a wrong sense. It is spoken of as if it were a cause, whereas it is an end. In adopting a certain line of conduct towards an individual my motive is either to injure or to benefit him—that is the end to which my action is directed. So that a motive is really an end in which self-satisfaction is sought, and therefore made the goal of endeavour.

If the question be, can we act in any other way than what would be most agreeable to us at the time—in other words, in opposition to our strongest present desire? I think it must be within the experience of every one that we can and do often so act. And it is just here that the formation of character begins.

In a motive there are two elements—1st, a desire to be gratified; 2nd, a belief about it whether it be right or wrong. In adopting a desire and making it a motive or an end to be sought, a man identifies himself with it and recognises it as his own creation. He is the author in the same way of all the acts which have made him what he is. I am glad to see that Mr. Conybeare (letter 26582) upholds the same view.

18th Dec. **J. A.**

A QUESTION IN COAL ECONOMY.

[26620.]—AT a recent meeting of the Metropolitan Board of Works Mr. E. R Cook is reported to have stated that in one street in West Ham there were five or six factories which contributed £15,000 to £20,000 a year to the coal dues. Assuming these figures to refer to the consumption of coal in steam-engines, it struck me that they represented an enormous amount of power; but it may be that they are used in some other way. Nevertheless, a little consideration of what the figures imply may be instructive. According to my calculation, taking round figures, £20,000 would represent the tax on 400,000 tons of coal, and as there are six factories, that is 66,000 tons a year each. Taking 300 days as a working year, that is 220 tons a day, or 20 tons an hour, allowing 11 hours as a working day. A ton of coal ought to give through a good engine 700 horse-power for an hour, and therefore 20 tons an hour would represent 14,000 horse-power as the working power of each of these six factories for eleven hours in each day. Can any of your readers throw some light on this matter? Do West Ham Engines use 10 or 20lb. of coal per horse-power, or is the coal used in some manner less economical than a steam-engine, or what is the explanation? I know that in the Midlands where coal is cheap the waste is enormous; but surely nowadays 3lb. per I.H.P. is a fair estimate for a good steam-engine.

Nun. Dor.

RANGE OF BAROMETER.

[26621.]—THIS is a matter on which information from different latitudes is greatly needed. We know vaguely that the extreme range increases with latitude from less than 0·1in. at the Equator to fully 3·0 in Scotland (at sea-level); but does it exceed this at higher latitudes? Everywhere the mean is between 29·7 and 30, and much nearer the highest limit than the lowest. The occasions of sinking below 28, and still rarer ones of rising above 31, within living memory, might surely be given in a short table, and would all be confined, I think, to the coldest months. Our June or July range hardly ever exceeds the annual one of California, as given by "M. C. B." (letter 26583)

E. L. G.

[26622.]—M. C. B——, of San Francisco, gives 29·65 as the lowest, and 30·25 as the highest he has seen in California.

Contrast this with the records in the *Daily Telegraph*, many of which I have cut out and pasted in a book for years.

I give the following, all of which have been corrected for sea level and reduced to 32° F.:—

Year.	Month and Day.	Height of Bar.
1869	Dec. 5	30·7
"	" 11	29·5
1870	Jan. 16	30·5
"	" 19	30·65
"	" 31	29·8
"	Sept. and Oct., for nearly a month	30·5
"	Nov. 19	28·45
"	Dec. 1	30·77
1871	Nov. 30	29·0
"	Dec. 1	28·87
"	" 8	28·87
1874	" 8	28·45
"	" 11	28·6

In the *Times* of March 15, 1876, there is a letter showing fluctuations on one day 28·46 and 28·82.

Year.	Month and Day.	Height of Bar.
1876	March 12	28·8
1877	Nov. 11	28·6
"	Dec. 14	30·35
"	" 22	30·4
"	" 25	29·5
1878	Jan. 8	29·4
"	" 11	30·15

Note.—1877, October 15, there was the cyclone which had been telegraphed from America. Cleopatra's Needle nearly lost. Bar. 29·47.

Year.	Month and Day.	Height of Bar.
1879	Dec. 12	30·75
"	" 13	30·79
"	" 22	30·80
1881	" 20	28 9
"	" 23	30·5

A rise in $3\frac{1}{2}$ days of 1·6in.

The highest known in London was, I believe, Jan. 18, 1882, when some say it touched 31·0, but most agree that it was only 30·95. My own aneroid stood, on 17th, 30·86.

The last low state of the barometer of which I have a record is so recently as on evening (midnight), Dec. 8, 1886, 28·2. I do not say that this is the lowest point known; but taking my records, which, I say, are from the *Daily Telegraph*, the highest and lowest have been:

Highest	30·95
Lowest	28·2
	2·75, or $2\frac{3}{4}$in.

R. S. T.

HORIZONTAL WIND-POWER.

[26623.]—WE who are outsiders, and seekers after knowledge in science and mechanism which many of your contributors amply possess, are bound to approach with great diffidence any experimentalist who gives us the benefit of his experience, and is good enough to teach us how we may accomplish the same measure of success that he himself claims to have achieved. Thus, when Mr. P. Vallance states that he has driven seven ploughs through a stiff and heavy soil (which always required three horses to each plough) by two horizontal wind-mills of six 12ft. arms, each arm carrying a sail 12ft. high by 6ft. wide, we are bound to believe him.

We may listen with mistrustful ears to what a man is going to do; but what he really has done, and can doubtless produce plenty of witnesses to prove, he may defy the world to discredit. And, besides, what he has by his skill and ingenuity once achieved, may be done again. Such a cheap and useful engine should become very popular; but where is it to be seen? And this brings me back to my original inquiries, of which that was not the last; yet it is one to which no reference is made either by Mr. Collingridge, or by Mr. Vallance himself, in their letters to you (26597 and 26598, p. 346) of your No. for Dec. 17, purporting to be in answer to mine of the 3rd December, at p. 303.

Will Mr. Vallance permit me to call his attention to some apparent inaccuracies in the figures he has put before us, to satisfy us of the possibility of what he has set forth as the result of his experiments? In the first place, he describes the wind engine he most approves of as carrying 24 arms of 14ft. long in two tiers of 12 arms parallel to each other, between which are set 60 sails of wood, each sail being 7ft. long by 9in. wide. This would give $5\frac{1}{4}$ square feet as the extreme area of each, and there being five to each pair of arms, we have a total of $26\frac{1}{4}$ft. of working sail, or the 12 = 315ft. at the outside for all. But Mr. Vallance takes credit for 600ft., which arithmetic cannot reconcile with his basis of calculation. Again, from this 315ft. a liberal deduction must be made for a strong resistance that has to be met, on the side constantly pressing against the wind, or what may be called the return side of the engine, in action. The thick edge of the sail, or that on which it turns, is stated to be $2\frac{1}{4}$in., and five of them on each arm would offer a solid resistance per arm to the wind of 7 superfical feet, and the breeze would be so much the stronger on that side by the velocity with which they were driven against it. There are many other *impedimenta* which I need not particularise—and even on the side that was going before the wind, the sails would be liable to becalm each other, in various positions, so that the 600ft. claimed is reduced to the actual surface possible to use, of 315ft., at least one third of which will be in a perpetual struggle against the wind (in greater force). We may therefore conceive that the actual power would not be that of the clear surface of two complete arms, which would be a spread of about 50ft. In fact, lower down in his letter, Mr. Vallance seems to acknowledge this, when he says:

"The best total width of sail I found, after experiment, was about $\frac{1}{3}$rd more than the diameter of the circle described by the sails, so that the sixty sails, 9in. wide, will be 45ft., and the diameter of the circle 30ft."

In his estimate of cost, and his explanation of the materials required, one is rather staggered, in our appreciation of the good qualities of Mr. Vallance's windmill, by its cumbrousness and ponderosity. The weight of the wood alone, which he specifies, with its fixings, would not be less than two tons, not counting the shaft, and, I imagine his calculation of expenses leaves out the charge of the necessary appliances for putting it together, and the platform for afterwards attending to it. And, possibly, Mr. Vallance has taken no account of his own valuable time in superintending the construction.

The problem of a popular horizontal windmill has long puzzled the engineering community. Nor have we yet, I fear, sufficient evidence that either Mr. Vallance or his disciple—Mr. Arthur Collingridge—have resolved it. The latter seems to have reluctantly gone back to steam, and the former has not told us where his invention can be seen in operation.

London, Dec. 20th. **Raymond Browne.**

ELECTRO-THERAPEUTICS.

[26624.]—THE following extraordinary effusion appeared recently in a provincial paper, and is well calculated to raise a hearty laugh amongst those who have not made electricity a "special study," but have taken the trouble to understand the rudiments of the science. This is what the newspaper says:—

"The public of Portsmouth and vicinity are indebted to Captain Arthur Byng for placing electricity for an alleviation and cure of all kinds of nervous diseases easily, cheaply, and safely within their reach. We understand that Captain Byng has made this science a special study for some years past, and he has, after numerous experiments, fitted rooms with appliances that will enable electricity to be taken with perfect ease by any number of people at the same time. The rooms are situated at 23, Landport-terrace, and being quite close to the King's-road Tramway Junction they are easily accessible from all parts of the borough. They are comfortably furnished, and are situated on the ground floor so as to be on a level with the street and obviate the climbing of stairs. From a personal inspection we are enabled to speak of the complete success attending the various methods by which electricity is administered. There is no occasion to take off even outside wraps, and the current may be taken either sitting or standing. A number of regulators are placed in the room, which are worked with the utmost ease and accuracy by the patients themselves, so that they actually regulate the force of the current themselves and take it any strength they like. They are also enabled to instantaneously diminish the strength of the current as they wish. Captain Byng claims no new method of generating electricity, as his patent applies only to a new method of subdividing the current so as to disseminate it equally throughout a room and administer it in various strengths to individuals sitting in that room. The positive and negative poles of a large coil are placed in connection with an insulated floor and an insulated ceiling, the floor consisting of sheet metal, and the ceiling consisting of wires broken by steel points, so that anybody placed on the floor of the room by that simple act is actually between the poles, and thus becomes charged with the electric fluid. Although heavily charged our representative ascertained that he could sit, read, write, or do any of the ordinary requirements of business without the slightest inconvenience, thus renewing vitality at the expense of no bodily labour. The medical men of Portsmouth, we may assume, will not be slow to appreciate the benefits thus placed within reach of a very large proportion of their patients, at whose disposal the rooms are now placed at most reasonable charges. We understand that the electrical rooms will be worked by a company, of which Mr. J. Y. Martyr is the secretary, to whom the public should apply for all information. The rooms are to be opened from

ten till four, and patients will be charged from one shilling to five shillings, according to the treatment they receive and the length of time they remain in the electrical room." One would like to know if there is a science school in Portsmouth.

E. M. F.

VACCINATION A PREVENTIVE OF SMALL-POX.

[26625.]—A LETTER from Dr. Allinson in your issue of the 29th October last contained, amongst other matter, the following statement:—

"Vaccination does not prevent small-pox, as any-one may see who will go statistically into the subject."

Circumstances led me some years ago to make a careful inquiry into the matter, with a result exactly the opposite to that stated by Dr. Allinson.

Before replying to his letter I was desirous of obtaining the latest available returns, and finally applied to the Registrar-General for information.

This I have lately received, and, as I anticipated, it proves that vaccination is a preventive of small-pox, and would be still more so if vaccination were repeated at the age of 16 to 18; its protective power being less marked after 20.

The last year's return for London was as follows:—

Deaths from small-pox	899	
Unvaccinated	330	
of which—		
Vaccinated	218	569.
Not stated	351	

Proportion of persons vaccinated to those unvaccinated, 19 to 1. These last figures are approximate, but the Registrar-General informs me that they are substantially correct.

Now, the total number of deaths is in round numbers 900, and taking the proportion of vaccinated to unvaccinated persons as 19 to 1, on the supposition that vaccination is no protection, the deaths should be in that proportion nearly—viz., vaccinated 855, unvaccinated 45.

On comparing these numbers with those actually registered, we find the deaths of persons not vaccinated were $7\frac{1}{3}$ times more numerous than they would have been on that supposition; whilst on the other hand the deaths amongst the vaccinated (including those entered not stated) were 286 less.

Thus, making every allowance, there is undoubted proof of the protective power of vaccination.

This becomes more marked if we take the proportion of deaths under 20 years of age: the total number was 428. Taking as before the proportion of 19 to 1, the deaths should have been—

Vaccinated	407	they were	200
Unvaccinated	21		228

(including 159 doubtful with the vaccinated, which were registered at 41, thus making 200). This gives the deaths amongst the unvaccinated $10\frac{1}{2}$ times more, and amongst the vaccinated less than half what it would have been had vaccination been no protection.

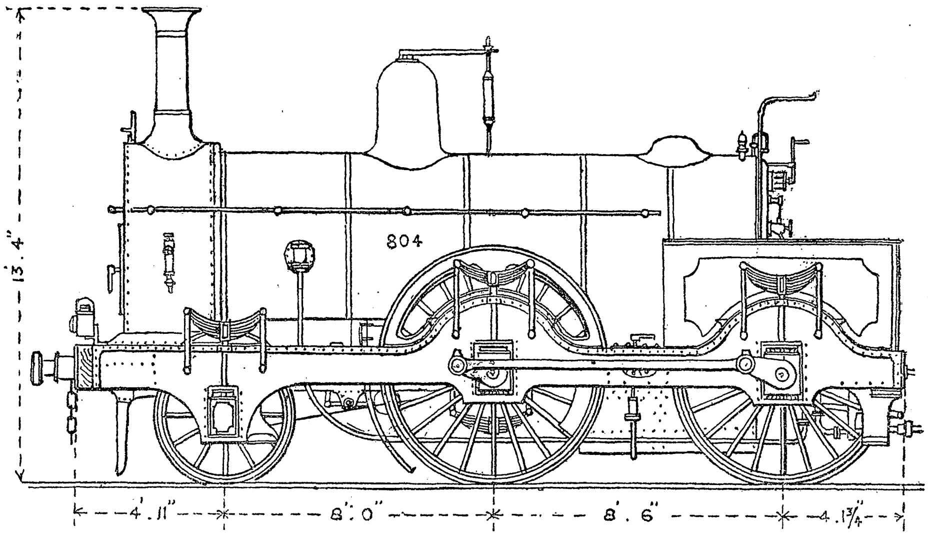
In other words, amongst the $\frac{1}{20}$ of the population not vaccinated, there were more deaths than amongst the $\frac{19}{20}$ who were. I have in all cases added to the vaccinated those deaths in which no report was made as to whether vaccinated or not; but there is no doubt that a considerable number of them should have been on the other side, which would have made the disparity more striking.

I believe Dr. Allinson must have been led into error by not taking into consideration the relative number of persons vaccinated to those unvaccinated, without which it is impossible to arrive at any correct conclusion as to the protective power of vaccination. I have seen small-pox in countries where vaccination is not practised, and the effects of it in an epidemic form are so terrible that I consider it a duty to protest most strongly against any statements which may tend to lead to vaccination being neglected.

Lavant.

MIDLAND ENGINES—800 CLASS.

[26626.]—YOUR correspondent "Midland," page 348 in this day's issue, is perfectly correct when he states that the 800 class of Midland engines, although constantly referred to, has never been illustrated in your columns, and I believe no engine of the class has ever been illustrated in any paper. The only drawing I have is one I made of No. 804 in July, 1870, when the engine was quite new and commenced to work trains from London to Leicester, the dimensions of her being taken daily during the times she was standing at the locomotive sidings at Leicester. The 800 class (800 to 829 inclusive) was designed by the late Mr. Kirtley and constructed by Neilson and Co., 1870. The engines had cylinders 17in. by 24in., and four coupled wheels 6ft. 8in. diameter, and, therefore, capable of exerting a tractive force of 86·7lb. for each pound of effective pressure per square inch in



the cylinders; distance between centres of cylinders, 2ft. 6in.; total wheel base, 16ft. 6in.

	Tons.	Cwt.	Qr.
Engine	35	18	2
Tender	24	15	2
Total	60	14	0

All the other dimensions of these engines have been given in back volumes, and it is unnecessary to repeat them. It may be pointed out that the engines are all similar in appearance, with the exception that some have a step on either side of the leading axle box. Various forms of reversing screws were fixed upon the foot-plate, and since their construction they have been rebuilt.

The 800 class, it is well known, has done excellent and very heavy work on the Midland Railway, and that is the *sole* reason why I have spoken highly of it; and I can assure "Midland" (page 348) that the fact that I knew the designer, or that 20 years ago I entered the engineering profession as a pupil, *does not in any way* influence my opinions.

Clement E. Stretton.

40, Saxe Coburg-street, Leicester, Dec. 17th.

PASSENGER TRAINS AND PARTING COUPLINGS.

[26627.]—I DO not see why an electrical contrivance should be used to warn a driver that he has lost part of his train, when a simple cord will answer as well. In the accident referred to by Mr. Rogers, p. 348, a goods train parted, and a passenger train ran into the hind portion. There does not seem to be any insuperable difficulty in running a cord from the rear brake to the engine, and in so attaching it to the latter that any strain upon it will cause the whistle to sound—an unmistakable method of calling the driver's attention. The cord would take a few minutes to arrange when the train was made up, and a minute or so to alter when waggons were dropped at stations; but it would be a safeguard, and would at least prevent a driver going on in the belief that he had all his load with him. The cord must be strong enough to exert the required pull on a lever attached to the whistle before breaking, and the expense would be merely nominal. I should like to know what objection, if any, can be urged against the adoption of so simple a device.

The accident to which Mr. Rogers refers has not been clearly reported—that is, not reported with knowledge; but I was lucky enough to catch the train that preceded the goods, and according to my reckoning it was a train fitted with only the old-fashioned hand brakes that ran into the goods. The line is on a down gradient from Farringdon; but in spite of that, I think a train fitted with even the vacuum brake could have been pulled up in time. Be that as it may, it seems to me that goods' drivers ought to be supplied with some automatic indicator, so that if the tail of their train breaks away they should know it directly. No doubt this event will be kept as quiet as possible, and we shall hear no more of it than we did of the King's-cross accident, when trains from two lines tried to run into the station at the same time.

Nun. Dor.

THE MAY ISLAND ELECTRIC LIGHT.

[26628.]—THE May Island Lighthouse, off the Firth of Forth, now throws a powerful electric beam across the waters, and some of your readers may be interested in a few particulars. The light was formally installed the other day, and we can now see the four flashes which are given in quick succession with a dark interval of 30 seconds. The May Island Lighthouse in itself is a good example of the progress made in connection with mariner's guide posts at night. Two hundred and fifty years ago an open coal fire was shown from the top of the old tower, now used as a pilot's shelter. This light, though kept up at considerable cost, was uncertain in its appearance, varying with the ever-changing character of the weather. The coal fire gave place in 1816 to reflectors and Argand lamps, fed with sperm oil, inclosed in a glazed lantern. Fifty years ago the reflectors, in their turn, were superseded by a dioptric apparatus with a central flame from a four-wick lamp. At a later date colza oil was substituted as the illuminant for the more expensive sperm, while in 1874 paraffin took the place of colza, the intensity of the flame being thereby increased by fully 10 per cent., and this, too, at about one-fifth of the cost. The power of the beam of light from the paraffin flame when operated on by the apparatus and exhibited to the mariner was equal to 9,500 candles, while that of the electric light now shown is equal to about three million candles, or fully more than three hundred times that of the intensity of the paraffin light, and can, if desired, be increased to six million candles during fog. The new dwellings and engine-house are placed in a gulley which intersects the island crosswise, at some distance from the tower. At the northern end of this gully there is a small lake which has been converted into a reservoir, the water being used for condensation purposes. In the engine-house there are two steam-engines for driving the electric machines, each of 16H.P. There are also in the engine-room two electrical machines supplied by Baron De Meritens, Paris. Only one engine and one electric machine are as a rule used at a time, the spare engine and machine being provided to guard against accident, and unless when very foggy weather occurs, it will not be necessary to use the full power of both engines and electric machines. The electric machines are "alternate current" magneto-electric machines of the largest size hitherto made, having 60 permanent horse-shoe magnets arranged round a centre in twelve sets of five each. The pulsations of electrical energy are taken off by collectors at each end of the central shaft, and conveyed to the lighthouse tower, situate at a distance of 880ft., by copper rods, 1in. diameter. These rods or conductors are placed in a groove in a low wall of cement rubble concrete, which has been built between the engine-house and the tower, and alongside of which a pathway has been formed. The engine-house and tower are also placed in communication by telephone. The conductors are led up the tower to the lamps inside the dioptric apparatus. The electric lamps are of the most improved kind, one being always in its place inside the dioptric apparatus, while another is ready, with the carbons adjusted to the correct height, to be shunted into the focus of the apparatus when required. The carbons are fully $1\frac{1}{2}$in. diameter, and have a small core of pure graphite running through the centre. These improved carbons are found to burn with great steadiness and regularity.

Dunbar. J. M'I.

UNCAUSED VOLITION — EXPRESS RUNS—DISPERSERS OF SOUNDS—LUMINIFEROUS ETHER.

[26629.]—IF a man be actuated by a motive of strength = 10 to do a certain act, and by a motive of strength = 8 to refrain from doing it, then, to my mind, it is as certain as anything can be that he will perform the act, and I cannot see how the reverse theory can for a moment be upheld. I take it as being axiomatic that if a man does an act, the motive or motives urging him to do it are of greater intensity than the motive or motives

urging him to desist. Mr. Conybeare (letter 26852, page 325) will scarcely contend that a man would or could run away from his guns while his courage and sense of duty were greater than his fear of being hit by the enemy. I quite agree with my friend that a man may remain at his post while very much afraid indeed; but in this case his fear, great though it might be, would necessarily be less than his sense of duty, dislike of being deemed cowardly, and fear of being shot for running away. A story is told of two officers going into action, one of whom was very pale and nervous. His companion remarked, "Jack, I believe you are frightened"; to which, replied Jack, "Yes, I am very frightened; and if you were half as frightened as I am you would run away." I think that what Mr. Conybeare terms the "agent's view of the environment" is really involved in the terms constitution and training. No doubt men differ enormously in the view they would take of precisely the same external environment. A set of conditions which would cause one man to take hydrocyanic acid would merely nerve another to energetic efforts to extricate himself. The problem as to what a man will do under a given environment is usually a difficult one for others to solve; but cases are by no means rare in which his action can be predicted with as much certainty as though he were a piece of mechanism, every detail of which was perfectly understood. Let us consider first a case in which approximate certainty can be attained, and then see the change which converts the approximation into exactness. A man makes a winning score at a rifle meeting in a competition for prizes in kind, and is called to choose his prize; he will generally take the article of highest value, but not invariably. He may not be a smoker, and may therefore choose an article of less intrinsic value than the cigar-case to which his score entitles him. He may choose a cup of less value than a timepiece, because he has already won a timepiece; or, on the contrary, he may take a timepiece of less value than a cup, because a timepiece is most useful. Thus we see that in a general way the action of the competitors can be predicted, but not with certainty. If, however, competition be for money prizes, then the action of each competitor may be predicted, not merely approximately, but with absolute certainty; he will take the highest prize to which he is entitled. Of course few cases in practice are as simple as even the first of these, but I give them to show that, under certain circumstances, the action of any number of men may be predicted not approximately, but certainly. All our laws, all our dealings with each other, whether in business or friendship, are based upon the theorem that a person will act in obedience to his strongest motive, and, in fact, did people really exhibit "uncaused volition"—the free will about which many persons talk so fluently—it would be well-nigh impossible for society to exist. The only places where anything like free will—i.e., utterly capricious action without assignable or discoverable motive—is to be found are lunatic asylums, and even there the capriciousness is more apparent than real, and mainly arises from our inability to follow the workings of the diseased nerve centres. An insane man not only has insane opinions, but he reasons from these insane ideas in an insane way, and hence it is often impossible to deduce from the acts of a lunatic the particular delusion to which he is subject. I assure my friend that I do not think the problem of "free will" at all simple: it is not possible except in few cases to solve the equation

$$A = \psi\ (C.T.E.);$$

but to imagine that the solution is capricious and uncertain savours of absurdity; and the idea of "uncaused volition" is forbidden alike by the views of the scientist and by the dogmas of the theologian.

In letter 26288, page 86, I asked for details of run of 10 a.m. express London to Grantham; I now wish to remind our railway correspondents that the question has not been answered.

It is well known that sound can be refracted like light. Does anything analogous to dispersion occur in the refraction of sound? No textbook mentions it; but neither does any book I have read state that it does not occur.

I hope to say a few words next week in reply to "Sigma" on the subject of the Luminiferous Ether (query 61033, p. 310).

W. John Grey, F.C.S., Analytical Chemist. Newcastle-on-Tyne.

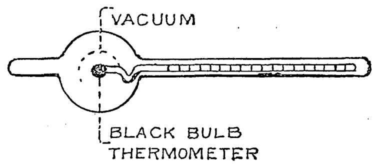
THE Carrier-Pigeon Service in Paris is now most carefully organised, and the latest census shows that there are 2,500 trained birds, which can take despatches in and out of the capital in the roughest weather. Some are taught to go to the neighbouring forts and towns, others to distant parts of the provinces.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60514.]—**Silvertown Firing Battery (U.Q.)** —This battery was made up in two forms, square and round. In the square, the zinc was of the U shape, as in Grove's batteries, thus offering a large surface. The large carbon plate (nearly the same size as the opposing surfaces of the zinc) was fitted in a sort of canvas bag, wherein was also inclosed the carbon and manganese. The internal resistance was obviously very small, while the current, when the circuit was closed, was a "sudden and powerful rush," and immediately sank to almost nil. Is was eminently suitable for firing purposes, and that was all.—S. BRETTON.

[60815.] — **The Sun's Radiation.** — Now "B. R." has enucleated his query, and thrown more light upon the "modicum of *confined* air," as he has it, one may now see what he wants to know. I am very well acquainted with the fact that an absolute vacuum is a practical impossibility; but, speaking of the infinitesimal amount of air remaining in an exhausted tube "as the modicum of confined air" at once sets one off the track. Do you see much confinement about air attenuated to 100 times its original volume? How about the airlike freedom the aëronaut enjoys in the diminished atmosphere at an altitude of only a few thousand feet above the sea-level? Is this confinement? My critic has in his original query the following statement:—"I suppose when the sun shines for any lengthened time, the modicum of air confined in the glass containing the vacuo thermometer becomes more heated than when it shines but a short time, and so gives a higher record, &c." Well may one look at this with surprise. It is evident to the youngest of children that the more you heat a body the hotter it becomes. Confound this modicum of air that has so entangled itself in your brain! The more physically perfect the vacuum in which the blackened bulb thermometer is contained, the more perfect the instrument; in short, it is this "modicum of air" that prevents philosophical instrument makers from producing a really reliable instrument. The following cut may assist the



querist in solving the enigma that *will* present itself. When a blackened bulb thermometer is contained in an exhausted tube, as above, it is isolated from currents of air that would materially affect its registration, and, consequently, this specific arrangement gives a higher record by as much as 20° or 30° than one immersed in air under precisely the same conditions. It is the mercury in the thermometer that is expanded by the direct impact of the solar rays, and not through the agency of the minute portion of air left, which is supposed to pervade the whole of the circumambient space with equal tenuity. In answer to your query on page 287, I may state that the very name obviously indicates its purpose — *id. est*, to measure the amount of radiant heat impinging upon the earth at any noted time. Our distance from the sun, of course, varies as we journey around him, and, therefore, instruments of this description are necessary for the determination of his heating effect upon our crust. A sky may appear optically clear and unobstructed by clouds, but, when we apply the instrument to determine the amount of solar heat, we find that it records very little above the air thermometer in the shade. From this we learn the invisible, yet real, obstruction of radiant heat is due to minute particles of water held in suspension in the air. The earth absorbs heat during the day, and radiates it into space during the night. Perfectly dry air is as transparent to heat rays as a vacuum. The vapour or moisture in the air prevents the sun's rays from their terrestrial heating effect during the day, and also the radiation of absorbed heat during the night. Therefore this vaporous inclosure acts as a blanket upon the cosmical surface, maintaining it at a higher temperature than it would be if did not exist. From the above maxims gardeners profit, by covering up their tender plants that would inevitably be "nipped up" by the chilling effect of radiation during the night, although the air thermometer may be some degrees above the freezing point. "B. R." may read my previous answer without the slightest reservation.—A. TREYER EVANS, Newport, Monmouthshire.

[60866.]—**Equatorial Pedestal.**—Why does not this querist look up back volumes, and choose the mounting which he thinks will suit him best? Try Mr. Vallance's stand, illustrated in No. 1049, p. 189; and see Nos. 973, 976, 979, for some useful papers on equatorial stands generally.—THUBAN.

[60868.]—**Numbering Stamps.**—Better procure fresh ink. It seems strange, though, that while "not apparently sufficiently fluid," it should at the same time not dry quickly. These inks are usually kept in the moist condition by means of a little glycerine, and they ought not to be fluid in the usual sense, though they ought to sink into the pad.—SAML. RAY.

[60869 and 61185.]—**Twin Screw and Paddle Engine.**—Twin screws are advantageous, or supposed to be so, because they enable the vessel to be manœuvred with more celerity, and also because to obtain the driving power now required, a single propeller has to be of enormous size, with other parts in proportion. Similarly, twin screws are employed where the draught of the vessel is not sufficient to allow of the use of a single propeller large enough to transmit the full power. Then it must be remembered that in case of accident to one set of engines, the vessel is in a safer condition, and is enabled to prosecute her voyage, and, finally, the use of twin sets enables the builder to run a longitudinal bulkhead from stem to stern, by which means he obtains a great increase of strength, and presumably adds to the safety of the ship. To a certain extent these remarks apply to paddlewheel boats, as it is a great advantage to a tug, for instance, to be able to disconnect her wheels at pleasure and work them independently. This query appears again on p. 355, so the gentleman is evidently in a hurry.—NUN. DOR.

[60871.]—**Coir Yarn.**—Is this stuff bleached in practice? However, the querist can easily make a few experiments with the fumes of burning sulphur, and with suitable apparatus may be able to save the sulphurous-acid gas by absorbing it in water, which can be used for soaking the coir before submitting it to the fumes.—SAML. RAY.

[60873.]—**Business Done in the Dark.**—It has been decided that meetings of boards of guardians may be held in private, Lord Chief Justice Cockburn holding that it was the proper course to pursue when matters affecting the conduct of a particular person were being discussed. Every local board or urban authority has power to make regulations with respect to the management, &c., of their meetings, and can therefore exclude reporters. As a rule, I think reporters are admitted; but when they are excluded systematically, the electors have the remedy in their own hands by appointing as members of the local boards those persons who pledge themselves to admit reporters. —SAML. RAY.

[60874.]—**Dynamo.**—This querist may be recommended to look in back numbers—recent ones —and see in what way he can utilise his "oddments." At present his query is very much as if he said, "I have some pieces of brass tubing, how can I make them into a telescope?"—OHMI.

[60881.]—**Pitch-pine Stopping.**—I do not think there is any good and efficient stopping for pitchpine, if by "stopping" your correspondent means some transparent preparation which will prevent the exudation of the resin or turpentine. Pitch-pine is usually varnished on the wood; but if to be painted, the knots may be killed by means of patent knotting. Still, the query is very indefinite.—NUN. DOR.

[60887.]—**Enamel.**—The best thing "Pro Bono Publico" can do is to polish his tinplate reflectors. An enamel is produced by a frit, which is melted on the plate by considerable heat, more, I think, than the tin would stand; but if he must have enamel, he will find plenty of recipes in back volumes. Tin melts at something less than 450° Fahr.—NUN. DOR.

[60889.]—**A Good Battery.**—I observe that on p. 356, an impatient correspondent asks whether this query has been answered. Referring to "Cato's" letter on p. 219, it will be seen that it ends with the sentence, "I shall be happy to give any further particulars to those interested." Those particulars do not seem to have been given. Probably the battery is not yet patented, and it would be unwise to give more details.—E. M. F.

[60905.]—**Induction Coil.**—I should think that if this querist looked through the last volume, for instance, he might find some useful information about coils; or, if he refers to p. 138 (Oct. 8 last), the principal data for a coil which is practically identical with the one he wishes to construct.—THUBAN.

[60912.]—**Dividing Brasses.**—Do makers ever find the "correct angle" for dividing brasses? If so, what is it? Brasses are made in pairs or halves, that is all.—M.I.M.E.

[60914.]—**Writing Ink.**—If querist makes his ink of decoction of galls and sulphate of iron, it will not turn brown or rusty. There are plenty of recipes in back volumes. Roasting galls is practised, because it is found that it develops a little pyrogallic acid, which is very soluble in water, and strikes an intense bluish-black with the iron salt at once.—NUN. DOR.

[60915.]—**Tannin.**—In Slater's "Manual of Colours and Dye Wares," published by Lockwood, "O. J. K." will find a method of ascertaining the percentage of tannin under the head "Divi-Divi."—F. C. S.

[60916.]—**Daniell's Battery.**—It depends on the resistance of the lamps; but you would probably require at least a dozen such batteries.—E. M. F.

[60936.]—**Oxygen.** — What does "Holland" mean by "when the light is removed"? And, again, when he says "the gas is turned lower, and immediately stops when the light is taken away?" Does light mean heat.—R. S. T.

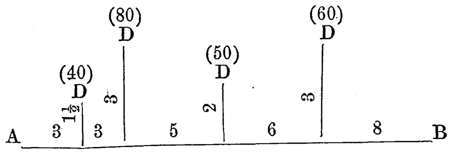
[60975.]—**Paraffin Oil or Coal-Gas.**—Replying to "Jimbo," the first part of the query is, no doubt, answered by the particulars received from the "Patent Paraffin Gas Lighting Company." Personally, I am not acquainted with the system of manufacture patented by this company; but the idea has been tried in different forms over and over again. The manufacture of oil-gas is very simple, and the apparatus could be put together by any handy fitter; there is also very little skill required to keep the apparatus going. It is necessary, however, to free the gas from carbonic acid by passing it through a lime purifier. Crude paraffin, which is obtained from bituminous shale at a low heat, can be made into a good gas; but it is not so permanent as coal-gas, and this is very noticeable where it has to be stored or passed through long lengths of pipe. Taking 6d. per gallon as a fair value for the raw material, it has been found that the gas costs 5s. 8d. per 1,000ft.; for 25-candle gas, fuel, attendance, interest on capital, &c., would be about 10d., making 6s. 6d. per 1,000ft. Mid-vein shale, holding about 11 per cent. of hydrocarbon, yields 9,000ft. per ton of 20 to 30 candle-gas. Oil-gas in its different forms has been made, I believe, for some years in America, on account of petroleum being so cheap and coal-gas the reverse, and the naphtha (a lighter distillate than paraffin) is preferred for gas making. Reckoning the cost of the raw material there at 3d. per gallon, it was found that one gallon of the ordinary commercial naphtha would produce 80ft. of 70-candle gas. The cost of manufacture was about 4s. 10d. per 1,000ft., which allows for fuel and renewal of retorts; but not for labour and interest on capital. In using this oil-gas, however, considerable trouble was experienced after a time with the meters; it was also found that carbon accumulated very quickly in the retorts, thus causing a waste of material. Less trouble, no doubt, would arise with consumers in introducing oil-gas where coal-gas had not been previously used; no residuals result from the manufacture. Special circumstances, such as a long distance from a railway station, may warrant the making of oil-gas, on account of price, &c.; but the pros and cons must be weighed very carefully, and judged entirely by local considerations before undertaking either one system or the other.—F. M. E.

[60982.]—**Chronic Inflammation of Nostrils.**—I have just read through the answers to "Misery" on his query. I may thus sum them up: "Ponto" sends a homœopathic remedy, which mode of treatment is only mild allopathy. "B.Sc., Plymouth," recommends a nasal douche as a palliative, and iodoform snuff. "R. E. F." advises a sulphate of zinc douche, and to improve health by drugs. (Curious advice this—improve health by means of poisons, which the system cannot use as food.) "A. E. O." says that zinc ointment will cure. Then he wants to know if piercing the ears will prevent respiratory diseases, as he believes it does the eyes good. This boring of the ears to improve the eyesight is a piece of humbug that wants to be ousted from the brains of all intelligent persons; it must have originally been invented by some jeweller to increase his trade as an ear-piercer. "Doctor Medicinæ" shoots at him a whole chest full of lotions, each guaranteed to cure (until it fails). To this external warfare he adds internal treatment with arsenic, and other equally poisonous drugs. If "Misery" does not get worse under this treatment, especially if he takes that damnable drug (excuse the strength of expression, but I mean it), he will surprise me. "Cured and Thankful" swears by a cold bath and injection of eucalyptus oil. A. Dunlop Stewart, M.B., says this complaint is due to inhaling cold air while the body was warm. (Pray, doctor, is the body ever colder than 98° Fahr. in health?) He says other lotions are bad; but recommends one of his own, and says nothing will cure if cold baths are used. Any sensible reader of the "E. M.," after reading these answers over, must pinch himself hard to know if he is dreaming or not, for the advice varies in every case—no two alike. The reason of this variety is because none of the writers (please include those qualified by law and nothing else) have a proper idea of disease and its origin. All disease comes from disobedience of hygienic laws; whilst the form and locality depend on the patient's habits and personal constitution. "Misery" is living wrongly and breathing bad air; very possibly gas-laden air. The wrong living causes retention of waste in the system, whilst the irritating bad air is the exciting cause of the local inflammation. Now, "Misery," observe these rules: To be well, you must learn to live hygienically; you must take no intoxicants, as ale, wine, or spirits, as they waste vital power and produce disease. In the same way, you must not use tobacco in any form. Have three meals a day, five hours apart, eat your food slowly, chew it well, and stop at the first feeling of satisfaction. Eat brown bread always instead of white. Do not drink above one large cup of fluid at a meal; cocoa is less harmful than tea or coffee. When tea or coffee are taken they should be weak. All fluids and foods must be drunk only lukewarm, and not hot. At breakfast have a cup of cocoa, brown bread and butter, an egg, or stewed fruit; or porridge and milk eaten with brown bread. At dinner, about 4oz. lean beef, mutton, poultry, or fish, two vegetables always, afterwards a milk pudding, a fruit pie, or fresh fruit. At tea take a cup of cocoa or weak tea, brown bread and butter, some stewed fruit, or some green stuff, as boiled Spanish onion, boiled celery, or salad; a little jam or plain cake may be eaten. Exercise regularly two hours a day, or walk from six to eight miles. Breathe pure air always, and have bed-room window open two inches all year round. Have a tepid sponge down daily and a fortnightly hot bath, or a weekly warm bath alone. Live as I direct, and you will enjoy better health than you have done for years. No medicine or drugs required. If you want to know how Nature cures disease, and how the doctors interfere with her, read my leading articles in the medical column of the *Weekly Times* and *Echo* for Dec. 11th and 18th. They can be got for two stamps each from the office of the "E. M.," 332, Strand, W.C. They will repay perusal.—T. R. ALLINSON, L.R.C.P., Author of "A System of Hygienic Medicine," &c.

[60983.]—**Chloride Battery.**—The modified form of bichromate known under the above name not being suited to the querist's wants, I beg to give him particulars of a form of Leclanché that will probably serve his purpose. An engraving of it is to be found in Vol. VII. of the *Electrician*, page 235, or if he would like to procure the number from the office, its date is August 27th, 1881. The name of the cell is Howell's Patent Manganese, made by L. Clark, Muirhead, and Co. It consists of an outer jar A, perforated stoneware jar B, and porous cell C. Put porous cell inside B. In the space between A and B the usual carbon, with a mixture of crushed carbon and dioxide of manganese, with manganese sulphate (the white manganese of commerce) added. The zinc rod is put in C, with some mercury at the bottom to keep it amalgamated. Inside B (that is, the space between the outside of porous cell) sulphuric acid is placed, 1 to 4 of water. In the porous cell containing the zinc a solution of sulphate of ammonia, 25 grammes to 1 litre of water. Its E.M.F. is 2·14 volts, with an internal resistance of 5 to 6 ohms. I should be glad of the opinion of Messrs. Sprague and Bottone concerning this cell, especially as to its constancy. I am told a great many of them are used.—ASSOC. SOC. OF TEL. ENGS.

[61033.]—**Preparation for Mixing Bronze Powders.**—When I have wanted to mix some Bessemer gold or bronze paint and have been out of the special varnish, I have used copal which has been treated to a dose of quicklime in small pieces and thinned severely with turpentine. Shake well and allow to settle. I have been told that this is the special varnish sold for the purpose; but be that as it may, it answers perfectly.—NUN. DOR.

[61048.]—**Electric Conductors.**—I am much obliged to Mr. Edward Conry for his long reply to this query, and shall be much pleased to hear from him on the subject (in Address Column). At the same time I think it may be useful to many readers of the "E.M." if we continue to discuss this question, which has reference to a real project for applying water-power to the working of a railway by means of electricity. Mr. Conry has reversed my question, or at least the question I intended to put, and asks the weight of train I wish to run, its resistance, &c.; whereas this is just what I wish to arrive at through him and such others who may kindly assist me. I have certain power at my disposal for turning dynamos which are in certain relative positions and distances from the line upon which I wish to run trains, and I think I gave sufficient information, except that I did not say at what points in the line the various branch cables would deliver their currents. If the Editor will kindly insert the synoptical sketch below, I think the position will be made clear. The figures are somewhat different to those given at first, as I have since received more favourable information, and find 230H.P. instead of 170. The sketch is in plan. The plain figures indicate the distances in



miles, and those in brackets the H.P. of the respective four turbines at D; A, B the main conductor 25 miles long. As the maximum and almost ruling gradient of the 25 miles of line would be 1 in 20, I consider stored electricity, as suggested by Mr. Conry, impracticable because of the power required to take the weight up such an incline, and have in my mind a conductor or a pair of conductors in the middle of the road, unless the two rails themselves could be made to serve as conductors; but I shall be pleased with any better idea. Now, what I wish to know is the best means of applying this power, leaving the question of "ampères and volts" to those kind enough to reply, preferring that the tension should not be so high as to endanger the lives of workmen on the line. What loss of power will there be between the dynamos D—which would all be suited to work together—and the motors of the train or car (for we shall not be able to take up a heavy train)? Or (1) What available H.P. can I reckon upon all along the line? (2) What should be the size and shape of the various conductors? (3) What tension is recommended at the dynamos, and what would be available at the main conductor for the motors? I can then work out the weight and speed of the trains which could be run upon it. Any suggestions about using the motors reversed as dynamos (as they naturally would be if left attached) during the descent to be used as brakes, and to help in generating electricity, and so helping an "up" train. In all cases should the idea be carried out, good plant would be adopted; but as there appears to be a good supply of water power, a good margin may be taken for resistance where that would considerably reduce the cost.—ACIER.

[61060.]—**Gut v. Leather Belts.**—Don't use gut at all, use either soft line or twisted leather. The 1in. flat belt will not be as effective as a round one, if the pulley is less than 8in. diameter, except at quick speeds. You had better make your own hooks and eyes, as those sold in shops have either hardly any thread at all or else a very sharp one. The thread should be deep with the tops well rounded off to prevent cutting the band. Hooks and eyes made thus will resist a strain of about 60lb., provided, of course, they have not been burnt in hardening. If a strand in the band breaks, get a new band at once. Some mechanists I know are so devoted to an old band as to add new pieces every time it breaks. I have seen bands in use on the heaviest 200mm. foot lathes with no less than four sets of hooks and eyes.—A. F. SHAKESPEAR, Lüttichaustr., 14, III., Dresden.

[61069.]—**Telegraph Wires.**—The metal flaps about which Mr. Thurlow inquires are intended to preserve the grouse. It is found that all birds are apt to kill themselves or lose their wings by flying against the wires, and where there are many grouse the loss is sufficient to cause complaint. They do not seem to see the wires, but it appears that they can see the flaps; at all events, the method of hanging them on the wires answers very well. Some people imagine the birds are killed by electricity; but this is entirely a mistake—it is practically impossible.—R. S. CULLEY.

[61070.]—**Lathe.**—I understand the principle of the reversing motion well enough. What I want to know is how the rocking-plate is in fixed gear and out of gear, also what it rocks on? I may add that the lathes I have seen here have the rocking-plate swinging on the tail of mandrel or on the cross-piece; while on a lathe upwards of 30 years old there is a bungling contrivance of a slide, a slotted plate, and a weight.—A. F. SHAKESPEAR, Dresden, Lüttichaustr. 14 iii.

[61071.]—**Planing-Machine Tools.** — I had already, before writing query, tried turning the tool-box about in every direction, but all to no purpose. My slewing-plate turns 45° from the perpendicular. The plate is not pivoted at the end, but near the centre; will this affect it?—A. F. SHAKESPEAR, Dresden, Lüttichaustr. 14 iii.

[61090.]—**A Rule of Grammar.**—"Weald" is wrong in his German grammar. "Es est mich" would be both awkward construction and bad grammar. The reply to "Wer ist da?" would be "Ich bin es," or, quite short, "ich." "Mich" could not be used in any case. There appears to be a certain amount of elision in the phrase "It is I." "Who is there?" "I am there," "It is I

who am there." You could not say, "Me is there."—P.

[61081.]—**Number of L. and N.W. and G.W. Engines.**—The following, from Dorsey on "English and American Railroads" (1883), may be of interest:—

Name of Railway.	Total No. of Locomotives.	Average earnings of each Loco. in 1 year.	Miles in Work.
L. and N.W.	2,451	£4,228	1,793
Midland	1,629	4,520	1,381
G.W.R.	1,577	4,957	2,268
N. Y., Lake Erie, and Western	785	5,615	—
Boston and Albany	244	6,643	—

—SPECTATOR.

[61084.]—**Fireclay.**—"H. B." gives the following as analysis of two fireclays:—

	No. 1.		No. 2.	
Silica	98·0	per cent.	50·0	per cent.
Alumina	0·72	"	32·6	"
Iron	·18	"	3·5	"
Potash	·14	"	2·3	"
Lime	·22	"	0·4	"
Magnesia	0·0	"	0·4	"
Water	·40	"	9·7	"
	99·66	"	98·9	"

I always thought clay was a silicate of alumina, and No. 1 is as much silicate of alumina as a plum-pudding without the plums. Again, I do not see plasticity or power of cohesion in No. 1. Is No. 1 really correct? And for what is it used, and where? If it will hold together, will it not easily fuse? If I am wrong, please set me right, and, if you please, set me down as well.—R. S. T.

[61091.]—**Phosphorescent Insect.**—I do not think that "W. E. D.'s" insect is a glow-worm, which latter is an insect of the Coleoptera family, Malacodermata, though "Gamma Sigma" says it is not an insect; but "W. E. D." has found a phosphorescent arthropod, a centipede (commonly called). I have found them rather rare; but when found in a place they are found in considerable numbers—i.e., are very localised in their habitat. I believe that they differ from other phosphorescent creatures in that the light shows along their whole length, and specially at their joints, and not only from the cells composing the lower ventral layer of the abdominal segments, as in the glow-"worm." These luminous centipedes also leave a trail of phosphorescent fluid for a short distance behind them, the oxidation of the phosphorus (?) is, however, soon accomplished. I remember collecting about 500 of these centipedes in the gardens of Morden College, at Blackheath, during the late autumn in 1870.—GERARD SMITH, Upper Clapton.

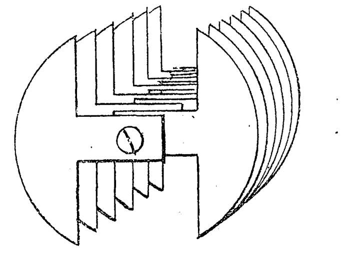
[61092.]—**Hot-Air Motor.**—TO MR. SEAL.—I should very much like to have drawings to scale of ¼ man-power, or of 1 or 2 man-power, which would be better still, if you will kindly send them. —G. M. S.

[61099.]—**A Rule in Grammar.**—It seems to me that both sides are, to a certain extent, right. Nouns not being inflected in English, the case depends upon their position, the first being the nominative and the second the accusative. "The man struck the woman" is one thing; "the woman struck the man" is just the reverse. In Latin this is not so; you may arrange the words in any order you like, the sense will remain the same. So, even in English, with pronouns—"he struck her," "her he struck," "he her struck" all mean the same; if you want to reverse it you must say, "she struck him." In Dean Alford's example the sentence is not fully completed. "If you see, &c., that [man] will be me," is correct; or you may put it, "I shall be that man." In the original query, I or me would depend on the full answer. "Who is there? Who did it?" "It is I who am there. It was I who did it," shortened colloquially into "It is I." A reply bringing "me" in would be so ponderous that it would not be ordinarily used, and so custom takes the simplest form for granted, and says "It is I."—P.

[61101.]—**Stars visible from Well.**—I am quite unable to conjecture how 8½° of latitude may appear when "viewed from the stars" [*sic*]. "E. D." does not seem to be *very* clear about it himself, and I would recommend him to read the other answers in the same number (1134).—R. E. F.

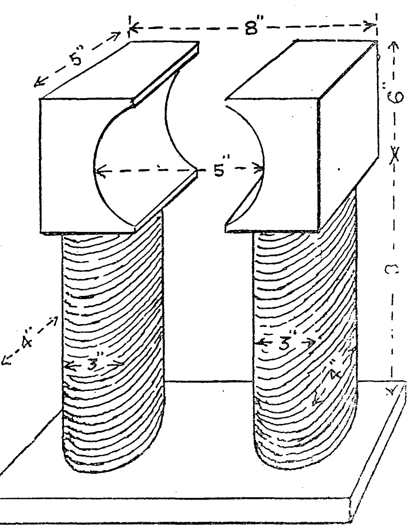
[61101.]—**Stars Visible from Bottom of Well.**—I think "E. D." must have misunderstood the letter of "R. E. F." on this subject. As a matter of fact, according to Sir John Herschel's statement in his "Outlines," that only those stars are visible which *pass* the zenith, γ Draconis would be about the only star likely to be seen in the latitude of London; and as regards the remainder of "E. D.'s" contention, 8½° variation in latitude would (on the same principle) include several bright stars in Ursa Major, Cassiopeia, &c., with a Northern Declination corresponding to a given intermediate latitude. But, on the other hand, Arago, in his "Popular Astronomy," says (if I remember rightly) that any star whose distance from the zenith is less than 50° should be visible in the supposed position. This extreme seems to me to amount almost to an absurdity; but with two such eminent authorities as Herschel and Arago at variance, I do not see how the matter is to be solved. Perhaps "F.R.A.S.," or some other talented correspondent, would favour us with their estimates of the radius in degrees of such a circle as Arago supposes to be visible.—B. A., Handsworth.

[61114.]—**Dynamo.**—TO MR. BOTTONE.—The slight difference in size will not make much difference in power, provided the iron be nice and soft. In the laminated armatures I send out, made from punchings of sheet iron, the shape of half a section of an ordinary H armature, the laminæ are laid as in the annexed sketch—viz., one to the right and



one to the left of the spindle—until the spindle is full up. By this means the laminæ are closely clamped together at their centres, but have air spaces at their extremities.—S. BOTTONE.

[61119.]—**100-Candle Dynamo.**—TO S. BOTTONE.—Herewith you will find sketch, with



dimensions, for Edison-Pacinotti dynamo, which is the best form; have the yoke below as a base plate, and pole pieces upwards. If wound as a series machine, put about 4lb. of No. 18 on the armature, and 8lb. of No. 16 on the fields. You will easily get 100c.p.—S. BOTTONE.

[61122.]—**Magic-Lantern Slides for Boy's Lantern.**—Gelatine films, 3¼in. square, are sold (see Sixpenny Sale Column) for tracing magic-lantern slides. Lay the gelatine film over the engraving to be copied, with a piece of thin tracing paper, or transparent oiled tissue paper between, and trace with Indian ink, using a fine-pointed pen. When finished, mount between glass slips or squares, as the tracing makes the surface rather uneven and wrinkled. In back numbers of "Ours" there are full directions by "Sable" for both outlining and painting slides, which have been reprinted and published by Mr. W. C. Hughes, who advertises in this paper. "Sable" recommends, for plain outlining, lampblack in oil mixed with mastic varnish and turpentine, using a very fine sable-hair brush. If "M." has not got this book, the outlay of 1s. over it will repay him in the information gained.—ARINAS.

[61127.]—**Force Pump.**—Such a pump as is used in connection with an air-gun seems what you want. It is an iron tube about $\frac{11}{16}$ diameter, 14in. long, having a smooth bore and a well-fitted iron piston about 2in. long, with a piston-rod, which by means of a cross-piece is held by the feet while the receiver is worked up and down by hand. Air is admitted by a hole in the tube when receiver is up, and at opposite end of stroke it is forced through a hole about $\frac{3}{32}$ at upper end of pump. For simplicity, make your tube of mandrel-drawn brass tube, and the plug of lead, tin, or type-metal cast in tube and on to piston-rod; smoke inside of tube before casting, and in any case use plenty of oil in working pump. To get greater power lengthen tube and decrease its diameter.—H. O., Glasgow.

[61136.]—**Screw-Cutting.**—The correspondent has not understood the rule of "J. H.," which applies to a leading screw of any pitch. For example, a thread of 2¾ to the inch would be in fractional form $\frac{4}{11}$, and the nut would gear properly every 4in. The matter may be grasped by him if he will divide his required pitch by that of his leading screw; if it will divide by 4 his nut will gear at any thread of leading screw. If double the number, will so divide at every second thread; if four times the number at every fourth, and so on.—H. O., Glasgow.

[61136.]—**Screw-Cutting.**—For external work run saddle back against back poppet, or stop, if you prefer it; then take distance to where thread is to terminate, and you will find if 1⅝in., and you are anyway smart, you will drop nut in right, unless you are running lathe too quick; 1⅝in. gives more time, and the same by longer distances. Internal work: Run tool in as far as it is to go, and mark it at face of work. Now run tool back with saddle until it is just clear about ¼in.; then take distance from face of work to mark on tool, if 1⅝in., 2⅝in., or 3⅝in., you can scarcely go wrong by keeping lathe in motion, provided you run back poppet up to a stop against saddle as before—a bit of wood I use; and with a little practice this is all that you need mark, provided you occupy the same time in running saddle back every time, because you can scarcely do that in the time occupied in leading screw revolving ⅛in.; therefore, you could not drop nut in at ⅝in. in cutting screw. It is in only exceptional cases that I mark anything else.—ONE OUT OF WORK.

[61139.]—**Chromic Acid v. Bichromate.**—On title page of "E. M." an advertisement states chromic acid is 20 times as strong as bichromate solution. What I want to get at is, is this borne out by the experience of any of your subscribers? What will a given weight of chromic and sulphuric acids do? What are the best proportions to use? Mr. Bottone says chromic acid 1, water 2, sulphuric acid half by weight. Now, at this rate I am able to compare: bichromate solution saturated 14 pints costs 2s. 1½d., and does for a certain purpose 30 hours' work. Chromic acid solution, 14 pints, would cost 5s. 1¼d., and so, price for price, it should do same work for about 70 hours, and if it is 20 times as strong as bichromate, then 20 by 70 equals 1,400 hours of work. Of course, I know all advertisements are to be taken with a grain of salt; but does the experience of any of your readers come anywhere near this—say, half, or a quarter the time?—W. W. N.

[61140.]—**Stains on Marble.**—I think that if the stains are not marks in the marble itself, the following will remove them:—Two parts of soda, one of powdered chalk, and one of pumice stone; sift through a fine sieve, and mix into a paste with water. Rub this well on, and wash off with softsoap, and then polish with a soft cloth.—BROSCENICUS.

[61141.]—**Screw-Cutting.**—If "Chaser" knows how to cut the threads he describes with single train, why run double one? However, if 20 and 80 will cut two threads, 20—80—40—80 will cut 12 threads; consequently $\frac{20—80}{50—80}$ will cut 13 threads, and $\frac{20—80}{70—80}$ will cut 15 threads.—ONE OUT OF WORK.

[61141.]—**Screw-Cutting.**—Pursue usual rule for single train, viz., mandrel wheel = threads per inch of leading-screw × say 10; screw-wheel = required pitch × say 10. For $\frac{1}{19}$in. pitch you would have mandrel 20, screw 190, which last you would split into 95 × 2, making your train $\left\{\begin{matrix} 20 & 30 \text{ drivers} \\ 60 & 95 \text{ driven} \end{matrix}\right\}$. For the 60 and 30 you may substitute any wheels of same ratio; but you cannot dispense with 95 and 20. I find simplest form of calculation to be—say, for $\frac{1}{13}$in. pitch, 13 ÷ pitch of lead screw (2) = 3¼ × 2:—Train: $\left\{\begin{matrix} 20 & 40 \text{ drivers} \\ 65 & 80 \text{ driven} \end{matrix}\right\}$; the first pair represent 3¼, the second pair represent 2. The position of drivers is of no consequence.—H. O., Glasgow.

[61143.]—**Launch Engine.**—The cut-off is usually spoken of as at the portion of stroke of engine, which is a simple way of expressing it for that cylinder; but it is in reality the proportion of

its capacity at which steam is cut off. So, if you increase length of cylinder, but cut off at same length of travel of piston, it is clear that is a less proportion of the cylinder's capacity, and consequently a greater amount of expansion takes place, with a consequent saving of fuel in proportion to power. In the cases given, expansion with 5in. stroke is 1·5 time, and with 6in. would be 1·8. The effect of the proposed alteration would be an addition to present power of about $\frac{1}{8}$th for same amount of steam. This is due to increased piston speed = + $\frac{1}{5}$ decreased by average reduced pressure on piston = probably − $\frac{1}{13}$. Power is in proportion to area × speed × average pressure.—T. C., Bristol.

[61143.]—**Launch Engine.**—By increasing the stroke from 5in. to 6in. you would gain in power about a $\frac{1}{4}$H.P. You must bear in mind that you would use more steam by increasing the stroke; in your case, $\frac{2}{3}$ of 5 = 3·3 distance travelled by piston before steam is cut off. Now, by increasing the stroke to 6in. you have $\frac{2}{3}$ of 6 = 4, the distance travelled by piston before steam is cut off, consequently you will use $9\frac{3}{4}$ cubic inches of steam more every revolution. Instead of lengthening the stroke, and if your cylinder will allow it, why not bore it out to $3\frac{3}{16}$in.? It will be much cheaper, more economical, and will develop the same power as the extra inch in the stroke;—all that you will require will be a new piston. To prove that by enlarging the cylinder's diameter less steam is used, we will take the 3in. by 6in., point of cut-off 4in., area of cylinder 7in., then 4 × 7 × 2 = 56 cubic inches per revolution, and 56 × 300 × 60 = 1,008,000 cubic inches per hour, which divided by 1728 = 577 cubic feet used per hour. Now, take the cylinder as $3\frac{3}{16}$in. diameter × 5in. stroke—area = 7·9; point of cut-off in this case will be 3·3. Then 3·3 × 7·9 = 26·07 × 2 = 52·14 × 300 × 60 = 938520; this divided by 1728 = 543 cubic feet per hour, so that enlarging the cylinder $\frac{3}{16}$in. you have the same power as you would have by increasing the stroke 1in., and at the same time you save 34 cubic feet of steam per hour.—ENGINEERING, MANCHESTER.

[61145.]—**Does it Boil?**—Boiling, or ebullition, means the rapid evolution of bubbles of vaporised liquid accompanied by movement of the mass of the liquid and a characteristic noise. The true physical definition of ebullition or boiling is this. "A liquid is in ebullition when it gives off vapour of the same tension as the atmosphere above it." Hence the temperature at which boiling takes place will vary with the atmospheric pressure. Water, for instance, boils at 100° Cent. or 212° Fahr. at an external pressure of 760mills. But under the receiver of an air-pump, water may be made to boil at any temperature between 0° and 100°. As to the production of vapour or steam, that occurs over a very wide range of temperature. Ice and snow are continually giving off vapour, even at temperatures below 0° Cent. This vapour or steam, however, is not visible unless it meets with colder air, when it instantly condenses to form the so-called "steam" as seen coming out of the spouts of our kitchen kettles. This is the explanation of the visible steam over the teacup. The steam given off by the hot water meets with the colder atmosphere, when it instantly becomes condensed into vesicles of water, and hence visible. The same reasoning explains the steaming of a fence on a sunny winter's day.—S. BOTTONE.

[61145.]—**Does it Boil?**—I put my query (p. 333), which was quite bonâ-fide, with a presumed belief that water sometimes became invisible and aëriform by a process other than boiling, and essentially distinct from boiling, and I desired to know what was the scientific account of this process. I appealed to common teaching in favour of the statement that water, when raised to the boiling-point (*pro re*), acquired a special capacity for becoming aëriform which it was considered not to possess below that temperature. The examination student, or the professor who gives him marks, may feel that the matter is entirely elucidated by saying that one case is "ebullition" and the other "vaporisation"; but, to my own mind, two grand scientific names no more constitute an explanation than two dishes make a pie. I inquire of myself, and of others, What is the nature of "vaporisation," if it is so to be called, and what is the essential distinction between this and ebullition, owing to which vaporisation takes place at all kinds of temperatures, whilst ebullition cannot begin until a certain temperature (according to pressure) has been obtained? I know that when a pool abates its level, the case is one of solution of water in air. Just as a lump of sugar dissolves at the bottom of a cup of tea, so a lump of water dissolves at the bottom of the atmosphere. Now, I want to find the courage, and have nearly found it, to tell myself that when the kettle is in that condition at which the expectant tea-maker asks, "Does it boil?" the case is still one of solution of a liquid in a gas, and that a cup of steaming-hot water has more affinity with the secretly evaporating pool, in regard to its physical condition and mode of forming vapour, than with the truly boiling kettle. My query, as it stood, has been so universally misunderstood, that the fault must lie in the querist who framed it. Nevertheless, I am eager to thank my two instructors, "Nun. Dor." and Mr. E. Conry, and would add some acknowledgment to the "F.R.A.S.' for giving attention to the case.—WEALD.

[61148.]—**Screw-Cutting.**—Twentieth part of 3in. at the fifth of a rev., 20—100—40, or $\frac{3}{4}$in. pitch. Twentieth part of 3in. at the fourth of a rev., 60 and 100 drivers, and 80 and 40 driven.—ONE OUT OF WORK.

[61148.]—**Screw-Cutting.**—Pitch of screws required: $\frac{1}{20}$ of 3in. = $\frac{3}{20}$in. which × by 5 = $\frac{15}{20}$ or $\frac{3}{4}$in. or $1\frac{1}{3}$ thread per inch, and $\frac{1}{20}$ of 3in. = $\frac{3}{20}$in. which × 4 = $\frac{12}{20}$ or $\frac{3}{5}$, or $1\frac{2}{3}$ threads per inch. See reply 61141 for rule, or take $\frac{1}{4}$in. and $\frac{1}{5}$in. pitches from your index plate, and drive your screw in each case three times as fast. Train for first: Mandrel 40, driving by means of two idle stud wheels 30 on same stud as which is 90 driving 40 on screw. Train for second the same, except screw wheel, which is 50; alter to suit size of lathe if required. Above is for $\frac{1}{4}$in, pitch lead screw.—H. O., Glasgow.

[61151.]—**Liquid Fuel.**—If "K. N. S." is near London, he can see the liquid fuel furnace at work, just as it has been for several years, at Hackney Wick; but he should refer to back volumes for illustrations. The creasote is usually supplied to the nozzle by gravity, being forced up a pipe by its own weight. Just as it reaches the top it is blown into spray by a powerful jet of steam and driven into the furnace as a sheet of flame. Probably some readers can give you actual dimensions to suit; but, although creasote, or the dead oil known generically by that name, has been used for years, the accounts we have heard lately about the economy of liquid fuel require to be taken with a considerable grain of salt. A lining of firebricks is not necessary, though it may be an advantage to some conditions. See the description of the Shipman steam-engine with petroleum furnace on p. 419, Vol. XLII.—SAML. RAY.

[61157.]—**Liquid Fuel.**—The good form of spray producer would be a short funnel shaped passage leading into the firebox high enough up to inject all over the bars, the shape being rectangular, corresponding with that of the firebox, and the slant of the sides sufficient for the sides if produced to describe a rectangle rather larger than that of the firebox. Towards the narrow end should be fixed the spray-producers. There are various forms; but several strong grids of metal-work with the openings not coinciding, and placed pretty close together, are a cheap and good form. Several thicknesses of strong galvanised wire netting placed one behind the other answers well for a time; but the zinc wears off the iron with the rush of the steam, so the layers should be made easily replaceable. I should suggest arranging the funnel to be removable, with a movable connection to a permanent steam nozzle, or else have a sliding shutter to close the end of it. The length of the funnel may be 3ft., and diameter at smallest end 1in. The oil-drip should not be less than 12in. from the steam jet. The firebox should be covered with asbestos knots, or pieces of broken firebrick (cinders soon pulverise) as closely as possible without absolutely choking up the air draft. A very little space will do for this latter, as the oil spray acts as a powerful steam-blast. Use as little steam at as high a pressure, and as dry, as possible.—EDWARD CONRY.

[61162.]—**Sewing Machine (Wheeler and Wilson).**—"Pestered Man" does not say a word about the top tension. If he will make this tighter, the machine will perhaps cease to pester him. The lifting of feed-bar has nothing to do with the top thread, and is only that the teeth can grasp the work before moving it forward another stitch. The thickness and stiffness of the work has more to do with the fault, and this hook should have a stout needle, large stitch, and sufficient tension to draw up the loop or work if white soaped, and the arm should be properly timed with the rotary hook. If not cured as above, ask again.—J. I. S.

[61166.]—**Engine for Boat.**—"Novice" is expecting rather too much from a boat 36ft. by 6ft., for it would take about 62H.P. to drive it at 12 miles = 10·4 knots per hour, and unless he is prepared to put in loco. boiler, forced draught, with closed stokehole and special engines, similar to those in a torpedo boat, the weight of engines, &c., would just about sink her, leaving nothing for fuel or passengers. About seven knots, say, eight miles per hour, is an outside speed for such a boat; even then she will have to be much stronger than he indicates by his weight.—GFYUNG.

[61166.]—**Engine for Boat.**—I have assumed your boat to have an immersed midship area of 6sq. ft., and to drive the boat 12 knots an hour it will require an engine of at least 15h.p. Taking your boiler pressure at 80lb., a compound engine to develop this power must have h.p. cylinder $6\frac{1}{2}$in. diam.; l.p. 11in. diam., with a stroke of 6in. For boiler I would suggest the marine return-tube type, 3ft. 6in. diam. by 5ft. 6in. long; firegrate area not less than $3\frac{1}{2}$sq. ft.; and total heating surface, 45sq. ft. This type of boiler would cost about £80. A vertical boiler would be cheaper, costing about £45 to £50.—ENGINEERING MANCHESTER.

[61169.]—**Safety Couplings.**—The hook-pole coupler has been in use for some years on several railways, and consists of a stick or pole with a hook at the end for lifting the shackle on to the waggon hook. No safety coupling has been adopted, nor, so far as I can see, is likely to be. I am afraid your correspondent has been misled by the newspapers.—NUN. DOR.

[61173.]—**Varnishing Fishing Rods.**—"Brown hard" spirit varnish, as used by French polishers, procurable at any oilshop, applied with soft camel hair brush in a warm room, will do the trick. It would be well to "paper down" the rods first with, say, No. 1 glasspaper.—S. BRETTON.

[61173.]—**Varnishing Fishing Rods.**—I do not think the querist will do much good with a shellac varnish, even if it is made with rectified spirit. (N.B.—Rectified spirit is out of place in making a varnish when methylated alcohol answers the same purpose.) I think it would be better to use stoving copal, and "stove" the joints of the rod; but possibly the best amber varnish, put on in a suitable temperature, would answer as well; or if shellac is used it should be just as French polish is put on. I think if I wanted to varnish a fishing rod I should try French polish, and do the work in the warm weather; but as a guess, I fancy the rod makers "stove" their work.—SAML. RAY.

[61177.]—**Plate Machine.**—This is just the very subject our estimable friend Mr. Bottone took so much trouble about a few months ago. See back numbers; can't refer myself, as last two vols. at the binder's.—S. BRETTON.

[61177.]—**Plate Machine.**—Yes; an 8in. disc will give a 1in. spark. For information as to mounting discs, both with and without central aperture, kindly turn to the first and second numbers of my "Electrical Instrument Making for Amateurs," in the ENGLISH MECHANIC, Vol. XLII. No. 1,086, p. 396.—S. BOTTONE.

[61178.]—**Electric Lamp.**—Cannot be satisfactorily done.—S. BRETTON.

[61178.]—**Electric Lamp.**—I have found that the difficulty can be overcome thus. Heat the glass (at the point where the breakage is) very carefully and gradually over a spirit lamp; when sufficiently soft, push it back from the platinum with the point of a knife till a little bit of the wire is uncovered: a very short end of this can be bent over so as to form a hook (not loop), to which any required attachment may be made, and all will be right.—TRY.

[61178.]—**Electric Lamp.**—I have frequently been able to solder a copper wire loop to the flush end of the platinum. To do this, hold a thin rod of solder in the flame of a spirit lamp; approach the lamp to the flame (having previously touched the platinum end with soldering fluid). As soon as the solder softens, rub it on the end of the platinum;—some will adhere. Allow the lamp to cool gradually. Now get a little globule of solder to adhere to the tail of a copper loop, shaped like Q; again warm both lamp and loop, bring them together, and the job is done.—S. BOTTONE.

[61178.]—**Electric Lamp.**—I have many times mended broken lamps as follows, provided a small portion, say, $\frac{1}{16}$in., projects beyond the glass. Scrape platinum clean with knife, cut two copper wires (No. 18) 3in. long, tin one end of each, make small soldering iron out of No. 4 copper wire, and quickly solder a wire to each platinum, using muriate of zinc. This done, select piece of tube (any material) large enough to slip over small end of bulb up to shoulder, passing the wires down centre. Rest the whole on a box of earth or sand (terminal end uppermost) to make a steady rest, and fill up tube with plaster of Paris. Leave 24 hours to set. Use copper wire for connectors.—W. W. N.

[61179.]—**Concrete and Cement.**—Concrete and cement made up with sea-water is liable to get damp in wet weather, and to "bloom" out with white powder on the surface in dry weather; also to break up in frosty weather. This is caused by the deliquescent salts held in the water, which cause the concrete or cement to absorb moisture from the air.—GEORGE EDWINSON.

[61179.]—**Concrete and Cement Plastering.**—Sea-water is not suitable for making concrete or cement, on account of the salts it contains. If your correspondent really wishes to make some of the best concrete or cement plaster he should use a saccharine liquid, not sea-water. A little sugar in the water—a decoction of malt, or probably

even treacle-water would answer; but the simplest arrangement will be to mix the mortar, cement, or plaster with water containing, say, 2oz. of sugar to the gallon. If any reader tries this, please report results whether favourable or not. It is an old dodge—goodness knows how old,—but is not much used nowadays, although there is no doubt that sugar-water enormously increases the strength of mortar.—SAML. RAY.

[61180.]—**Dynamo.**—I am rather doubtful whether you will be able to light six lamps with so small an armature. Try 2lb. No. 22 on the armature, and 8lb. No. 16 on the fields.—S. BOTTONE.

[61181.]—**To Mr. Bottone.**—The proportions given are fairly accurate.—S. BOTTONE.

[61182.]—**Lead Hammers.**—Add the antimony wrapped in lead to the rest of the lead whilst in a molten state, then stir all well together.—GEORGE EDWINSON.

[61182.]—**Lead Hammers.**—If this querist cannot manage to get what he wants in any other way, he can melt some lead and add old types to it until he thinks he has made the lead hard enough. The types will probably contain metal which will improve the lead hammer. If "W. M." wants only a few heads he should get some tea-chest lead, melt it, throw in a little bit of tallow, and stir briskly. The dirt will rise and can be skimmed off, when the antimony, or the old type or stereo-plate is added by degrees, the lead being raised to a red heat as it is called; for if merely at fusion temperature it will simply vaporise the antimony, as you have found. If you use old type, you will avoid much of that difficulty.—SAML. RAY.

[61189.]—**Precipitating Gold Chloride.**—The solution of cyanide of potassium to dissolve chloride of gold should be a strong one. Perhaps yours is too weak. When the chloride is dissolved in distilled water, there is frequently a small quantity of white precipitate at the bottom. The pale straw-coloured gold solution is to be poured off from this, then the strong cyanide solution gradually added, stirring with a glass rod. A brown precipitate should be formed, and the cyanide should be added drop by drop until it produces no further effect.—BOBADIL.

[61189.]—**Precipitating Gold Chloride.**—You probably mean potassium cyanide, not "gold cyanide." Gold cyanide is not easily precipitated from a solution of gold chloride by amateurs. You have prepared the gold chloride rightly. It should be dissolved in distilled water in the proportion of 5 fluid ounces of water at least to 1 of the chloride. Add the solution of potassium cyanide with much stirring until a precipitate begins to form, then leave it at rest for several hours. Again stir well, and leave at rest. The precipitate forms slowly, so you must be patient with it. The battery process of forming the solution for gilding is much the more convenient and economical for amateurs. Next to that is the solution made by throwing down the gold as an oxide with calcined magnesia, washing the pp. and dissolving in a solution of potassium cyanide.—GEORGE EDWINSON.

[61192.]—**Colouring Gun-Stock Fittings.**—One portion of your gun furniture should be blued, the other case-hardened; the butt, or heel plate, and guard should be blued; the trigger-plate, triggers, and lock-plate should be case-hardened. First, get as good a polish as you can on all the parts. For blueing, make a rough sheet-iron box, say, 8in. square; just cut the sheet-iron, and double over the ends. No rivets required. Next fill your box with powdered charcoal; now put the box on a good fire, stir up the charcoal now and then till you find it is partly ignited. Then put one of your articles into the centre of the charcoal, so as to be nicely covered from the air; but, first, before putting the article in, rub it over with a piece of rag or tow dipped in dry powdered lime. Every seven or ten minutes lift it out with a pair of tongs; don't keep it longer in the air than you can help, and every time you take it out brush it over with the dry lime—you must be quick about it. The first blue you will get fades; go on till you get the second blue, which should be rich dark, bordering on black. When you have obtained the desired colour, stand by to cool, then oil; any oil will do. There must be no grease on the things you want to blue. You did not say what kind of gun, so that I don't exactly know what kind of fittings you have. For the case-hardening you may use the same iron box as for the blueing. But do the blueing first, as the case-hardening may spoil your box if it be of thin iron. Proceed thus: half fill your box with bone-dust, lay all your articles in, then fill up the box with more dust; place your box in or on the fire, put some red coals on top; keep a good fire. Forge or kitchen fire will do; any fire where you can get plenty of heat. Let the box remain in fire till the whole is a good red heat, bone-dust and all. Now lift your box off the fire, and quickly turn the contents into a pail of cold water, they are now case-hardened. You have only to dry and oil the articles. They should have a nice mottled appearance. If you cannot get bone-dust, get some bones, burn them in the fire, and pound them up. But if neither can be got at, get some old boots and scraps from a shoemaker, put the leather on the top of a fire till well burnt; now powder, and use as you would the bone-dust. For my part, and I have had years of experience, I prefer the leather—I think it gives a better colour than the bone-dust. If you case-harden your lock-plate, mind you take off all the posts: and of the lock case-harden only the base-plate. Write again if you have any difficulty. You have not given your address, so I cannot send the tool until I know.—ARMOURER.

[61195.]—**Damage by Woodworms.**—Try soaking the woodwork in paraffin oil if turps has failed entirely. Are you sure that the wood was well soaked in turpentine?—GEORGE EDWINSON.

[61195.]—**Damage by Woodworms.**—A bad piece of wood does infect another; cut out all the bad pieces where this can be done without damaging the appearance of the furniture, substituting new and sound wood. Where this is inconvenient, soak the parts affected for a week with common petroleum. I have found this effectually stops the little game.—S. BRETTON.

[61195.]—**Damage by Woodworms.**—If you can get any oil (even paraffin) thoroughly into the holes you will kill the boring insects, but that is not easy. As a simple remedy try forcing lard into the holes until full, and then heat the furniture sufficiently to melt the lard. The really effective remedy would be to put the woodwork into a chamber from which the air can be thoroughly exhausted.—NUN. DOR.

[61195.]—**Damage by Woodworms.**—Make up a strong solution of corrosive sublimate, and if you have nothing else to do, squirt it into the holes with a very fine syringe. Or you may go over the woodwork several times with a rag well soaked in the solution; but be very careful with it, as it is a deadly poison. If well applied, the worms will be instantly killed, and the wood will be free of them until it drops to pieces. This is also a valuable method for preserving skins against moths.—R. E. F.

[61196.]—**Staining Leather.**—Staining leather is really dyeing leather, and "F. K." should therefore use the aniline dyes, and refer to an article in your last volume, p. 431, and to p. 388 in same volume, where he will find full particulars. Those pages are in Nos. 1110 and 1112, which appeared only a few months ago.—NUN. DOR.

[61198.]—**Induction Coil.**—This coil, if well-wound, should give about ¾in. spark.—BOBADIL.

[61198.]—**Induction Coil.**—If your coil is really carefully insulated, it should give from ½in. to ⅝in. spark.—S. BOTTONE.

[61200.]—**Work Done by the Heart.**—The following daily diet is sufficient for an adult man:

Albuminous food	3·5oz.
Fats	3·1oz.
Starch	10·7oz.
Salts	1·0oz.
Water	5 pints.

It is estimated that a man produces in the 24 hours over 2½ millions of units of heat, which are lost by the skin and lungs, and in heating the ingesta and the air breathed. The strange part about it is that if the heat value of such a diet be calculated, it does not nearly equal the heat given off by the body.—R. E. F.

[61200.]—**Work of Heart.**—The average weight of so-called solid food consumed by an adult doing ordinary work is from 40 to 60oz. According to W. Blyth, the diet of an English soldier consists of 12oz. meat (one-fifth bone), 24oz. bread, 16oz. potatoes, 3¼oz. of milk, 1·3oz. sugar. Such a diet, being equal to 266gr. nitrogen and 4,718 carbon, will provide sufficient energy for internal work, and also 300ft.-tons external work. Dr. Parkes' calculations, based on Dr. Frankland's experiments, show that the energy to be obtained from 1oz. of different foods in their usual condition is as follows:—Cooked meat, 106·2; bread, 87·5; oatmeal, 130; potatoes, 33; cabbage, 13; eggs, 67·3; milk, 26·9; cheese, 149·9ft.-tons. The work of heart is only part of internal work; respiration and various other expenses of energy must be also allowed for. The total internal work of body being estimated at 260ft.-tons (Blyth), this, with 300 to 340ft.-tons external work (a good day's work), make 600ft.-tons, the equivalent of which must be obtained from food. It must not be forgotten that many conditions must be taken into account in these calculation—e.g., digestion, individual, &c.—KENSINGTONIAN.

[61206.]—**Clothing.**—I would recommend this good housewife with the long name to consult the mistress of the nearest National or Board-school. Since needlework was made compulsory in elementary schools, cheap little books on sewing and cutting out have been published; a school teacher could, therefore, advise "J. C." where to find the instructions she needs to enable her to carry out her most praiseworthy wish to shape the garments of her little cusses.—A SCHOOL MANAGER.

[61206.]—**Boy's Clothing.**—My wife gets a good pattern old coat, vest, or trousers, takes it to pieces, and uses the parts as patterns for the new clothes; or she will get a garment, take it to pieces, cut out paper patterns of the same shape as the pieces, and keep these patterns in stock. As the boys grow she makes sufficient allowance for the growth by cutting the parts larger than the patterns.—GEORGE EDWINSON.

[61209.]—**Psychological.**—This query is addressed to "Garrison Gunner"; but as I am personally acquainted with the wonderful case referred to by Mr. T. Edge (details of which are given in last month's *Nineteenth Century Review*), I take upon myself to offer an opinion, and it is that there is a great difference between the case of his friend "wholly given up to drink," and that referred to. "The patient in the Salpetrière" was insane, and the insanity was of such a frightful type that neither I nor any of my collaborateurs in the Paris hospitals ever saw anything to equal it. On the other hand, the craving for intoxicants is associated oftener than not with persons who are perfectly sane. They (the intoxicants) may be said to produce temporary insanity; but that is very different from the "wonderful case." In a word, the one could not be held as a precedent for the other, and as far as I know, mesmerism has not as yet cured a drunkard.—B.SC., Plymouth.

[61209.]—**Psychological.**—By all means try the effect of mesmerism with your friend. If anyone can be found who can mesmerise him, and who will take trouble with the case, and use patience, the cure will have every chance of success. If Mr. Edge has time at his disposal, he would do well to try to mesmerise his friend himself; and let him try at least six sittings of an hour each, on six consecutive days, before he comes to the conclusion that he cannot do it. If no one can be found in the patient's circle of acquaintances able to mesmerise him, I would say seek out a man who is known to have the power, and who does not exhibit it for gain. If such cannot be found, apply to a professional mesmerist. There is no doubt whatever of the possibility of cure by this method, and, curiously enough, I was talking last week to a man of some note as an investigator, who told me that exhaustive experiments were being made at present in Paris, which had already established the fact of the possible cure of drunkenness by mesmerism, and also the power of mesmerising from a distance. I shall be glad to give Mr. Edge any help I can, and hope he will let me know the result of his experiments. In case of difficulty in obtaining a mesmerist, I would advise Mr. Edge to write to the Secretary of the Society for Psychical Research, or, if in London, call at their office (I think it is in Southampton-buildings), and ask for Mr. Frank Podmore, who, I doubt not, would be able to recommend him to the right place.—GARRISON GUNNER.

[61211.]—**Planing Machine.**—If my advice is worth anything you will have your driving as simple as possible, and with equal speed in return as in cutting—the rest to the leg is very welcome. If driven by power you might have a quick return. I fitted one as follows to a small machine:—A slotted link pivoted at one end to frame outside driving-wheel, and the connecting-rod pivoted at one of sundry holes between this and end of link, to vary the throw. The crank-pin of driving-wheel slid in the slot of the link, and that completed the affair; but, of course, a block in slot would have been better.—T. C., Bristol.

[61213.]—**Engine Query.**—You must have a good bit of play in the motion bars. If you will make a rough sketch of piston and rod, and connecting-rod and crank, you will notice that (as they are not in a straight line except at end of stroke) when the crosshead is making the in stroke in back gear, it must necessarily be pulled against top bar and thrust against bottom bar in the out-stroke. When the engine is in forward gear all the motions and strains are reversed, and so the reverse action is shown on the bars as you note. A simple chalk sketch will make it clear.—T. C., Bristol.

[61215.]—**To Mr. Bottone.**—I may not reply to this query, as the reply would be an advertisement. Will you kindly refer to the "Sale" column for my address, and communicate to me personally, when I will do what I can for you? The lamp gave about 5c.p., and required 2 volts.—S. BOTTONE.

[61219.]—**Gold Solutions.**—To keep these in working order always use an anode of pure gold slightly larger than the article to be gilded; also add a small piece of potassium cyanide to the solution occasionally. Your solutions become spent for want of sufficient pure gold and free cyanide to dissolve the anode.—GEORGE EDWINSON.

[61219.]—**Gold Solutions.**—Reading this query between the lines, as it were, permit me to ask

whether the troubles of the querist do not arise from the simple fact that he has taken much of the gold out of the solution after "four or five times" using? Probably if he put a piece of gold into his solution and kept it there while the battery was working he would not experience any difficulty. I have always heard from electro-platers that strong solutions work best, and in nickel-plating it is almost a sine quâ non to surround the article with anodes of nickel, so that the solution may be kept fully charged.—NUN. DOR.

[61219.]—**Gold Solutions.**—It will be difficult to fix upon the fault in "Puzzled Jeweller's" solution, but there are three methods which might be tried to get the desired results—(1) An article with a pale deposit, after being brushed, should be immersed in the bath again for an instant, and immediately plunged into boiling water. This should result in a fine gold colour. (2) A solution worked at a lower temperature than 130° Fahr. invariably yields a pale deposit. The best colour is got when the solution is rather above than below this temperature. (3) Whenever a gold solution gives bad results as to colour, the best and simplest remedy is to evaporate it to dryness; re-dissolve the dried mass in boiling distilled water, and add a little cyanide. There is no expense in this operation so far as the gold is concerned. Last of all, keep the solution in any large enough vessel other than a corked-up bottle. The act of pouring it out of the latter stirs up the impurity which gathers through time. In a suitable vessel with a lid to keep out dust, the impurity will lie at the bottom.—BOBADIL.

[61223.]—**Balancing Millstones.**—For true running it is not only necessary that there should be the same weight each side of a diametrical line, but also that there should be the same weight above a horizontal line through top of cockhead on each side of a diametrical line, and also a similar—not the same—balance on the lower half. If this were so, stone would be in both running and standing balance; if not, it is clear the centre of gravity of one-half is higher than the other half. Some stones have means of lowering the loading or raising it as required. If stone is out of balance, spindle will soon begin to wobble; hold a piece of chalk against it when running, and it will mark the heavy side.—T. C., Bristol.

[61224.]—**White Metal.**—I have not tried this for toe brasses, but have sometimes repaired them with ordinary solder, and they have run fairly well. The great secret to make the toes last is to have ¼in. hole drilled in bottom, but not through, by ⅜in. to ½in.; never mind side grooves; this prevents them heating.—T. C., Bristol.

[61227.]—**Model Boiler.**—You must really give us some dimensions, as well as describe the shape; an 8-gallon pot might be any depth or diameter. I should, in any case, recommend you to sell it for the value of the metal, and procure new brass with the money.—T. C., Bristol.

[61228.] — **Lantern Transparencies.** — I always use lampblack ground up with pallette-knife on a glass slab, with gold size and turps.—S. BRETTON.

[61231.]—**Dynamo (Ten 20c.p.)**—TO MR. BOTTONE.—An A gramme, with Pacinotti ring armature, laminated, gives as good results as any for a machine this size; it is also easy of construction. My castings for this size machine stand 1ft. 1in. in height, and are 1ft. 4½in. long; armature, 4⅞in. in diameter, 2½in. wide; 4lb. No. 18 on armature; 8lb. No. 16 on fields for series wound; or 20lb. No. 20, if shunt-wound. If I am spared, I intend shortly to send a paper to the Editor for publication, referring specially to the ring armature type of machine.—S. BOTTONE.

Alloys of Lead and Tin.—A paper was recently published on the specific heat of alloys of lead and tin, by W. Spring (*Bull. Soc. Chem.*). At low temperatures, alloys of lead and tin behave as simple mixtures of their constituents, each element still keeping its specific properties; as the temperature rises, a molecular action takes place, the molecules of each metal being broken down into molecules of simpler construction. This molecular modification increases in rapidity with the rise of temperature, and at a certain point attains its maximum, when the alloy melts, and it is to what the author terms the simplification of the molecules of the metals when heated in intimate contact with one another, that alloys so frequently have a melting point situated below that of either of their component metals. After the alloy is fused, the molecular change becomes less active, and finally, at a certain temperature varying with the composition of the alloy, ceases altogether; the alloy then once more behaves as a mixture of the component metals, each, however, having a more simple molecular structure than that of the separate metals at the same temperature. On cooling a melted alloy, an inverse action takes place.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last S. Bretton has replied to 60514.

60655. Strength of Type Metal, p. 162.
60684. Shaft, 163.
60692. Relative Positions of Flat and Eyepiece, 163.
60694. Phosphorescence, 163.

60861. Wind Wheels, p. 247.
60878. S.E. Locos, 247.
60879. Test for Field-Glasses, 247.
60882. Model Gas Engine, 247.
60886. American Lever Timepieces, 248.
60888. Achromatic Lantern Objective, 248.
60897. Fire-Engine Boiler, 248.
60898. 5in. Gregorian, 248.
60901. Gas Engine, 248.
60904. Lilium Auratum, 248.

QUERIES.

[61232.]—**Bracelet Snaps.**—Will any of "ours" kindly tell me how the snaps or catches on gold and silver bracelets are soldered on, so as to retain their elasticity? I can get them on all right, but they are, of course, as soft as can be through the heat in soldering, and are consequently no use as snaps. I have tried ready-made snaps, and have made others myself, but with the like result. My solders are fusible at a fair heat, and are not extra hard.—PUZZLED JEWELLER.

[61233.]—**Permanent Way.**—Can any of our railway correspondents inform me what kind of permanent way is used for the railways on the Continent—the French, German, and Belgian particularly? Do they use the double-head rails and cross sleepers, with chairs and wood keys, the same as are generally used in England? I should also be glad of any information as to the same in the United States of America. What is Mr. Webb's system like of the L. and N.W.R.?—A. W. M.

[61234.]—**Bursting Pressure.** — Would "T. C., Bristol," or some other of our intelligent readers, kindly help me to find bursting pressure that I can produce by the following means? I have a screw, 1¼in. diam. in the bottom of the thread, and four threads to an inch; lever, 4ft. long; inclined plane, one in twelve. Plain figures will oblige—NON-CONFIDENT.

[61235.]—**Telegraph.**—Will Mr. Bottone, or some electrician, assist me in the following difficulty? I have erected a line wire of copper between two buildings, 50 yards apart, with earth plates of galvanised corrugated iron, 24in. by 18in., and galvanised iron wires leading from same, soldered to plates. Upon trying the circuit with one Leclanché, No. 2, I was surprised to find the bell would not ring, so I put galvanometer in circuit, which gave a slight deflection, proving there was a current passing, so I added two more cells, making three, coupling them first in series, then parallel; but still the galvanometer gave the same deflection in each instance. I then attached a common iron wire from each wire leading from earth plates, which rang the bells beautifully, proving the fault to be in the earth current. The plates are buried 6ft. deep, and the earth is saturated with moisture after the rain we have had. Of course, if there is a second wire for return, all will be right; but why am I obliged to put one, and why will not sufficient current pass through plates, as in other telegraphs?—CONQUERED.

[61236.]—**Colliery Winding Engines.** — Could any of your correspondents inform me if there are any winding engines (pairs) working expansive, and at what part of stroke they cut off?—CROXHALL.

[61237.]—**Lathe.**—What is the largest diameter in cast iron that can be turned with safety on a 7½-centre engineer's screw-cutting lathe, with gap to take in 30in.? Have asked several in the trade, and all gave different replies.—P. O. J.

[61238.]—**The Brown-Allan Relay.**—Will some electrical corespondent kindly give through these columns a detailed description of the above form of relay?—ANNESUIR.

[61239.]—**Circular Saw.**—I have a small circular saw to work in lathe; but with a long cut it buckles very much from heat, caused by friction, I believe. What diam. should the shoulder on spindle bear in relation to diam. of saw? Also, ought guide to be longer than diam. of saw? I am a novice, and an answer from one experienced would greatly oblige—WOODWORKER.

[61240.]—**Microscopical.**—Will some reader kindly solve the following problem for me? What diam. must a 5in. tube be to give the same field as a 10in. tube with an internal diam. of 1⅝in., the eyepieces having the same magnifying power, notwithstanding the different focal distances, 5in. and 10in. respectively? I am presupposing that the field given is in proportion to the diam. of the field lens of the eyepiece.—H. J. P.

[61241.]—**Climate for Chronic Catarrh.**—I have been suffering three years from this. The symptons are: continued discharges through the nose and into the throat, pungent, yellow, and extremely offensive. I have tried hospitals, doctors, physicians, without success; the winter weather especially keeping the nose in a continued state of inflammation, cold succeeding cold. There is also continued and excessive expectoration, indoors and out. I am in weak health, being a student of meditative and sedentary habits, using the head a great deal, but not the physical man. I must put a stop to it, if I have to go to the antipodes. Can anyone recommend a climate that does not aggravate nasal complaints? I thought California was the place; but have heard from a resident that they have continually cold west winds and fogs along the coast; and inland too hot, except for natives. Has Nelson Co. New Zealand, a good reputation for an even, temperate climate? Any information will be of inestimable service, if coming authoritatively.—NECESSITOUS.

[61242.]—**Canvas for Diagrams.**—Can any reader tell me how to prepare a sheet of canvas for drawing diagrams on with chalks, same as on a black-board? I have seen a lecturer use a portable screen, which appeared to be made of black canvas. Any information will much oblige—J. B.

[61243.]—**Failure of Amalgamation.**—Will some of our practical friends kindly assist me? I cannot get my zinc rods or plates to resist dilute sulphuric acid, even when the battery circuit is not complete. It is not for the want of mercury. A ½in. rod broke through the other day, almost by its own weight, through being saturated with mercury; yet it gives off hydrogen in abundance when placed in the cell. I have used the various tests mentioned in Mr. Sprague's "Electricity," and lead seems to be the substance mostly present. This is accounted for by its being made in lead chambers. I have changed the place I buy the mercury from, and have tried three fresh respectable firms for the acid, but my difficulty still continues. It is not caused by the mixture heating when mixed, because I always mix them over night and allow to cool for next morning. To see how dilute it really would act on the zincs, I made a solution of 1 of acid to 40 of water; still the hydrogen came off in abundance—in fact, with three Smee cells the place in ten minutes was unbearable, circuit not complete either. A sample of "pure" did show a little nitrous acid on testing; but, supposing this is causing the mischief, how am I to get rid of it? It seems almost impossible (at least, so it seems to me) to buy acid without it. Any help will greatly oblige—M.M.I.SC.S.

[61244.]—**To Tell the Age of Eggs.**—(See from *La Nature.*) Has anyone from the country tried this? They have more opportunities than we Londoners.—R. S. T.

[61245.]—**Saccharine Matter in Mortars.**—Has anyone tried it?—R. S. T.

[61246.]—**Wrought-iron Castings–Aluminium added to Wrought-iron.**—(See *Engineer*, p. 443, 3rd Dec., 1886.) Can anyone give further particulars? After reading the article I came to the conclusion that wrought iron is semi-faced, and then aluminium added, which acts as a flux. Am I right?—R. S. T.

[61247.]—**Hot-air Motor.**—TO MR. J. SEAL.—Having partly finished one of your hot-air motors, I should like to know the best or most suitable size to drill the port or air passage from cylinder A to D? Also if the cylinder D should be in any relative size to A? If so, what?—W. S.

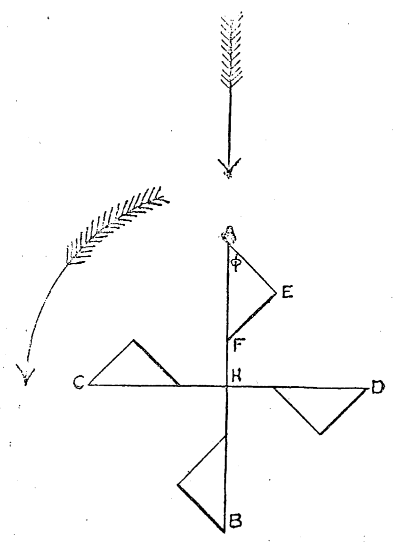
[61248.]—**Electrotyping.** — I wish to be able to deposit copper on to the surface of a gelatine photo.? I believe such is done. Any information regarding this process, electro-depositing on gelatine, will be thankfully received.—T. M. P.

[61249.]—**Boiler for Boat.**—I have a model compound engine, with cylinders ⅝in. and 1⅜in. by 1in. stroke. Will some reader kindly give me a description of boiler, and best way of heating the same?—STEAM.

[61250.]—**Telescope O.G. for Photography.**—Wishing to utilise two telescope object-glasses for photographic purposes, as a species of doublet, the one being a 4in. of 62in. focus, and the other a 2⅜in. of 42in. focus, at what distance apart should the lenses be mounted, and which lens should be posterior? Is it likely that there will be much difference between the visual and chemical foci?—J. C. H.

[61251.]—**Boiler.** — Could anyone kindly give the dimensions of a boiler for a double-cylinder engine, cylinder 2in. bore, 3½in. stroke? Also the best way of heating the same?—F. S. R.

[61252.]—**Windmill.** — Will some kind reader of "E. M." help me out of a difficulty? I wish to construct a horizontal windmill after the following manner, and would like to know whether or not the mill would work? If not, why? On each of the four ends of the cross, A, B, C, D, I affix a triangular plate of sheet iron, having the side A E equal to E F. The general direction of vanes



will be seen from the figure. The whole is to turn on its centre H, while H itself is permanently fixed. It appears to me that if we had a wind pressure of x power blowing in the direction of the straight arrow the mill would have a rotary motion in the direction of bent arrow equal to $2x \sin \phi$, provided the angle A is within certain limits.—MILLER.

[61253.]—**Electrical.**—Will any kind reader inform me if there is any method of registering the strength of a rapidly varied electric current?—H.

[61254.]—**Combination Machines.**—Some time ago I saw in a paper a firm advertising milling attachments for planing machines. I wrote to them on the subject, but they declined giving me any information. If any reader could tell me how to make such an attachment I should be much obliged.—A. F. SHAKESPEAR.

[61255.]—**Embrocation.**—Can anyone give me a good prescription for an embrocation for exciting the action of the liver? I had one some years ago, but have unfortunately lost it.—A. F. SHAKESPEAR.

[61256.]—**Hand Planers.**—Being engaged in building a new planer with the latest improvements, I should be much obliged to any reader answering the following questions:—(1) Have the capstan handles of the English machines any real advantage over the crank handles and reducing gear of the American and German machines, or are they only perpetuated from a conservative idea? (2) Have ⊥-grooves any advantage over dovetailed ones? The former are certainly more difficult to make, and necessitate a heavier table, as they cut into the metal more. (3) Is weight a necessity—i.e., must a machine 30in by 16in. by 12in. capacity weigh about 11cwt.? Why should it not weigh about 5cwt. or 6cwt.? (4) Is there any objection to the Haas machine with the clutch reversing motion? (5) In machines where the bed is about 1½ft. or 2ft. longer than the table, I have found a tendency in the bed to wear hollow. Is there any necessity for the bed to be longer than the table?—A. F. SHAKESPEAR.

[61257.]—**A New File.**—A file has lately come under my notice which claims the advantage over other files of being able to be ground on an ordinary grindstone, and of being easily repaired. The file is composed of pieces of steel ground at the edges to an angle, and strung on a rod of square steel. Can anyone tell me if such a tool has been tried in England, and with what results? I understand that the file will cut as much in a day as an ordinary one will in two days, and is easier to drive. Is this possible?—A. F. SHAKESPEAR.

[61258.]—**Organ Manual Couplers—Swell to Great in Octave and Sub-octave.**—Will some reader kindly favour us with a sketch (side view) showing the general principle of the action of above movements from key tail to pallet chest on a simple and effective plan? I may say that I have "thought it out" from an amateur's point of view; but as these movements entail a considerable amount of work, and should be constructed on sound principles to be really effective, I wish to obtain information from a higher source before proceeding. The clear space from underside of chest to suface of key tail, great organ, will be, say, 14in.—W. W.

[61259.]—**Induction Coils.**—Will Mr. Bottone and "Bobadil" kindly tell me how they calculate the length of spark obtainable? Also, in planning a spark coil, how they arrive at the sizes of the various parts in order to obtain maximum efficiency? Would there be any advantage in using two condensers—one in the primary circuit and one in the secondary?—MICKY DOOLEY.

[61260.]—**Dip for Brasswork.**—I want to dip the goods in, and on taking them out to get a black colour for lacquering.—BROSCENICUS.

[61261.]—**Mirror Galvanometer.**—I intend constructing an astatic mirror galvanometer, and purpose winding the four coils on brass bobbins. Will so doing affect the delicacy of the instrument in any way? What are the essential features of a galvanometer for measuring capacity?—MICKY DOOLEY.

[61262.]—**An Electrolytic Estimation.**—A current gives 1 to 5c.c. of electrolytic gas per minute; the time required to deposit the metal, 1 to 5 hours. What is the strength of the current in ampères and volts?—R. T.

[61263.]—**Electric Units.**—Are the "practical electro-magnetic units" at page 237 Sprague's "Electricity" correct modern units? I fancy an international committee made some alterations. If so, kindly state which have been altered.—R. T.

[61264.]—**Safety Valves.**—I shall feel obliged to any of your readers for helping me to find blowing-off pressure. 1⅞in. diam. of valve, 2½in. length of fulcrum, 13½in. length of lever; weight of ball in pounds, 28.—LONDON BRUM.

[61265.]—**Loss of Magnetism.**—Could any reader tell me why a machine suddenly loses its magnetism for a minute or two and then regains it again? I have known it in the Edison-Hopkinson and Bürgin machines, the Edison-Hopkinson being a shunt-wound machine, giving off 320 ampères and 105 volts; the Bürgin also being shunt wound.—ONE ANXIOUS TO LEARN.

[61266.]—**Induction.**—Can any of "ours" inform me of any ready means of preventing or lessening the induction between two telephone wires erected across country on ordinary wooden poles for a distance of about 20 miles? It is the induction from one wire to the other that I refer to, not that from any exterior source. The trouble is that one hears so plainly all that is spoken on the other wire. Is there any means of twisting the wires that would be beneficial? To simply make one revolve round the other would, I imagine, be of no service if in the same direction throughout.—C. F.

[61267.]—**Iron Poles.**—Which of the two following iron poles would be most likely to stand the strain (wind, snow, &c.) imposed upon housetop telephone standards: (1) 20ft. length of circular tube, 2½in. diam. (internal) and ¼in. metal, making 3in. ex. diam., (2) two 20ft. lengths T iron, bolted back to back?—C. F.

[61268.]—**Soldering Lamp.**—Shall be glad if any of "ours" can recommend me one that can be used for soldering wires on housetops in windy weather—one that can be readily lighted.—C. F.

[61269.]—**Gramme Dynamo.**—I am about to make one, to be able to light four 5c.p. lamps well, and also for general experimental work; but, before doing so, would like the opinion of some of our correspondents versed in this matter. As regards the proposed dimensions and methods of construction, the F.M.'s are four in number; the plain part for winding wire on is 4in. long by ¾ diam.; the pole-pieces are 1¼in. thick, into which the F.M.'s are screwed, and 3in. broad; diam. of space for armature to revolve in, 4⅝; shaft to carry armature, 8in. between bearings, ⅝ diam., turned down at each end for bearings to ½in.; the armature to be made with a core of soft iron wire or a number of thin iron washers, internal diam. 2¼in., external diam. 3½in., and 3in. wide. I would much prefer the latter method but for the difficulty in obtaining the iron washers; the armature to be wound with No. 20 c.c. wire, 16 sections. Please give probable length of each section, and total length, weight, and resistance of wire to be used. The F.M.'s to be wound with No. 16 c.c. wire, crowded towards the centre to obtain uniform magnetisation; please give weight and resistance. It may be said that the F.M.'s are not large enough in diam. I may say these I already possess. It is required to be driven by foot-power. Any hints as to the actual construction of the armature and commutator gratefully received.—R. A. K.

[61270.]—**Coil.**—Will Mr. Bottone or "J. W. B." kindly answer query 60818 of Nov. 5th, as I am in the same hole with one myself? Description as follows: Primary, two layers 16 d.c.c., shellac varnished, three thicknesses of Corbridge paper well varnished over same to divide primary from secondary; secondary, 3lb. 26 s.c., each layer being well insulated with rosin, and one layer of paper, as described in Dyer's book; on top of this is 2oz. of 38 s.c.; condenser is 50 sheets of foil, 4½in. by 5in. The longest spark I can get without condenser is 1-32in., and with it is ⅛in., with three quart bichromate cells. Please state main fault. "J. W. B." advises to rebuild. I have done this three times, and get the same result each time. I have also watched queries very closely, but find none relating to my own difficulty. Any information will be esteemed a great favour.—J. B. PC.

[61271.]—**Electric Bell Circuit.**—A friend of mine has an electric bell communication from the house to the stables, a distance of about 200ft. The battery (Leclanché) is connected thus: The carbon is joined to "earth" at one end, the push to "earth" at the other end, and bell between push and zinc. Is this correct? Should not the earth be used as the return wire, and not the positive wire? At any rate, the arrangement seems faulty, because the bell frequently fails to ring. Will some electrical correspondent say whether this method of interposing the earth in circuit is theoretically correct, as a treatise on electricity in my possession says that when not in use the electricity resides in the positive wire (in this case the earth) as a static charge? Is this so?—H. B.

[61272.]—**Trains on Greenwich Line.**—Can any of your readers inform me why on the South-Eastern line from Greenwich, Westcombe Park, &c., to London Bridge the trains run from left to right instead of right to left, as on other lines? What one would naturally expect to be the down line is the up line, and the up line the down line. —OBSERVANT TRAVELLER.

[61273.]—**Saddle Boiler.**—I have a saddle boiler for heating house. It works about six coils from base to top floor, and I have found a great quantity of air in pipes. Have opened air-valves about once a week. Have been told should not require opening only once every three months. Would someone please tell me the probable cause and the regular times the valves should be opened? Also if it has any injurious effect in letting air off every week? The air completely stopped circulation on one occasion, having not been opened for a few weeks.—F. H. R.

[61274.]—**Cell.**—Wanted, a suitable portable cell for testing wires, circuits, &c., something of the Leclanché type, but were the liquid is prevented from slopping about. Is there anything really suitable in the dry battery line?—FIX.

[61275.]—**Coppering Carbons.**—I have just been trying to electrotype some carbons with copper in order to form a connection to use them for a Leclanché battery; but find that after the electric action has been going on for the space of a few hours the sulphate of copper begins to deposit itself in a kind of muddy form, which easily comes off. The apparatus I use consists of a jam pot containing saturated solution of sulphate of copper, and also porous pot, which contains sulphuric acid diluted with ten parts of water, in which is placed zinc rod. Both solutions are kept level. Will some reader please explain cause of muddy deposit?—J. W. J.

[61276.]—**Solar Parallax.**—To "F.R.A.S."—Can you oblige me by giving the rule for finding the distance of the sun, knowing the horizontal parallax? In the issue of Dec. 3rd you give the distance as 92,359,000 miles. Please say whether the value of the solar parallax given by Mr. Gill in 1877 as 8·783″ is not considered the most reliable yet attained, and whether from this the mean distance of the sun is not deduced as 92,660,000 miles?—S. FORD.

[61277.]—**Multiplex Copying Ink.**—To MR. W. C. HALE.—I have tried your recipe for a graph given in the issue of Dec. 10, and find it to answer well. I used a multiplying ink made by Judson's, but find that I cannot readily clean the apparatus. I understood the impression to come off with sponge and cold water. This entirely fails in my case. Will you kindly say how you clean the graph?—S. FORD.

[61278.]—**Hot-air Motor for Organ.**—Would Mr. Audsley add to his valuable and useful information by suggesting a good motor (of the hot-air description) for use where neither water nor gas is available? Would he also give the scale and size of his double mouth flute?—C. C.

[61279.]—**Rhea Fibre.**—I am deeply interested in the experiments made on this fibre, as related by "Urtica" in letter 26585, and should be glad to know where I can obtain a sample of it spun into thread, twine, or cord? It will be useful for driving small machines where now gut or silk bands are used.—GEORGE EDWINSON.

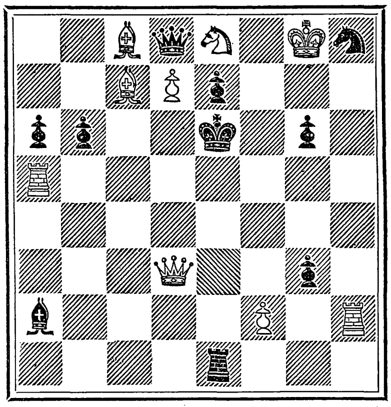
FOR lecture experiments, Herr F. C. G. Müller recommends a thermometer containing sulphuric acid blackened with sugar, as it is readily seen; sulphuric acid expands regularly, and has a coefficient of expansion three and a half times greater than that of mercury.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXIII.—BY J. P. TAYLOR.

Black.



White. [9 + 10

White to play and mate in two moves.

SOLUTION TO 1,021.

White.	*Black.*
1. B-Q R 2.	1. Anything.
2. Q mates accordingly.	

(Three variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,021, by J. Rowland Turner, W. Hewson-Kilber, F. Krasser, Link, J. Mackenzie; to 1,020, by Link (but second move is B-R 5).

W. DUFF.—1. K-R 2 will not do for 1,021, on account of 1. Kt-Q B 6 (ch).

H. BALSON.—Thanks for games.

W. HEWSON-KILBER.—Name entered for A and B. It considerably detracts from the value of a problem for the first move to be either a take or a check.

H. HOSEY-DAVIS.—We have entered your name for both Tourneys.

AS fourteen have entered for Tourney A, and fifteen for B, we shall be prepared to start with the first Tourney Problem next week. All who have not paid the entrance fees are requested to do so. The regulations will be the same as before, except that solutions must be received within twelve days of publication of the problem. All the principal variations must be given. Additional marks will be scored for the discovery of second solutions and of duals (but not of duals in two-movers). Marks will be deducted for mistakes in solutions, and for incorrect solutions. The first six two-movers published will be common to both Tourneys A and B. We shall be glad to enter any more names in either Tourney up to the time of publication of solution of first Tourney Problem.

AS the Game Correspondence Tourney is nearly concluded, having lasted about eighteen months, we propose starting another (the fourth) in February next. The number is limited to 12, and there are now five vacancies. Entrance fee, £1, the total amount constituting prize money, to be divided (in proportion to the number each wins) among the six who win the greatest number of games. Each competitor plays two games with two opponents simultaneously. Drawn games reckon ½.

Failing Axles.—Of the 238 axles which failed during the first nine months of this year on our lines, 147 were engine axles—viz., 130 crank or driving, and 17 leading or trailing; 20 were tender axles, two were carriage axles, 63 were waggon axles, and six were salt-van axles; 29 waggons, including the salt-vans, belonged to owners other than the railway companies. Of the 130 crank or driving axles, 91 were made of iron and 39 of steel. The average mileage of 85 crank or driving axles made of iron was 233,057 miles, and of 39 crank or driving axles made of steel 223,933 miles. Of the 164 rails which broke, 79 were double-headed, 83 were single-headed, one was of the bridge pattern, and in one case the pattern was not stated; of the double-headed rails 49 had been turned; 31 rails were made of iron, and 133 of steel.

A NOVEL method of measuring the deflection of railroad bridges has been tried in Russia, and is thus described by the American *Engineering and Mining Journal*:—An iron pipe 1½in. in. diameter was carried along the outside of one girder. From this pipe, on each abutment of the pier, and at five intermediate points at each span, vertical pipes of the same diameter branched out. Inside, and near the top of each vertical pipe, was fixed a graduated ¾in. glass tube, the iron pipe being cut away on both sides. The zero divisions on the tubes were all the same distances above the flange of the girder. Before the bridge was loaded, the apparatus was filled with water, the tops of the upright pipes covered over, and the water was then drawn off until it stood at zero in each gauge. On the bridge being loaded, the deflection could be read with ease.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Tuesday evening, Dec. 21, and unacknowledged elsewhere:—

A. J. S. COMPTON.—Rev. R. Swift.—King, Mendham, and Co.—Jawler.—B. T.—Not Known.—A. J.—T. O.—Tiler.—J. R. L.—Mensuration.—Barilier.—J. W.—W. J. T.

W. BUTTERWORTH. (Presumably you were attended by a medical man, and he would know whether there is any possibility of removing the mark. We think any alleged remedy would leave quite as objectionable a mark.)—R. R. R. ("Simple and efficient" remedies are desired by all; but tonsilitis is a troublesome complaint, for which it is often necessary to extirpate the tonsils. Consult a medical man.)—W. GARDNER. (We do not know, but should think it scarcely likely, as it is too old an invention. See Hints No. 5.)—ANXIOUS. (To what does the number 61170 refer? The only remedy for down draught is to secure a sufficient up-draught, or to put something on the chimney-pots which will prevent the downward suction. Boyle's cowls and similar inventions, by creating a permanent up-draught, prevent the smoke from adjoining chimneys finding its way down into rooms. Impossible to answer before.)—C. A. W. (What you describe is known as the magneto-telephone (Bell or Dolbear), and in its best form is made with horse-shoe magnets. Your failure is probably due to the fact that the diaphragm is too far away from the magnet, or the latter is not strong enough. A battery is easily inserted in the circuit. If the two telephones are connected by two wires, you can surely put a battery on one. See the back volumes from Vol. XXIII. onwards.)—F. W. S. (You can obtain a diagram of the Joy valve-gear from the patentee, or find it in several back numbers. Applied to a marine or vertical engine, it is illustrated in No. 806, and in No. 954 it is shown as fitted to a locomotive. 2. The numbers from 1050 to 1067 contain articles on the exhibits at the Inventions. 3. Of course. The L. and N.W. compound was illustrated in perspective in No. 1052; in elevation in No. 953.)—CARLISLE. (The standard wire gauge was given in No. 1101, and Stuo's can be obtained direct from the firm or found in most of the pocket-books.)—F. E. W. (Presumably you mean ventriloquism. It is an art that requires considerable aptitude and a large amount of practice. Procure a little sixpenny manual on the art by Hardy, published by Warne and Co., Bedford-street, Covent-garden, W.C.)—A. J. POOL. (In all probability they are spoiled. You will possibly find a remedy on p. 201, No. 1049, or in the back volumes by consulting the indices.)—H. A. SMITH. (You might succeed by mixing extra gum with the ink and adding finely-powdered coke. Use a quill pen, and stir the ink at each dip.)—E. G. W. (Whittaker and Co., White Hart-street, Paternoster-square, publish a "Grammar of Volapük.")—LEVER. (You may soften it slightly by warming it; but if it is vulcanised it has probably become permanently hard.)—T. L. H. (Can be done with dry compressed air stored in a reservoir, or with carbonic acid, as used by the soda-water bottlers. You must have a reservoir weighted to give the required pressure.)—B. ROLSTON. (Directions for erecting sundials in No. 924, in other back numbers, and in the cyclopædias.)—R. S. THOMPSON. (You can take photographic enlargements by following directions frequently given in our columns, or you can redraw by the use of the "squares"—that is, pieces of cardboard with silk threads stretched between so as to form squares; or, if the original is not valuable, you can rule squares in pencil over that, and then larger squares on the paper on which you wish to reproduce the larger picture. It is easy to draw then.)—ANXIOUS TO KNOW. (Similar queries have been answered over and over again as far as they can be. See the series of articles commenced on p. 1 last volume. The cotton is not sufficient insulation.)—A. H. (Answered not long ago. The copper can be deposited in the letters by the electro-process, or be brought out by dissolving the zinc from the surface. 2. As to filling up the letters, you can use sealing-wax, heating the plate so as to melt it; or mix the pigments with copal varnish and allow it to dry.)—W. S. C. (We do not know who could do such work for you, and the question should really be put into the Wanted Column of advertisements. It will be necessary for you to say what is meant by a semi-conducting plate.)—A SMITH. (By "pincat" we suspect you mean tincal, a commercial name for crude borax. Felspar is a constituent of rocks or rock itself, and consists of silicate of alumina combined with silicates of potash, soda, or lime. Orthoclase is a common potash felspar forming about 40 to 45 per cent. of granite. Albite, oligoclase, Labradorite, Anorthite are names of well-known felspars.)—JAPANNER. (Apparently you require to do what would seem to be impossible. If the labels are stuck to the plates while the latter are cold, the expansion of the metal when heated will naturally tend to split the labels off. The remedy is to transfer whatever appears on the labels to the metal itself, as is done in many cases now, and then you will have no trouble. If you can show that what you want has already been accomplished, no doubt some of our readers will help you; but at present you appear to ask for an invention.)—GLASS GILDER. (A method of gilding on glass was given so recently as No. 1082, about a year ago, and there are other methods in back volumes—see No. 891, p. 157. Probably the simplest method of gilding is to use a solution of chloride of gold rendered alkaline by the addition of soda. The reducing solution is proof spirit saturated with marsh gas, and we presume you know that the glass must be chemically clean. You can gild with the prepared "golds" in the usual way.)—666. (Query quite inadmissible; for friends of dealers might give their names as firms which "deal honestly.")—LONDON BEUM. (Consult a work on mensuration.)—WILLIAM SIMMONS. (The address was given in the number for July 28, 1865. We have no further information. See Hints No. 4.)—H. J. (Try Metzler, Great Marlborough-street, W. See p. 56, No. 1095.)—ALKALI. (It consists simply of apparatus by means of which a jet of sand is forcibly directed against an object by means of steam or air. See p. 235, Vol. XVI, and pp. 314, 437, Vol. XXVII.)—NOVICE. (You will find a variety by consulting the indices; but if you wish to understand the principle of secondary or storage batteries, see p. 279, No. 949. A simple and easily-constructed accumulator was described in No. 1016, p. 28. 2. See makers' lists for the cost of frictional machines.)—BELA BUCKEN. (The use of the Daniell battery for electric lighting has been under discussion recently. See p. 240 ante. 2. For Schanschieff battery see pp. 26, 257, last volume. 3. For nitrate of soda cell see pp. 320, 435, Vol. XLII.)—G. M. S. (Certainly not; it is a powerful antiseptic. 2. The clean metal has the effect of neutralising acid and precipitating what may be termed the "fat" of the oil.)—W. S. C. (Certainly it is, if he has the apparatus—a machine which costs about £30 to £50; but it would not be worth his while, as he can buy what he wants more cheaply than he can make small quantities.)—SCIENTIST. (There is no experimental method known—it is a matter of faith or belief.)—W. WILSON, Liverpool. (By immersion in hot water or steaming—sometimes dry heat—and pressure.)—INQUISITIVE. (Query not definite. Do you mean by taking them off the cards, rendering transparent, and printing from them?)—A. J. (The factitious birdlime is made by boiling linseed-oil with a little resin. You have boiled it too much.)—J. A. (We do not know what you mean; but suspect you will find what you want in such a book as Main's "Astronomy," published by Crosby Lockwood and Co., Stationers' Hall-court, E.C., price 2s. There is no lack of works on astronomy.)—A. TISNER. (The electric gas-lighter referred to was illustrated in No. 1033. It contains a little static induction machine, set in motion by pressing the knob or spring.)—ONE IN DOUBT. (The French reed is used in the instrument named—that is, the same reed as is used in harmoniums. See indices for full information about construction.)—J. B. HALIFAX. (Not suitable to our pages.)—WM. SALOP. (We cannot make much out of your letter. Such work is usually done by templates; but there are machines nowadays.)—A PRESENT SUFFERER. (Any druggist can supply you with ointment of galls; but you should consult a medical man. Various remedies have been suggested in back volumes.)—J. H. REID. (We cannot publish your letter. We regret to say we have had other complaints, and shall not allow the people concerned to advertise again. We have sent them your letter, and if they do not at once refund the money we advise you to communicate with the police.)

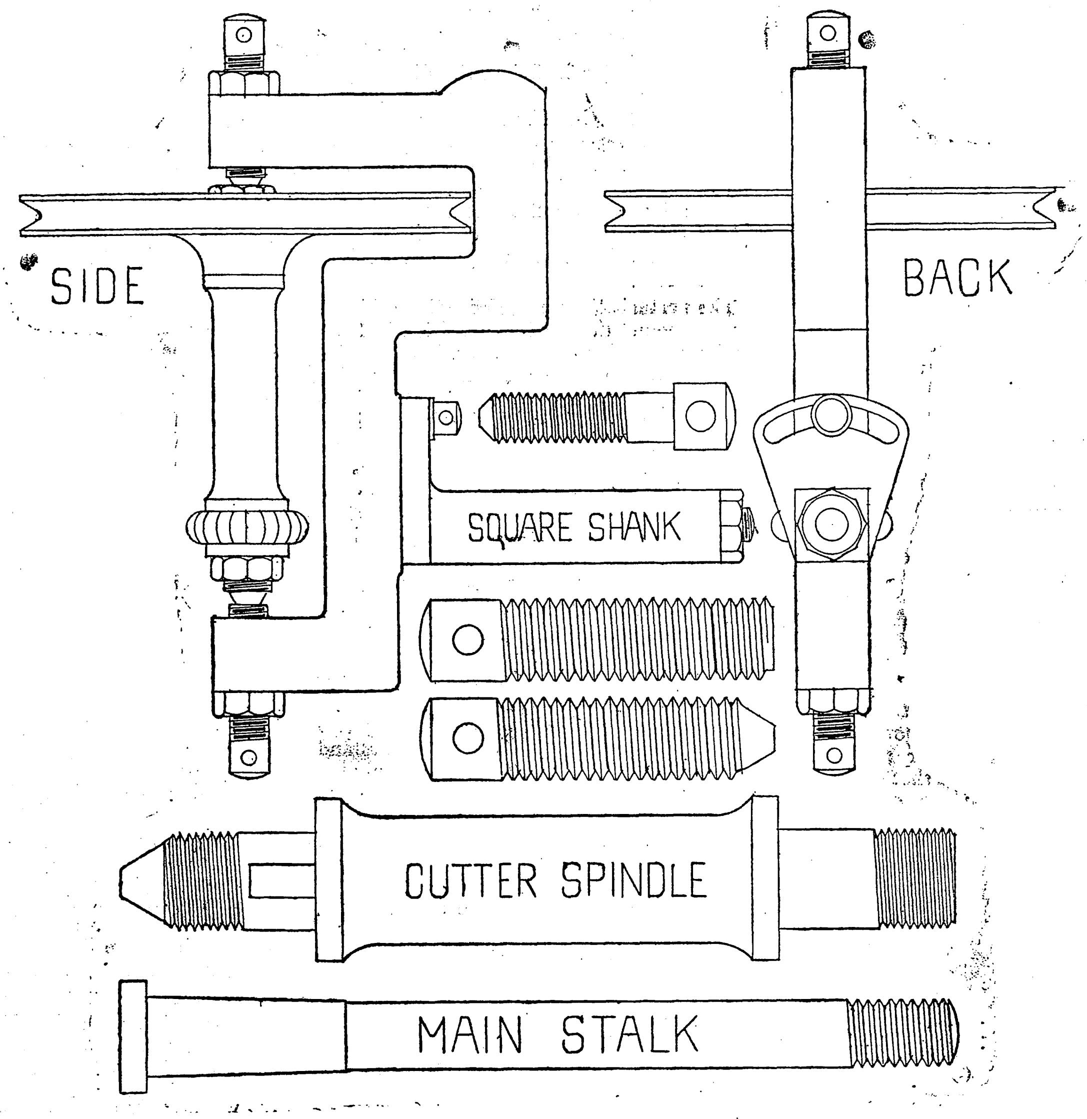
PROFESSOR HELMHOLTZ has shown that it follows from Faraday's experiments on electrolysis that while a monovalent atom carries to the electrode one charge of electricity, a divalent atom carries two charges of electricity. For instance, when we electrolyse potassium chloride, we have each potassium atom delivering a charge of electricity at the one electrode, and each chloride atom delivering an equal charge of electricity at the other electrode, all monovalent atoms, carrying with them an equal charge of electricity, which we may call the unit charge. When, however, we electrolyse magnesium chloride, we have two atoms of chlorine set free for one of magnesium, and consequently, while each chlorine atom carries its unit charge with it, the magnesium atom carries two units of electricity to the electrode. In fact, electrolysis proves that differences of valency mean differences in the electrical charge on the atom.

IT has for some time been stated that electricity may be used in soap and bleaching works, and now the *Electrical World* says:—M. Rotondi has discovered that by the employment of suitable vessels it is possible to effect the saponification of oils by the electrolysis of an emulsion of the oil in a concentrated solution of sodic chloride. This, at least, is the nature of the process so far as can be gathered from a not very lucid description in one of the French technical journals. During the process it is said that caustic soda, free chlorine, and glycerine are formed, and it is suggested that at bleaching works it would be found economical to prepare chlorine by this process in order to obtain the soap and the glycerine as by-products. It is also suggested that as the process requires practically no supervision, it would be practicable to employ in this way at night steam power already in use during the daytime for other purposes.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 31, 1886.

UNIVERSAL CUTTER-FRAME FOR USE IN THE LATHE.

THE accompanying illustrations show a cutter-frame of substantial proportions, which is used in the slide-rest for cutting wheels, grooving taps, squaring nuts, and many purposes of a like nature. Those beautiful wheel-teeth cutters, made by the Brown and Sharpe Machine Company, of America, can be used in first-rate style in this cutter-frame.



The drawings, having been made carefully to scale, will show all dimensions correctly. The side and back views show the complete cutter-frame. The details are all drawn twice as large. The principal piece is an iron casting, the form of which is shown in the side view; it has a uniform section $1\frac{1}{8}$in. square. The shank is forged of $1\frac{1}{8}$in. square iron, with a piece bent up at one end, as shown in the back view, pierced by a segmental slot to allow the spindle to be canted over. It is useful to cant the cutter out of perpendicular for several purposes— for example, when cutting worm wheels. The shank has a hole bored through to clear the $\frac{1}{2}$in. steel stalk. The stalk is a piece of $\frac{1}{2}$in. mild steel rod, with one end upset to form its head, and about $1\frac{1}{2}$in. of the rod below the head is swelled slightly, so as to make a taper fitting both in the casting and in the mouth of the hole through the shank.

The cutter spindle is made of 1in. round steel, and has two collars $1\frac{1}{4}$in. diam. jumped up on it—one to form a shoulder for the cutters to abut against, the other to serve the same purpose for the pulley wheel. Two $\frac{5}{8}$in. cone-ended screws, one $\frac{3}{8}$in. clamping screw, five octagon nuts, and the pulley wheel complete the materials required.

The cutter spindle is $6\frac{1}{2}$in. long, one end pointed, the other countersunk. The two screws which form the bearings of this spindle are shown, enlarged, just above it: one is pointed, the other countersunk. The cone on the spindle and that on the screw have the points taken off to allow the spindle to be readily removed from the frame. The extreme points do not serve any useful purpose; and if not rounded off, the spindle would necessarily be about $\frac{1}{4}$in. shorter. The threads on the spindle are $\frac{3}{4}$in. diam. One takes an octagon nut to hold the pulley, the other a similar one to hold a cutter. There is a mortise hole through the spindle to take single tooth fly-cutters; these are held by the octagon nut and a washer.

The pulley wheel is made of wood mounted on a metal centre piece. It is shown without fair-leader pulleys, as this particular spindle is driven by a band coming horizontally from pulleys at the back of the lathe. Fair-leaders are easily added, to guide a band from above, by drilling and tapping a hole through the upper part of the frame casting where the lump is shown, and screwing in $\frac{5}{8}$in. pins on each side to carry the fair leaders.

The simplicity of this cutter frame, and the completeness of the illustrations render further explanation unnecessary.

THE PROGRESS OF ASTRONOMY IN 1886.

IF nothing startling or sensational has occurred in connection with Astronomical Science during the year which has just ended, 1886 has not closed without leaving a record of much valuable work, accomplished both in practical and theoretical astronomy. We propose, then, according to our annual custom, to give here a short précis of the most noteworthy additions to our knowledge of the heavens which have been made during the past twelve months, and of such cognate matters as may be held to be interesting to astronomers generally.

Everyone is familiar with the investigation of the motion of the fixed stars in the line of sight which has been carried on by the aid of the spectroscope by Huggins and Seabroke, and much more thoroughly at the Royal Observatory at Greenwich. The observations thus obtained have been discussed by Herr Homan for the purpose of determining the direction of motion of the Solar system in space; as also the rate at which it is travelling. Taking first the Greenwich stars, he finds that they indicate that the apex of the Solar motion lies in R.A. 21h. 20m. 24s. and Dec. 41·2° N., a point upon a line joining and σ Cygni, at a distance of nearly two- hirds of the way towards th e last

named star. Discussing the observations of Huggins in like manner, he finds that the point towards which the Sun seems to travel lies in R.A. 20h. 38m., and in 69·7° North Declination; while lastly, the very few of those made by Seabroke give us the resulting position of this point as R.A. 18h. 35m. 12s., and Declination 13·6° North, which places it in that blank region in Serpens, west of ε and ζ Aquilæ. It will be noted that all three of these points differ pretty widely from those previously determined from the proper motion of the stars by Herschel, Argelander, Struve, Mädler, Airy, and Dunkin, which latter were all situated in Hercules; the two Greenwich astronomers placing it at the apex of a practically equilateral triangle, whereof λ and μ Hercules formed the extremities of the base. Homan adopts 18·6 miles per second as the most probable rate of movement of the Solar system in space as derived from the spectroscopic indications of stellar approach and recession.

The additions to our knowledge of the physical structure of the Sun and his surroundings derived from the observations of the Total Solar Eclipse of August 29th are but meagre. The person whose name was most prominently mentioned in connection with the English expedition to the West Indies neither saw nor did anything. Mr. Maunder and Father Perry were somewhat more fortunate; while Prof. Tacchini succeeded in showing that certain prominences seen on the sun's limb during totality can not be rendered visible by the spectroscope after the eclipse is over. He also observed the spectrum of Prof. Young's "flash," tracing it to a considerably greater height than that to which it had previously been seen to extend.

In connection with this eclipse, perhaps this will be the most convenient place to mention that Capt. Darwin's photographs would appear to have set at rest the question of the possibility of photographing the Corona of the uneclipsed sun. We mentioned last year (Vol. XLII. p. 352) that Mr. Woods was experimenting on this subject in the Southern Hemisphere. We are now in a position to add, with purely negative results. Captain Darwin, however, by a series of negatives taken before, during, and after the eclipse, has shown quite conclusively that the Corona cannot be photographed under ordinary circumstances at all. Disappointing as this result is, it was the means of eliciting a letter from Dr. Huggins, which, for dignity and impartiality, formed the strongest possible contrast to the utterances of another scientific man (we are bound to admit of much inferior reputation, though) on the explosion of his hypothesis of the terrestrial origin of the corona itself.

Although made some time previously, Prof. Langley's observations on the temperature of the Moon's surface have only been published during the last year. He comes to some conclusions so remarkable as almost to throw doubt upon the trustworthiness of the instrument he employs—the "bolometer"—whose hypersensitiveness is so excessive as to render it susceptible to the slightest and most distant change of temperature. This must, as it seems, introduce a large element of uncertainty into the determination of the source of the heat rendered perceptible by its indications.

There is very little new that is of interest to note in connection with the components of our Solar System. The great Red Spot on Jupiter, which has for some years formed so conspicuous a feature on his surface, has been, in a strangely blanched condition, systematically observed by the possessors of large telescopes during his apparition of the past year. Seven new members have been added to those already known to exist in the rings of planetoids which revolve between Mars and Jupiter, thus bringing the number up to 260. Palisa had the honour (?) of discovering five of these; while Luther and Peters (more venially) only found one a-piece.

No less than six comets have made their appearance in the heavens since the 1st of last January. The first three were, singularly enough, all discovered by Brooks at the Red House Observatory, Phelps, N.Y.; *a* was seen on April 27; *b*, three days later; while *c* was detected on May 22nd; Winnecke's periodical comet (*d*) was picked up at the Cape on August 20th; while on Sept. 26th Finlay, at the Cape Observatory, found *e*. Finally, Barnard, at Nashville, U.S., and Hartwig at Kiel, independently discovered the sixth comet (*f*) on the nights of Oct. 4th and 5th respectively. The last-named object is visible to the naked eye after sunset, as we write, although it has passed its brightest phase, and is diminishing in splendour.

Gore's new star in Orion, the discovery of which he announced last year (ENGLISH MECHANIC, Vol. XLII. p. 351) turns out to be merely a variable one with a period of about a year. At the beginning of July, 1886, it had diminished to the 12½th magnitude; by October 29th it had increased again to the 8½th magnitude, and it attained its greatest brightness during the first half of December.

The perturbations caused in the orbit of Encke's comet during its apparition in 1878, by its proximity to Mercury, have enabled M. Backlund to make a fresh determination of the mass of that planet. It is considerably larger than any previously obtained, amounting, in fact, to 1-2,668,700th of that of the sun. Herschel gives the mass of Mercury as 1-4,865,751th; Chambers as 1-4,862,134th; and Newcomb as 1-5,000,000th; while Le Verrier and Von Asten (especially the latter) made it smaller still.

Early in the year, M. Loewy read a paper before the Académie des Sciences in Paris, in which he described a singularly ingenious method of determining the constant, and other elements, of refraction. In front of the object-glass of his telescope he places a prism with silvered faces, thus forming two mirrors. It is not difficult to understand how in this way the images of two stars at a great distance apart in the sky can be brought close together in the same field of view of a micrometer. If we suppose, then, that one star is in the zenith and the other just rising, it is obvious that refraction will very sensibly affect their apparent distance apart. Such distance is then determined, and may be called measure No. I. If, now, we wait until the first star has descended, and the second one risen in the sky, until their altitude is equal (when obviously the effect of refraction is at a minimum), the measured distance between the images will, of course, have altered: this we may designate Measure No. II. The comparison of these observations gives the means of determining the amount of refraction with great accuracy. The *sine quâ non* in this clever method of deducing the quantity sought, is that the planes of reflection for the two stars must be absolutely coincident.

The improvement in stellar photography continues, and it would really seem difficult to surpass some of the astonishing charts of certain rich regions of the sky produced by the MM. Henry in Paris. They have succeeded, too, in securing a photographic representation of a nebula near Maia, one of the Pleiades, an object theretofore unseen by any human eye, but which has since been observed both at Nice and Pulkova with the huge instruments in use there. They have further photographed the planets in a most remarkable way, their pictures of Saturn, exhibited at the Royal Astronomical Society, showing Cassini's division in the ring perfectly. And, lastly, amid other miscellaneous work of an equally marvellous character, they have photographed the satellite of Neptune in every part of its orbit. In this country, Mr. Common continues his excellent work, while the Observatories at the Cape and at Rio Janeiro are co-operating with the Brothers Henry in the production of definite series of star charts. We may add that Mr. Isaac Roberts, in this country, has also succeeded in the production of stellar photographs, which give great promise.

Perhaps the two most notable things in connection with the progress of meteoric astronomy in 1886, have been the establishment by Denning of a distinct shifting of the radiant point in the case of the Perseids, and by Denza and Schiaparelli of a similar shifting in the case of the Andromeds; and the establishment by Ranyard of the fact that the meteors of 1885, Nov. 27, instead of radiating from a point, seemed to issue from an elliptical area of considerable extent. It is eminently worthy of attention that the longer axis of the ellipse, as seen from Nice, was some 10° or 12° west of north; the magnetic deviation in the same direction in Europe being a fact familiar to all.

A contribution to Physical Science of the highest interest and importance has been made by Professor Simon Newcomb, of Washington, U.S., in the shape of the publication early in the year of the results of his elaborate and exhaustive series of experiments to determine the velocity of Light. His final conclusion is that light travels in vacuo at the rate of 186,326 miles per second, with a possible error of $\pm$ 18·64 miles. Assuming the velocity of light to be 186,326 miles in a second, and the earth's Equatorial radius to be 3963·29 miles, and further accepting Nyrén's value of the constant of aberration 20·492″, he obtains a solar parallax of 8·794″, which is 0·055″ in defect of that now generally adopted.

"Everything comes" (said Lord Beaconsfield, in "Tancred") "if a man will only wait"; a dictum once more justified by the completion of the object-glass of the Great Lick Equatoreal. The mounting has been undertaken by Messrs. Warner and Swasey, of Cleveland, U.S., for the modest sum of £8,750. Irrespectively of some future needful adjuncts, the instrument, with its mounting, dome, &c., has so far cost £34,347 5s., within a trivial fraction. Let us hope that the additions to our knowledge of the structure of the Universe will afford justification for the unselfish munificence which has provided such an unprecedentedly powerful engine for attacking the problem. No other advance in the construction of astronomical instruments has been made of sufficient importance to demand notice here.

In connection with the Bibliography of Astronomy, the opening of 1886 witnessed the publication of Professor Pritchard's "Uranometria Nova Oxoniensis," in which the magnitude of every star visible to the naked eye, from the Pole to 100deg. N.P.D. was given, as determined by the method of extinction, with the author's wedge photometer. Even admitting, what its author strenuously denies, that the coloured wedge does not afford unerring means of absolute determination, such a catalogue as that of the Savilian Professor must always possess very high value for differential measures of brightness, and so afford great help to the observer of variable stars. A remarkably useful little book to the amateur possessors of equatorially mounted telescopes has been produced by Messrs. L. Clark, F.R.A.S., and Herbert Sadler, F.R.A.S., under the title of "The Star Guide," containing, besides the coordinates and descriptions of nearly 600 objects, excellent lists of test objects, and information on selenography and other subjects of interest to the student.

Three Star Catalogues have been issued during the past 12 months, to which we may

briefly refer. The first is the Pulkowa Catalogue of 3,542 stars for 1855! which, well done as it undoubtedly is, might and should have appeared many, many years ago to have been of much service to the working astronomer. Of the second on our list, the "Second Armagh Catalogue of 3,300 Stars for the Epoch 1875," we need only remark that it is fairly good. With reference to the third on "Astronomical Observations made at the Royal Observatory, Edinburgh," in which—to employ an expressive Americanism—Professor Piazzi Smyth "fools around" no less than 1,675 pages, "the least said the soonest mended." With the last month of the year that well-known serial, *The Astronomical Register* comes to an end after an existence, at once useful and honourable, of 24 years.

What Dr. Huggins so appropriately spoke of as "an infant Hercules," the Liverpool Astronomical Society, has long quitted its cradle, and developed a mighty adolescence, as astonishing as it must be gratifying to those to whom it owes its originally humble inception.

Death has, happily, been once more sparing in his visits to astronomers. Among the best known of those who have passed away may be mentioned Mr. C. G. Talmage, F.R.A.S., observer to Mr. J. Gurney Barclay, at Leyton in Essex, from whose observatory he issued three or four volumes of measures of double stars, &c. His scientific career commenced in the Royal Observatory at Greenwich, whence he was transferred to Mr. Bishop's Observatory in the Regent's Park. He was subsequently in France for three or four years, and on his return to this country went to Mr. Hind (with whom he had formerly worked at Mr. Bishop's) at the Twickenham Observatory, which was the successor of that in the Regent's Park. He left Twickenham in 1865 for Mr. Barclay's Observatory, which he directed until the date of his untimely death. The Rev. S. H. Saxby, who was an earnest and enthusiastic amateur, has also been taken from us. The death, too, was announced, at a very advanced age, of Mr. R. Potter, who was Professor of Natural Philosophy and Astronomy at University College in the days of our fathers, and in August died Dr. R. J. Mann, F.R.A.S., who, when in practice at Ventnor, many years since, wrote a very good little elementary work on astronomy. Of late years, after a lengthened sojourn in Natal, he mainly gave himself to meteorology. On one of his extremely rare appearances at the Royal Astronomical Society—it happening to be the annual one—he was made a scrutineer of the ballot, and gave rise to much subsequent unpleasant discussion by actually taking the whole of the balloting papers away with him when he left Burlington House! Among the deaths, too, we must chronicle that of the Rev. James Pearson, of Fleetwood, who for many years carried on a series of investigations on the tides, accumulating a great store of valuable information with regard to those in his own locality. Another astronomer belonging (like Mr. Potter) wholly to a past generation has gone. We refer to General Boileau, who died in November, at a very advanced age. Very many years ago he was head of the Observatory at Simla. Finally, we may say that the only foreign astronomers of any note whose deaths remain to chronicle were Professor Dorne, of the University Observatory at Turin, and A. Wagner, of the Observatory at Pulkowa.

SUBMARINE BOATS.

SUBMARINE boats are a much older invention than is generally conceived; but they are now coming prominently forward, because there is a useful field for their employment, and also because modern devices have rendered it possible to construct vessels which can be propelled safely beneath the surface of the water. Who first suggested the idea is not known; but it seems well authenticated that in the reign of James I. a Dutchman named Drebbel designed a boat which was actually propelled by twelve oars under the surface of the Thames, the air being revivified by some liquor, the composition of which Drebbel kept a secret. The Marquis of Worcester, in his "Century of Inventions" (1663), refers to a similar invention, and there is a record that a man named Day sank with his submarine boat in Plymouth Sound in 1774. It is, however, to Robert Fulton that we are indebted for the first definite ideas on the subject, for so long ago as 1801 he descended to a depth of 25ft. in the harbour of Brest, and demonstrated the fact that his "plunging boat" could be trusted to take himself and three companions under the water and return to the surface in safety. This boat was named the *Nautilus*, and when beneath the surface was moved 500 yards in about seven minutes, by two men turning the "engine," while Fulton regulated the position of the boat. On one occasion the boat remained beneath the surface for nearly six hours; but nothing in the shape of effective warfare was accomplished when Fulton was persuaded to lend his services to this country, though he did by way of experiment blow up some old vessels with torpedoes. Fulton published his work on the subject, "Torpedo War and Submarine Explosions," in 1810, at New York, in which he shows that a system of harbour defence based on stationary and movable torpedoes is the surest, quickest, and cheapest plan for protecting maritime cities against the naval forces of an enemy. In 1860 a submarine boat was made in France, in which compressed air was utilised for working the propelling device, and also for expelling the water taken in to produce submergence; but this vessel, too, does not seem to have been a success. A submarine boat has, however, been used for some time by the Pacific Pearl Company in carrying out their fishing operations; but it is not intended to serve as a torpedo boat, being flat-bottomed, with "doors" in the bottom, through which the oysters can be collected. Toselli's submarine exploring vessel, which we illustrated in No. 1,017, p. 57, is a fairly perfect device for diving, but has no means of propulsion; it is, in fact, an elongated diving-bell, with reservoirs of compressed air and two or three stories. Much attention has been devoted to the subject of submarine vessels in Russia, and many experiments were made in that country about twenty years ago; but no practical device of the kind was produced. The inventions of Denayrouse and Fleuss, which disclosed a method of carrying sufficient air to enable a man to breathe either in the ways of an exploded coal-mine or beneath the water, gave an impetus to the search for a submarine boat, and modern inventions in connection with electricity have helped to place the scheme on the road to ultimate success. A few years ago two submarine boats were built at Liverpool from designs by Mr. Garrett, who employed chemicals to revivify the air and render it respirable over and over again; but the most successful of these boats was lost off the Welsh coast. Since then Mr. Nordenfeldt has turned his attention to the subject, and has lately demonstrated that boats can be propelled for a few hours under water, although not with sufficient accuracy for torpedo work. As mentioned on p. 321 ante, a large and powerful vessel is being built from his designs, and will probably be ready for trial in the spring. Meantime Prof. Tuck is progressing with *The Peacemaker*, which we briefly described on p. 82 ante, and which has since been astonishing those who have witnessed her performances in the Hudson River. Both Nordenfeldt and Tuck employ steam for driving the propeller, the former carrying the heated water in reservoirs, the latter using the Honigmann caustic soda (or potash) boiler. Last week further trials were made with the modern *Nautilus* in the Tilbury Docks. That is a cigar-shaped vessel, 60ft. long by 8ft. in diameter, with a short raised deck in the centre, through which a conning tower projects, and provides access to the interior. The vessel is built of steel plates $\frac{5}{16}$in. thick, with 3 by 3 by $\frac{1}{2}$in. frames 1ft. 9in. apart, and is estimated to be strong enough to withstand the pressure of 50ft. of water. The boat is fitted with two screws, each driven by an Edison-Hopkinson motor at about 750 revolutions, the current being supplied by 104 secondary cells; but owing to the comparatively confined space of the dock, no trials of speed were made. The method of sinking and raising the vessel was designed by Mr. A. Campbell, and consists in a simple method of decreasing or increasing the displacement without affecting the weight of the vessel. This is accomplished by means of four horizontal cylinders on each side of the hull, which can be thrust outwards into the water, or drawn into the hull. The cylinders work through watertight sleeves, and can be moved either by hand or by screws worked by gearing from a shaft, so arranged that corresponding cylinders on each side are pushed out or withdrawn simultaneously. It will be readily understood that if the vessel with water-ballast tanks full and the cylinders within the shell-sinks to the bottom, the extra displacement which can be obtained by thrusting out the cylinders will bring her to the surface, while the tanks will enable her weight and trim to be regulated. Besides a rudder of ordinary pattern, the *Nautilus* has a horizontal fin or rudder for guiding the vessel or preventing a tendency to rise or dive, thus keeping a uniform depth below the surface. It is said that the air contained within the vessel is sufficient for a two hours' submarine trip with a crew of six; but no doubt if other vessels of the kind are constructed, either compressed air will be carried, or some means will be adopted for revivifying the air, as men engaged in such work as submarine torpedo warfare will need clear heads, and must run no risk from air heavily charged with carbonic acid. A patent has recently been secured in this country by Mr. C. D. Goubet, of Paris, for a submarine torpedo boat in which equilibrium is maintained by a pendulum acting through a horizontal bar on a clutch that actuates one portion of a double-action pump, which displaces water from one or the other of two reservoirs at the ends of the vessel. Water-ballast tanks assist in the submergence of the boat, and the motor is driven by electricity supplied from storage batteries. The screw propeller is movable, so as to be capable of giving the vessel an oblique direction in any sense in relation to the vessel's axis while having a regular continuous rotary motion. The vessel can thus be guided without a rudder, and can perform various evolutions. The torpedo is placed at the after part of the vessel, and is connected to an insulated wire wound on a drum. The crew enter an opening at the top closed by a dome, and sit on a compressed air reservoir from which air is taken and moistened by being caused to pass into the water compartments, whence it is discharged by a pipe into the dome. The vitiated air is constantly expelled by an air-pump. The torpedo vessel is fitted in front with a cutter or spike which can be projected forward several feet; it is worked by a lever, and serves to cut torpedo wires or nets. An obturator tube serves to discharge signal cartridges which, on reaching the surface, explode, and thereby give an indication to the ship with which the torpedo vessel is connected. A special arrangement enables this vessel to be propelled also by means of oars. We are not aware that any trials have been made with this vessel, or whether one has been constructed; but we may rest assured that it is only one of many patents which will be taken out for vessels and machines adapted to submarine navigation for the purposes of warfare.

LORRAIN'S IMPROVEMENTS IN ELECTRIC TELEPHONY.

THE improvements which Mr. J. G. Lorrain, of Norfolk-street, W.C., has introduced in connection with electric telephony form the subject of a patent. The object is to construct a long-distance system of electric telephony, and to overcome or avoid the difficulties produced by induction. The invention consists of an instrument capable of acting either as a transmitter or as a receiver. When acting as a transmitter it fulfils the usual function of a transmitter in telephony—namely, that of producing under the influence of sound-waves rapid variations of current in a conductor or

system of conductors; and when acting as a receiver it fulfils the usual function of a receiver in telephony—namely, that of producing under the influence of variations of current mechanical vibrations of the air or sound-waves similar to, and uniform with, those which actuate the transmitter. In carrying the invention into effect, the patentee employs an instrument which consists essentially of two conductors and a screen. The two conductors are arranged in proximity to one another, and the screen occupies a position between them. In one form of the instrument the two conductors are fixed, and the screen is movable. In another form the screen is fixed, and the two conductors are movable. In a third form the screen and one of the conductors are fixed, and the other conductor is movable. In a fourth form one of the conductors is fixed, and the other conductor as well as the screen is movable. The patentee prefers to attach the movable part or parts of the instrument to a diaphragm serving the usual purpose of a diaphragm in telephony; that is in order to concentrate or increase the effect of the sound-waves upon the movable part or parts when acting as a transmitter, and when acting as a receiver to concentrate or increase the effect of the movable part or parts upon the air so as to produce sound-waves or air-pulsations. The said conductors may be arranged in any convenient manner. One convenient manner of arranging them is in spirals or coils, and such spirals or coils may be flat, straight, or annular. The several parts of the instrument are so disposed with regard to one another that when in action the extent of surface of one conductor exposed to or screened from the other will vary according to the vibrations of the movable part or parts.

When used as a transmitter the instrument is connected up in such manner that one of the two conductors shall be in circuit with a battery, or other source or reservoir of electricity, so that a current shall pass through this conductor; and the other conductor is connected to the main circuit. When used as a receiver, the instrument is so arranged that one of the conductors is in connection with the main circuit and the other conductor is closed upon itself by putting its two ends in electrical connection with each other. For convenience of description, that conductor is called the primary through which the current from the battery or other source or reservoir of electricity is passed, and that the secondary one which is connected to the main circuit—that is in the case of a transmitter; but in the case of the receiver that is called conductor the primary which is in connection with the main circuit, and the secondary the one which is closed upon itself. By the term "main circuit" is meant the circuit connecting the two stations between which telephonic communication takes place, and which may consist of any of the usual forms of circuit—such, for example, as a metallic circuit or a line and earth circuit. The action of the invention is as follows:—Let us take the case where the two conductors are fixed and the screen, in this case attached to a diaphragm, is movable. The sound-waves impinging on the diaphragm of the transmitter will cause the screen to vibrate in such manner as to vary the amount of surface of the secondary conductor exposed to the inductive influence of the current in the primary conductor, and so vary the energy of the induced current transmitted through the main circuit. The variations of current passing through the primary conductor of the receiver will cause variations in the current induced in the secondary conductor, and these variations will cause the screen to move in unison with such variations, and so cause vibrations in the diaphragm which will produce sound-waves similar to and uniform with those which actuate the transmitter. From this description the action of the invention in the case of the other forms of instrument will be readily understood. In all these forms the effect is the same, whichever parts are fixed and whichever movable—the amount of the one conductor screened from the other will vary with the sound-waves in the case of the transmitter, and with the electric undulations or variations of current in the case of the receiver. To increase the inductive action of one coil upon the other, the patentee sometimes employs a core or cores or mass or masses of iron or other magnetic material (but preferably iron); and such a core or mass is called an "intensifier." To gain increased effect the several parts of the instruments are sometimes multiplied for the purpose of transmitting signals, instead of actuating the transmitter by means of sound-waves, tapping on the diaphragm where such exists, or tapping on the screen itself is sufficient.

Figs. 1 and 2 show diagrammatically one form

FIG. 1.

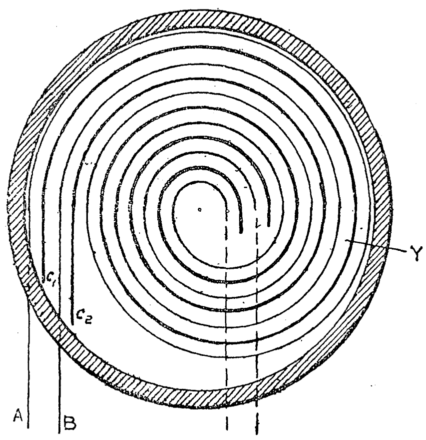
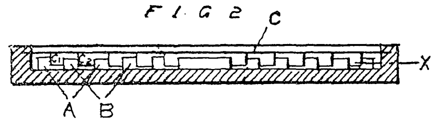


FIG. 2



of the invention. The primary coil A and the secondary coil B are formed of thin ribbons of metal wound each in a flat spiral as shown. C is a vibrating diaphragm having attached to it the screens c^1 c^2, which interpose more or less between the primary and secondary coils as the diaphragm vibrates. Sometimes in this form of instrument the patentee dispenses with the second screen c^2, and replaces it by a fixed strip of iron acting as an intensifier. Fig. 1 is a sectional plan on line X, and Fig. 2 a section on line Y. These figures show the instrument as a transmitter. In practice the patentee prefers to use two instruments at each station, one connected up as a transmitter, and the other as a receiver; but he sometimes uses only one instrument at each station; and when this is the case employs a switch, which, when the instrument is to be used as a transmitter, places the primary conductor in circuit with the battery, and connects the secondary conductor with the main circuit; and which, when the instrument is to be used as a receiver, places the primary conductor in connection with the main circuit, and closes the secondary conductor upon itself.

ASTRONOMICAL NOTES FOR JANUARY, 1887.

With the advent of a New Year we shall, in accordance with a now annual custom, give such an explanation of the various tables of which these Notes are made up as shall enable the amateur observer to employ them intelligently and beneficially. To this end we append, wherever it seems necessary, numerical examples worked out at length; and in the case of the lists of Occultations of Stars by the Moon, and of the times of the Greatest Eastern Elongation of Saturn's Satellites, furnish illustrative woodcuts of the methods of measuring the position angles at the disappearance and reappearance of the stars, and of the position of each of the satellites, at the times given in our tables respectively.

In the table which immediately follows, the second column gives, for every fifth day, the instant which should be shown by a clock at Greenwich, regulated to exhibit Mean Time, when the Sun is due South or on the Meridian, and a sundial marks 0h. 0m. 0s. What is called "The Equation of Time" in the almanacs, or the amount to be added to—or subtracted from—the instant of Apparent or Solar Noon, is calculated for the Meridian of Greenwich, but may, without any practical error, be employed for any other station in the United Kingdom; inasmuch as Valentia is only 41m. 23s. West of Greenwich, and the variation in the Equation during one hour is only 1·18sec. on January 1st—a quantity which further dwindles to 0·37sec. by the 31st of the month; and, notoriously, no sundial ever constructed can be read with anything like this amount of accuracy. Columns three and four give the Right Ascension and Declination of the Sun when a Mean Time clock at Greenwich marks 0h. 0m. 0s.; while column five shows the Right Ascension of the Meridian, or Sidereal Time, at the same instant.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 3 46·69 PM	18 47 4	23 0 39	18 43 17·08
6	0 6 3·64 „	19 9 3	22 30 9	19 2 59·87
11	0 8 8·55 „	19 30 51	21 48 35	19 22 42·65
16	0 9 58·76 „	19 52 24	20 56 26	19 42 25·43
21	0 11 32·18 „	20 13 40	19 54 17	20 2 8·21
26	0 12 46·77 „	20 34 38	18 42 52	20 21 50·99
31	0 13 41·00 „	20 55 15	17 22 58	20 41 33·77

The last-named quantity (the Sidereal Time at Mean Noon) is very often required by the observer for the instant of Local Mean Noon at his own station, and this may be obtained by the addition of 9·8565 seconds for every hour (and proportional parts for minutes and seconds) of Longitude when the place of observation is to the West of Greenwich, and by their subtraction when it is East. For example: What is the Sidereal Time at Mean Noon at Armagh on January 6th? Armagh is 26m. 35·5s. West of Greenwich; so we say 60m. : 26m. 35·5s. : : 9·8565s. : (what we shall find to be) 4·37s. We see from our table that the Sidereal Time at Greenwich Mean Noon on January 6th is 19h. 2m. 59·87s., and if to this we add, according to the precept (Armagh being West), 4·37s., we obtain 19h. 3m. 4·24s. as the Sidereal Time at Armagh Mean Noon on the date specified. Or let us take a station like Canterbury, which is 3m. 28s. East of Greenwich; then, as before, we say 60m. : 3m. 28s. : : 9·8565s. : 0·57s. If, then, we wish to know the Sidereal Time at Canterbury Mean Noon on January 26th, we simply subtract 0·57sec. from 20h. 21m. 50·99s., with the result that we find it to be 20h. 21m. 50·42s.

At 8 p.m. on January 2nd the Sun is said to be in Perigee; in other words, the Earth is in that part of her orbit which approaches the closest to him, and his apparent angular diameter is at its maximum. Accepting Newcomb's determination of the Equatorial Horizontal Solar Parallax (8·848″) and Colonel Clarke's measurement of the Earth's Equatorial Radius (3963·296 miles), there is, at that instant, an interval of 90,842,922 miles between the centre of the Sun and that of our own Globe. Days, and almost weeks, now pass without the appearance of any perceptible spots on the Sun's surface, whence it would appear that we cannot be far distant from a minimum period.

The Moon

Enters her First Quarter at 20·5 minutes after Noon on January 2nd, and is Full at 10h. 32·3m. on the night of the 9th. She will enter her Last Quarter at 3h. 22·0m. p.m. on the 16th, and be New at 3h. 1·1m. a.m. on the 24th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	7·1	5 29·6 p.m.
6	12·1	9 19·0 „
11	17·1	1 8·6 a.m.
16	22·1	5 41·0 „
21	27·1	9 57·9 „
26	2·4	2 0·1 p.m.
31	7·4	5 33·5 „

The Moon will be in Conjunction with Saturn at 11 p.m. on the 9th; with Jupiter at 3 a.m. on the 17th; with Mercury at 8 a.m. on the

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
4	μ Ceti	4	8 28 p.m.	Dark	77	87	9 33 p.m.	Bright	324	348
5	*f* Tauri	4	5 21 „	Dark	82	48	6 24 „	Bright	319	293
6	71 Tauri	6	6 50 „	Dark	30	359	7 7 „	Bright	3	334
6	θ^1 Tauri	4½	7 47 „	Dark	91	68	9 2 „	Bright	300	295
6	θ^2 Tauri	4½	7 54 „	Dark	68	47	8 55 „	Bright	323	316
6	B.A.C. 1391	5	9 2 „	Dark	113	108	10 19 „	Bright	274	289
6	85 Tauri	6	†10 19 „	S. by E.	12	27				
6	Aldebaran	1	12 17 „	Dark	130	165	1 15 a.m.	Bright	245	283
7	111 Tauri	5½	†7 51 „	S. by E.	11	340				
7	115 Tauri	6	8 53 „	Dark	115	95	10 6 p.m.	Bright	263	261
9	B.A.C. 2432	6½	7 6 „	*Dark	147	106	7 40 „	Bright	216	175
10	*f* Geminorum	6	3 5 a.m.	Bright	76	111	4 9 a.m.	Dark	263	303
11	54 Cancri	6½	†8 6 „	N. by E.	166	205				
12	18 Leonis	6	6 21 „	Bright	15	54	6 55 „	Dark	307	346
12	45 Leonis	6	9 11 p.m.	Bright	123	83	9 50 p.m.	Dark	210	171
12	ρ Leonis	4	11 29 „	Bright	96	61	12 30 „	Dark	228	199
13	49 Leonis	6	†1 29 a.m.	S.S.W.	340	320				
16	65 Virginis	6	2 5 „	Bright	93	61	3 5 a.m.	Dark	219	193
16	66 Virginis	6	2 48 „	Bright	71	44	3 57 „	Dark	238	221
16	l^2 Virginis	5	7 44 „	Bright	23	44	8 35 „	Dark	291	318
28	4 Ceti	6	7 16 p.m.	Dark	146	179	8 13 p.m.	Bright	259	296
28	5 Ceti	6	7 42 „	Dark	161	196	8 26 „	Bright	244	281
30	ν Piscium	4½	9 24 „	Dark	147	185	10 15 „	Bright	250	289

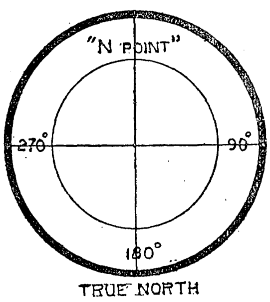
* But apparently bright. † Near approaches.

Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites.

Day of Month.	Satellite.	H.	Day of Month.	Name of Satellite.	H.	Day of Month.	Name of Satellite.	H.
1	Tethys	7·4 p.m.	13	Enceladus	3·1 a.m.	19	Rhea	11·6 p.m.
1	Rhea	10·5 „	13	Tethys	3·2 „	20	Mimas	7·4 „
1	Mimas	11·1 „	13	Dione	6·4 p.m.	21	Dione	11·3 „
2	Enceladus	4·2 a.m.	14	Tethys	12·5 „	22	Enceladus	5·2 „
2	Tethys	4·7 p.m.	15	Mimas	3·7 a.m.	24	Enceladus	2·0 a.m.
2	Dione	7·8 „	15	Enceladus	8·9 p.m.	24	Dione	5·0 p.m.
2	Mimas	9·7 „	16	Mimas	2·3 a.m.	26	Enceladus	7·8 „
3	Mimas	8·3 „	16	Tethys	9·8 p.m.	28	Enceladus	4·7 a.m.
4	Mimas	6·9 „	16	Mimas	12·9 „	28	Tethys	5·5 „
4	Enceladus	9·9 „	17	Enceladus	5·8 a.m.	28	Rhea	12·2 p.m.
6	Enceladus	6·8 a.m.	17	Mimas	11·5 p.m.	30	Tethys	2·8 a.m.
8	Enceladus	12.5 p.m.	18	Dione	5·7 a.m.	30	Dione	4·2 „
10	Rhea	11·0 „	18	Tethys	7·0 p.m.	30	Enceladus	10·5 p.m.
10	Dione	12·8 „	18	Mimas	10·1 „	31	Mimas	4·1 a.m.
11	Tethys	5·9 a.m.	19	Mimas	8·7 „	31	Tethys	12·1 p.m.
11	Enceladus	6·2 p.m.	19	Enceladus	11·5 „			

23rd; with Venus at the same hour on the 25th; and with Mars at 11 o'clock at night on the same day.

The following table gives the approximate Mean Time at which the stars whose names it contains will disappear and reappear at the Moon's Limb as viewed from Greenwich, and the points on that limb at which the phenomena will occur as seen in an inverting telescope. As probably everyone knows who will read these lines, the Moon travels from West to East through the sky. Hence, in her passage over such stars as lie in her path, her Eastern limb occults them, and they reappear at her Western limb. The "Angle from North Point" in our table means the arc included between the star when in contact, and that point of the Moon's limb cut by a circle passing through the North Pole and her centre. The "Angle from Vertex" is measured from a point where a circle through the zenith and the Moon's centre cuts her limb. The former is employed with the Equatoreal; the latter with the Altazimuth instrument. In the familiar case of the measurement of double stars, the initial point of the circle of reference is the true North—or bottom—of the field of view of the micrometer, and the angles are measured thence in the directions North following, South following, South preceding, and North preceding back to North again, or in a direction opposed to that of the hands of a watch. In the case of Lunar Occultations, however, a precisely opposite method is adopted, and angles are measured from the true *South* point of the Moon's limb, absurdly called the "North Point," because it is at the top of the field of view in an inverting eyepiece. Moreover, the direction of measurement is changed, too, and follows the same course as do watch-hands in their diurnal revolution. A diagram will make



this intelligible. The outer circle in the one above represents the field of view of a telescope, while the inner one may be conceived to show the Moon's disc with the angles as measured marked round it. We may add that the "North Point" and "Vertex" of the Moon coincide for the instant that the Moon is on the Meridian, but diverge widely when she is far to the East or West of it, as anyone may see by bisecting her image by a plumb-line at the time of her Transit, and again three or four hours afterwards. In the case of "Near Approaches," we give the *true* point of the Moon's limb to which the star most closely approximates; and we do so because she is so comparatively close to the earth, that while she may pass clear of the star as seen from Greenwich, she may pass over it as viewed from other stations in the British Islands. For example: If we suppose that, as regarded from the Royal Observatory, her South limb just passes North of a given star, she may well occult it to an observer in Yorkshire, and *vice versâ*. As we have said above, it is the Eastern or advancing limb of the Moon at which stars disappear, and as from New Moon to Full Moon this is dark, disappearances between these phases occur at the dark limb and reappearances at the bright one—a condition of things precisely reversed between Full and New Moon again.

Mercury

Is a Morning Star throughout the month, and from his great South Declination is about as badly placed for the observer as he can be. He rises, however, soon after half-past 6 a.m. at the beginning of January, so that he may possibly be glimpsed above the S.S.E. part of the horizon before sunrise about this time. His diameter remains pretty constant during the month at a very little over 5".

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	17 20·5	22 24·5	10 37·4 a.m.
6	17 50·7	23 22·2	10 47·9 „
11	18 22·7	23 53·7	11 0·1 „
16	18 55·8	23 54·8	11 13·5 „
21	19 29·8	23 22·8	11 27·8 „
26	20 4·4	22 15·6	11 42·6 „
31	20 39·4	20 31·8	11 57·8 „

Starting thus from the most Southerly part of Ophiuchus, Mercury travels across Sagittarius and into Capricornus. He does not, however, approach any conspicuous star in either of these constellations.

Venus

Is an Evening Star, but is barely visible before the end of the month, when she may possibly be caught twinkling close to the horizon, over the S.W. by W. part of it, after sunset. Her practically circular little disc increases imperceptibly in diameter from 9·8" at the beginning of January to 10·2" by the end of it. She is wholly destitute of interest as a telescopic object, though, at present.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	19 18·0	23 13·2	0 34·7 p.m.
6	19 45·1	22 23·4	0 42·0 „
11	20 11·8	21 16·6	0 48·9 „
16	20 38·0	19 54·0	0 55·4 „
21	21 3·6	18 16·9	1 1·3 „
26	21 28·8	16 26·9	1 6·7 „
31	21 53·4	14 25·4	1 11·6 „

It will be seen, from the above ephemeris, that the path of Venus during January lies across Sagittarius and Capricornus, and terminates in Aquarius. As in the case of Mercury, the part of the sky through which she travels is free from conspicuous stars.

Mars,

For the observer's purpose, is now quite invisible.

Jupiter

Is a Morning Star all through January. As he does not rise until between 2 and 3 o'clock in the morning on the 1st, nor even on the 31st until half an hour after midnight, crossing the Meridian on those days at 7h. a.m. and 5h. 33·2m. a.m. respectively, we shall defer our ephemeris of him until next month. He is in quadrature with the Sun at 4 a.m. on the 25th.

Saturn

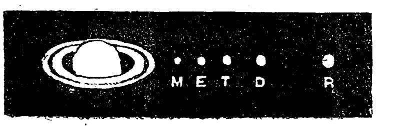
Is visible all night long, and, coming as he does into opposition to the Sun at 2 p.m. on the 9th, is most excellently placed in every way for the observer. The slight closing up of his ring

system will be perceptible to anyone who remembers the aspect of Saturn in 1885, and it will be noted that the South Pole of the planet now covers Cassini's division, and even barely projects beyond the ring A. His equatorial diameter is 18·4″ at the beginning of January, and increases to 18·6″ during a few days of the second week of it—only, though, to return subsequently to its pristine dimensions.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 25·1	21 49·1	12 39·7 p.m.
6	7 23·3	21 53·2	12 18·3 „
11	7 21·6	21 57·9	11 56·9 „
16	7 19·8	21 1·1	11 35·5 „
21	7 18·1	22 4·8	11 14·1 „
26	7 16·5	22 8·4	10 52·8 „
31	7 14·9	22 11·8	10 31·7 „

The short retrograde arc indicated by the above ephemeris begins at a point somewhat to the East and just to the South of δ Geminorum, towards which star Saturn is travelling, and to which he approaches so closely as to be in the same telescopic field with it at the end of the month.

The table (p. 383) gives the approximate times at which the five inner satellites of Saturn will be at their Greatest Elongation East of the planet and visible at Greenwich, and is intended to enable the student to identify them. The subjoined diagram (drawn to scale) shows the exact positions which they severally occupy at the times specified.



Titan is so prominent an object (shining as he does as a star of the 8th magnitude) as to be visible in the smallest telescope; while Iapetus describes so large an orbit as to be easily identified, especially when at its brightest to the West of the planet. Hyperion is hopelessly beyond the optical power of any of those who will be likely to employ these Notes; and even Mimas is invisible in any instrument less than one of between 6in. and 7in. aperture.

Uranus

Is a Morning Star; but as he does not rise until after midnight at the beginning of January, and between 10 and 11 p.m. at the end of it, we shall defer our ephemeris of him until March. He is in quadrature with the Sun at 2 a.m. on the 3rd.

Neptune

May still be well seen during the earlier hours of the night, but should be looked for as near to the time of his meridian passage as is convenient.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 33·7	17 24·4	8 49·0 p.m.
6	3 33·4	17 23·4	8 29·0 „
11	3 33·1	17 22·7	8 9·0 „
16	3 32·8	17 22·1	7 49·1 „
21	3 32·7	17 21·7	7 29·3 „
26	3 32·5	17 21·6	7 9·5 „
31	3 32·4	17 21·6	6 49·7 „

From which it will be seen that Neptune continues in a blank part of the sky some $6\frac{1}{3}$° South, and very slightly to the West, of the Pleiades.

Shooting Stars

May be looked for on the nights from the 1st to the 3rd inclusive, and again from the 15th to the 19th.

Greenwich Mean Time of Southing of Seventeen of the Principal Fixed Stars on the Night of January 1st, 1887.

Star.	Souths. h. m. s.
α Andromedæ	5 18 22·97 p.m.
α Cassiopeiæ	5 49 51·47 „
β Ceti	5 53 39·11 „
Polaris	6 33 27·51 „
α Arietis	7 16 19·58 „
α Ceti	8 11 44·72 „
α Persei	8 31 35·36 „
γ¹ Eridani	9 7 58·80 „
Aldebaran	9 44 33·77 „
Capella	10 23 22·20 „
Rigel	10 24 7·58 „
α Leporis	10 42 42·99 „
α Orionis	11 3 57·88 „
Sirius	11 54 56·50 „
Castor	12 42 1·93 „
Procyon	12 48 0·68 „
Pollux	12 53 0·71 „

Were the stars rigidly and absolutely "fixed," any given one would South 3m. 55·91s. (or 235·91sec.) sooner every day, as indicated by a clock regulated to show Mean Time. This is so nearly true with a large proportion of them that, for our present purpose, we may assume it to be accurately so, and to find the Greenwich Mean Time of Transit of either of the stars in the above list for any other night in January we have only to multiply 235·91sec. by the number of days which have elapsed since the beginning of the month (i.e., by the day of the month − 1), and subtract the result given in our table. For example: At what hour will α Arietis South at Greenwich on the night of January 11th, 1887? 11 − 1 = 10 and 10 × 235·91sec. = 2359·1sec., or 39m. 19·10sec. If, then, we take 39m. 19·10s. from 7h. 16m. 19·58s., we get 6h. 37m. 0·48s. as the Greenwich Mean Time of Southing of α Arietis on the night of January 11th. This differs 0·14sec. from the actual instant of Transit—a nearly inappreciable result. This discrepancy would, however, have been greater in the case of Polaris, though so slowly does that star cross a wire that it might even then be neglected. Let us now suppose, though, that we wish to ascertain the Local Mean Time of Southing of any one of the stars in our table. This we may do by subtracting 9·8565sec. for every hour of Longitude (and proportional parts for the minutes and seconds) when our station is West of Greenwich, and adding that quantity when our Longitude is East. For example: At what hour in Dublin Mean Time will Capella South in that city on the night of January 1st, 1887? Dublin is 25m. 22s. West of Greenwich; so, as in the example computed under the head of "The Sun" above, we say as 60m. : 25m. 22s. : : 9·8565s. : 4·17s.; and subtracting this quantity, according to the precept (Dublin being West), from 10h. 23m. 22·20s., we get 10h. 23m. 18·03s. as the instant when Capella will be on the Meridian of the observatory of that city. Had we been dealing with a station having East Longitude, like Dover or Yarmouth, the quantity found by proportioning must, of course, have been added to the time given in our table.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—XVIII.

By an Analytical Chemist.

Olive Oil.

(239.) On account of the high price of olive oil, and the importance of the uses to which it is applied, its analysis deserves special attention. The young analyst should make himself familiar with the physical properties of the several varieties found in the market. Indeed, in the examination of oils there is often a great deal of time saved by a judicious exercise of the eye, the nose, and the tongue. Opportunities for studying the taste, odour, and colour of the several oils, and varieties of oils, in the market should be sought, therefore, by all who desire to attain proficiency in this branch of analysis.

(240.) Olive oil when pure and fresh is almost free from odour; but in inferior qualities the smell is rather unpleasant. The taste is agreeable and free from that fattiness which characterises the oils of animal origin. The colour is greenish yellow; but the green is often more strongly marked in inferior samples.

(241.) *Sp. Grav.*—Unfortunately, authorities differ as to the limits for genuine oils, and the published figures of experienced analysts have so far shown that some of these limits are slightly in error. As the test is of some importance, and as it is desirable that future standards should be adopted in the light of wider experience, our results are given in full:—

Sp. gr. ·913	1·5 per cent.	(adulterated)
·914	6· „	„
·915	18· „	„
·916	39· „	„
·917	27· „	„
·918	2· „	„ } (adulterated)
·919	3· „	„ }
·921	2· „	„ }
·927	1·5 „	„ }

Those marked "adulterated" were found to be so by other tests, although when the gravity even slightly exceeds ·917 the purity of the sample is very doubtful. The gravity test alone, however, should never be relied upon, for samples are occasionally met with of a correct gravity produced by a judicious addition of oils lighter and heavier than the particular kind it is intended to counterfeit. Indeed, it is very desirable to bear constantly in mind that correct conclusions about oils can only be arrived at by a consideration of the results of several tests, such as those described in Art. 216. Many mistakes are made by placing too much reliance on one or two tests, however rigid their nature, unless such tests are sufficient to determine the suitability or unsuitability of an oil for a particular purpose. Even pure oils vary so much in quality that they occasionally fall without the recognised limits of a certain test; but show no other indications of adulteration.

From the above table the limits of ·914 and ·917 would appear to include the majority of genuine samples.

(242.) *Rise of Temperature.*—The figures given in tables showing results by this test vary somewhat, owing to the different conditions under which the test is performed. Some analysts weigh both oil and acid, some the oil alone, some take no precautions that the acid is of the correct gravity (1·845), and all do not use the same proportions of oil and acid, nor make the experiment in the same kind and size of glass vessel. An analyst with long experience can construct a comparative table for himself; but, wanting this, he must be dependent upon those supplied by Maumené (the originator of the test), Allen, and others. In large laboratories, it will probably be found more convenient to measure both oil and acid as described in Art. 218; and, as the densities of oil do not vary very much, the proportionate weights of oil and acid will be approximately constant. The advantage of using the same vessels in all experiments is that the same amount of heat is absorbed by them.

So far as my own experience goes, I have found that 25 per cent. of the samples of olive oil gave a rise of temperature of from 65° to 69° F; and *twenty-five* per cent. a rise of from 72° to 76° F. These represent two qualities—the lower figures the kind known as Lucca, the higher figures the inferior kind sold as Gallipoli. For the latter, the lowest rise obtained was 73° F., while the specific gravities of the several samples lay almost without exception between ·915 and ·916. But although the gravities were so uniform, the rise of temperature varied considerably, and reached as high as from 84° to 106° F., while the gravity did not exceed ·916. When the rise of temperature amounts to 84° it indicates adulteration; when it goes above that and approaches 106°, adulteration is certain; and when the gravity is not excessive tke adulterant used is probably colza oil. In one instance the rise of temperature was 116° F., and the gravity ·921, indicating poppy-seed or cotton-seed oil as the adulterant. This test is the more valuable in the case of olive-oil, since the rise of temperature of any of the adulterants ordinarily used is higher than that of the pure oil itself.

(243.)—*Solidifying Point.*—Olive oil begins to solidify at or above the freezing point. Some analysts observe the temperature at which the fat becomes solid, others that at which the fat begins to deposit. As it is not easy to determine the temperature at which a

fat is entirely solidified, we think that the latter method is to be preferred. It is always necessary to lower the temperature below that at which the oil begins to solidify for the purpose of ascertaining whether the bulk of the oil is or is not changed into fat within a few degrees of that temperature. Unless this is done, the fat deposited may be due to the presence of an adulterant having a higher solidifying point. The temperature at which the oil becomes clear again is also observed, as it usually helps to check the solidifying point. Rape, lard, nut, and poppy oils, especially the two latter, prevent the deposition of fat until the temperature falls below 30° F. If no fat is deposited before 20° F. is reached, adulteration may be suspected.

There is one other remark necessary in connection with this test. In cooling, as much oil as can be spared should be used. The temperature should be lowered gradually, and the oil constantly stirred the while. If the temperature be made to fall very rapidly by means of such a mixture as ice and salt, the fat will not be deposited until the temperature falls considerably below the correct solidifying point. A good plan for oils that solidify above the freezing point is to place the bottle in an ice-chest near a block of ice for a night. For olive oil this answers very well.

(244.) *Elaïdin Test.*—Olive oil, being non-drying, is converted into a firm, yellowish, white solid by this test, which gives fairly uniform results when applied as described in Art. 220. There are other ways of applying it, but this we have found answers very well in general practice. Two things have to be particularly observed: (1) the colour of the solidified mass; (2) its consistency. The time required for complete solidification is also of importance, and should be observed whenever possible. But it varies in the same oils according to the temperature at which the experiment is performed, and is longer when applied in the way recommended here—so long that some oils require to stand overnight. The time for solidifying is considerably increased by the presence of drying oils, such as poppy and nut, and to a less extent by the semi-drying cotton-seed oil. Any variation from the colour or the consistency would indicate adulteration. Rape or colza changes the colour more or less to orange red, according to the quality and quantity of the adulterant.

(245.) *Acidity.*—The amount of free acid should always be determined in olive oils, especially when they are to be used for lubricating. It is determined as described in Art. 230 (*d*), and when calculated as acetic acid varies from 0·03 to 0·64 per cent. Samples quite free from acid are rarely met with. Oils with the smaller amount of free acid attack copper, those with the higher amount much more so. The latter are quite unsuitable for the lubrication of delicate machinery. The acidity increases with the age of the oil, and in consequence of this, ordinary olive oil is growing more and more into disfavour as a lubricant.

(246.) To test the action of the oil upon copper, a few drops are placed on a sheet of copper the surface of which has been newly cleaned by rubbing with fine emery paper. The sheet is then placed horizontally (oiled side uppermost) in a clean white porcelain basin and left for twenty-four hours. The sheet is then tilted so that the oil may drop into the basin, and by means of a few drops of ether, the adhering oil is washed off the sheet completely. If the oil attacked the copper, the recently-covered part of the surface will be brighter, and the oil will have a distinct green colour. The fact will be more evident if there be added to the oil in the basin two or three drops each of acetic acid and solution of potassic ferrocyanide, to form the reddish brown precipitate of ferrocyanide of copper. The copper is affected by the oil in proportion to the amount of free acid in the latter.

(247.) *Colour Tests.*—With sulphuric acid, as in Art. 230 (*e*) olive oil forms a clear yellow clot; a violet shade would indicate cotton-seed oil, and a green or slaty shade colza. When violet shades are produced, the rise of temperature with sulphuric acid is usually very high.

(248.) In addition to the above, other colour tests may be applied in particular cases; but the purity of a sample can be determined from them alone. The viscosity test is also useful; but more will be said of it in connection with lubricating oils.

Other special tests, which would be out of place here, will be found in the textbooks.

(*To be continued.*)

LIQUID FUEL.

THOSE who believe that petroleum is to be the fuel of the future have the courage of their opinions, and lose no opportunity of advancing its claims. On November 10th two papers "On the Use and Transport of Liquid Fuel," by Messrs. G. B. Nicholl and J. Gravell, incorporated and taken as one, were read before that admirably-managed society, the North-East Coast Institution of Engineers and Shipbuilders. With the latter portion of the paper—that on the carriage of petroleum in suitable steamers—we do not propose to deal; we shall confine our attention to Mr. Nicholl's statements. He spoke in somewhat general terms of the efficiency of petroleum as a steam generator compared with coal. He sets it down as being competent to evaporate in practice twice as much water per pound as coal can evaporate. But in doing this he multiplies the theoretical efficiency of coal by ·7, while he uses ·9 as a factor in dealing with petroleum. This he justifies on the ground that the combustion of the latter is perfect, while the combustion of the former is not; and also on the assumption that less air is required to burn petroleum without smoke than will suffice to secure the smokeless combustion of coal. This, we think, postulates rather too much; yet we are content for the sake of argument to concede that a ton of petroleum will do as much work as two tons of coal. In this country the cost of petroleum is, of course, fatal to its adoption. It costs as much for freight alone in any north-country port as coal would cost per ton. We have not yet heard that the crude oil can be sold for the price of coal, and its value, whatever it may be, must be added to the freight. If we set the cost of petroleum against that paid for coal, say at Aden, then the comparison is more favourable to the petroleum. But there is a point to be considered which is quite as important as cost; and that is that crude petroleum is not burned in either steamers or locomotives, and it does not appear that it can be so burned. The risk is too great. Crude petroleum is a very composite material. It is really a mixture of a great many hydrocarbons of different specific gravities and igniting points. At one end of the scale we have the benzines—excessively volatile, giving off a gas highly explosive when mixed with air; and at the other end the dead tarry oils which have a comparatively high flashing point and evolve little vapour. We are told a great deal about the working of steamers on the Caspian and the Volga with petroleum, and of its use on South Russian railways. On examination, however, it appears, first, that coal is at prohibitive prices in these regions, and that it is not crude oil that is burned at all, but "astaki"—namely, the dead oil or refuse left in the stills after the crude oil has been refined. It is clear, then, that the supply of suitable oil fuel depends not so much on the oil wells as on the demand for the refined oils; for it would not pay to refine oil and throw away the better portion merely to get as fuel what is now a waste or by-product, of no value whatever. Those shipowners, then, who contemplate fitting up their steamers for this kind of fuel will have to reckon with the possibility of being unable to get astaki when they want it, save at an extravagant price. Furthermore, a ship sailing from England must find astaki here in sufficient quantity to take her, say, to Alexandria, where she can get her further supply to take her to Bombay, let us suppose. At Alexandria we may grant that it will be cheap enough, but what will it cost in England? Obviously the economical course to pursue would be to take coal in her bunkers sufficient to carry her to Alexandria, and fill up there with astaki. But it seems to be generally conceded either that a petroleum-fitted boiler will not do at all for coal; or that the superior advantages of petroleum cannot be realised with a coal-burning boiler. In the course of the discussion on Mr. Nicholl's paper, Mr. J. A. Rowe pointed out that, as no soot was produced, it would be possible to make boilers with much smaller tubes than are now used, so that the total heating surface could be augmented by 50 per cent. This is probably a sound argument; but every sea-going engineer knows that a small tube marine boiler cannot be used with coal.

Mr. Nicholl touched very lightly on the objections to the use of liquid fuel at sea. We do not want it to be supposed that we are in any shape or way opposed to the innovation. On the contrary, we are desirous to see petroleum a success, because there can be no doubt whatever that it is in many respects a most admirable fuel. But, on the other hand, we should not do our duty by our readers if we did not point out the difficulties which stand in the way of its adoption, and thus probably save some shipowners and engineers from loss and annoyance. We have no hesitation, therefore, in calling attention to facts which seem to be readily overlooked or forgotten. They ought to be kept prominently in view in order that they may be overcome. We have already pointed out that crude petroleum cannot be used without peril. This is due to the penetrating powers of the oil. Joints in tanks which are perfectly watertight will pass petroleum freely. The utmost care and special workmanship are needed to make petroleum-tight tanks. Again, all the space above the liquid, as the tanks are emptied, is full of vapour, which will explode like gunpowder if mixed with air and ignited. In the few cases where petroleum has been used at sea the water has been admitted to the tanks. The oil keeps on the top, and the water follows it up, so that there is no space for gas. A very small mistake in dealing with such a fuel as this may entail a possible catastrophe. With astaki, as we have already explained, the case is different. Again, nothing is certainly known as to the true evaporative efficiency of astaki. Mr. Nicholl cites some old experiments of Favre and Silberman on petroleum refuse, which give its theoretical efficiency as 19,794 units, that of coal being 14,000. But "petroleum refuse" is a wide term, and we are not certain that Favre and Silberman ever tested the astaki of commerce. Astaki has the great advantage that a tank will hold it without leaking if it will hold water. No one has said one syllable as to the action which underwriters on the one hand, and the Board of Trade on the other, are likely to take in the matter. Will the former underwrite at ordinary rates? and will the latter grant passenger certificates to steamships burning liquid fuel? These are most important questions, which will have to be answered before any considerable advance can be made in the use of liquid fuel.

There is, furthermore, an objection which may seem small, but is, nevertheless, of considerable importance—namely, the noise produced by the combustion of petroleum. Each furnace makes a thundering roar which must be heard to be realised as regards its magnitude. It is possible that this may be got over. It has not been got over yet. All the systems of burning astaki or petroleum used with success up to the present time are based on Aydon's method, patented many years ago. That is to say, the oil is blown into the furnace in the form of spray by a jet of steam. It has been found highly advantageous, if not essential, that this steam should be first superheated, and the loss of the steam—or rather of the water which it represents—must be made good either on such systems as those patented by Mr. Kirkaldy, or by Mr. Jones, of Liverpool, or else there must be a separate boiler to supply the steam for injection. Of course, these things are not insuperable objections; but they complicate the question. To us it appears that it would be far better to use compressed air than steam. This might be readily obtained by working a compressing pump off the back levers of the main engine, just as the air and circulating pumps are worked now. While the engines were standing steam might be used. We are sorry to see that Mr. Arnison, who certainly knows better, during the discussion on Mr. Nicholl's paper, referred, without contradicting it, to the statement that the boiler of the steamer *Ryde* evaporated 41lb. of water per pound of petroleum. In which case it is clear that each pound of the oil must have had a practical thermal efficiency of about 41,000 units, or, say, twice the theoretical efficiency of any oil yet tested, and he made matters worse by saying that this was "apparently accounted for by the utilisation of the hydrogen liberated from the steam used for injecting the oil." Now when hydrogen is burned with oxygen the result is water, and the energy developed in the form of heat is precisely the same, neither less nor more, than that expended in separating the steam—water—into its component gases. Put chemically, the heat of combustion is simply equivalent of the heat of dissociation; consequently there is absolutely nothing to be gained in the way Mr. Arnison seemed to suppose.

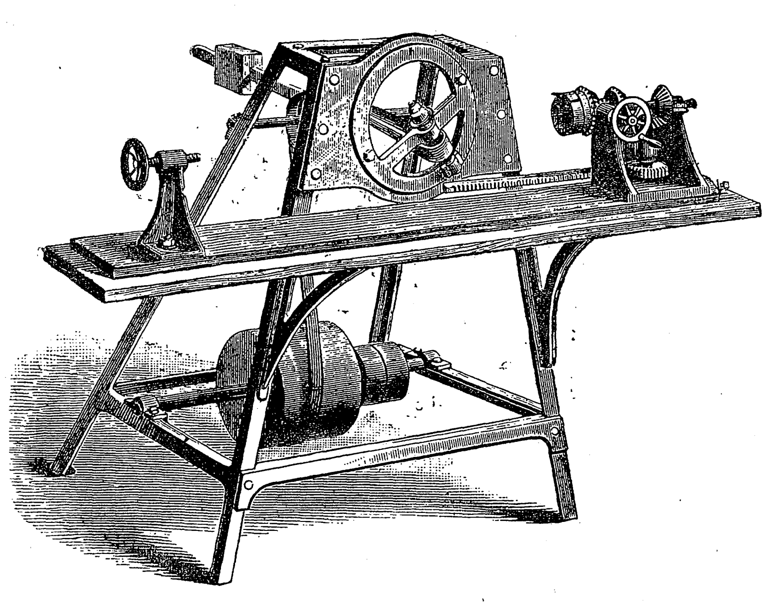
We have no doubt but that many more papers on the subject of liquid fuel will be read in the immediate future. We would direct the attention of intending readers to the points we have raised. Nothing is to be gained by passing over objections in silence. Everyone knows now that petroleum can be burned and steam raised with success. The points on which information is lacking do not refer to steam raising, but to its concomitants—such, for example, as the safety of astaki; the action of underwriters; the proper method of storing the oil; the effect of very intense temperatures on boiler plates; the probability of disaster as a result of the failure of any part of the apparatus; the means of taking the astaki on board—in fact, what we now want is information concerning those details on which the success or failure of the whole scheme depends. The soundness of the principle

may be freely conceded. The shipowning world has yet to be shown how the principle is to be carried out in practice to the best advantage. On this point next to nothing is known, and for this reason it ought to be easy to write a most interesting paper on this subject: that is to say, provided —which we doubt—that there is really sufficient information for the purpose available anywhere.—*The Engineer*.

LATHE FOR TURNING SPIRALS.

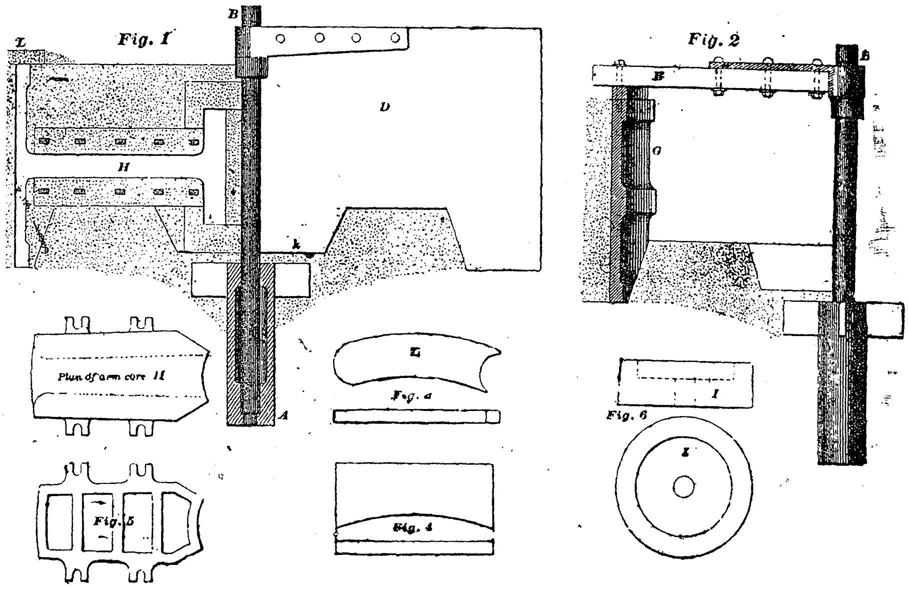
THIS machine is adapted for cutting spiral twist mouldings or forms on the exterior surfaces of turned work, such as stair balusters, newel posts, and the like, whether it be cylindrical, or tapering, or curved, and irrespective of the diameter or length of the work. The frame of the machine is made with a vertical front, to which the face plate is fixed. Fitted snugly, but movably, to the face plate is a frame, in which is journalled the spindle carrying the cutters, which may be formed to work beaded, fluted, or other forms in spiral twists of any pitch on balusters or posts. The spindle may be set at any desired angle with the horizon by turning the frame, but the cutters will always operate at the centre or axis of motion of the cutter frame. The spindle is driven by a belt passing over a tightener, and leading to tight and loose pulleys on a shaft driven in any convenient way. The main workbed of the machine is fixed to brackets secured to the main frame, and the carriage holding the head and tail stocks is laid loosely on the bed. The tail stock may be freely swung on the bed to carry the work to and from the cutters, and, at the same time, the carriage is free to be moved along the bed to feed the work along in front of the cutters. The headstock is fixed to the carriage, while the tail stock is adjustable along the carriage to accommodate the length of the work. In the head stock is journalled a live spindle, which holds one end of the work. On the inner end of a shaft journalled at right angles to the spindle is fixed a bevelled pinion, which meshes with a gear fixed to the head block. At the outer end of the shaft is a hand wheel, by turning which motion is imparted to the spindle and its connected parts.

On the spindle are placed two bevelled pinions, either of which may be engaged by a gear fixed to



a vertical shaft journalled to a cross bar of the head stock, and to the lower end of this shaft is fixed a gear wheel, which engages with a rack bar held to the bed in such a manner that it may be adapted to engage gear wheels of different sizes, to govern the speed of rotation of the spindle and work, in accordance with the diameter of the work and the pitch of the spiral mouldings to be cut. Operating the hand wheel with the right hand causes the work to be turned and the carriage to be moved forward, while the left hand is free to press the work to the centres by pushing the carriage inward.

After the first spiral cut has been made in the work, from the head stock toward the tail stock, the carriage is swung backward to carry the work away from the cutters, when a dividing wheel on the spindle is turned around a distance of one or more notches and held by a latch. The work is then fed along the cutters for making the second spiral; this is repeated as many times as may be necessary to go around the work. It will be seen that spirals may be cut upon tapering work for the whole or any part of its length, and upon cylindrical or curved work. By properly arranging the cutter spindle and turning the hand wheel in the reverse direction, left-hand mouldings may be cut. This invention has been patented by Mr. George Wood, of 4724, Main-street, Germantown, Philadelphia, Pa.—*Scientific American.*



MOULDING FLYWHEELS.*

THE following explanation of the method, and the direction for using all the appliances for moulding flywheels, as adopted by the Hartford Engine Company, are given for the purpose of assisting those who contemplate rigging up for casting flywheels.

The method here explained, but with a few slight changes in the appliances, is the same as that used for casting large flywheels in the Algers Iron Works, South Boston, 20 years ago.

My experience in this class of work leads me to believe that this method is the simplest, surest, and most correct way for obtaining a uniform thickness of rim. In a flywheel 12ft. in diameter with a face 36in. wide which I made by this method, I found that the unequal weights in the rim were inappreciable, and the wheel was very nearly balanced. I also remember casting a wheel 9ft. in diameter with a face 26½in. wide, which, when cast, was so well balanced that the owner of the wheel claimed the turning of the same to be unnecessary.

By this method the hub and arms are made of dry sand cores, and the rim up to 48in. wide is made in green sand. In moulding wheels with a 72in. face I have obtained excellent results by using loam outside and green sand inside of the rim; but yet, for wheels having faces over 48in. wide, I consider it to be a better and easier plan to mould the inside and outside of the rim in loam, or at least loam should be used for the outside and that part inside of the rim lying underneath the arms.

* By "FOUNDRYMAN," in *American Machinist.*

The appliances used for moulding flywheels are illustrated in the annexed figures, in which similar letters denote the same part of the appliances. A represents the gudgeon or centre. This centre, as shown in Fig. 1, is placed in the floor sufficiently deep to give 1in. or more clearance between the upper face of the centre A and the lower edge *k* of the sweep D. The centre A should also be placed in an exact vertical position, and then firmly secured. The wings cast to this centre will prevent it from turning. Place the shaft B into the centre A, and on this shaft slip the sweep D, adjusting the latter to a suitable height for the rim of wheel. In swinging the sweep D around the shaft B, its edge *k* will form a surface on which the hub core I is to be placed; the edge *l* will form a surface on which the arm cores H are to be laid, and the edge *m* will sweep a surface which is to hold the cheek and the bottom of the segment G of the rim pattern. After these surfaces have been formed, and the bed is well made up, the sweep D is removed. Now (see Fig. 2) place on the shaft B the arm E to which the segment G is attached. Place a flask cheek in position, and ram up the outside of the rim.

When this is done, lift off the flask cheek, dress and blacken the mould. Next (see Fig. 1) slip the bottom hub core I over the shaft B, and place it in an exact central position, in which also its upper face will be even with the bank made by the edge *l* of the sweep D, and ram the sand firmly around it. Now place the arm cores H in position, with equal spaces between them, and do not allow these to strike the segment G. Ram up the inside, and when this is finished dress up with blacking those ends of the arm cores which meet in the centre of the wheel, and hang the same in a fire in order to dry them. Finish the outside, black, and close on cheek. Cover rim with cores L, and with as many risers as desired. Slip the upper hub core over the shaft B, secure it in a central position, and then remove the shaft or spindle B. Fill the gudgeon A with sand, to prevent the iron from flowing into it, and set centre core. See that the holes for pouring gates are all right. Lay bars on top of mould to secure everything, cover these bars with a large plate, load it with weights, and then pour the metal.

Fig. 3 represents the covering core L, and is used for covering the rim, as shown in Fig. 1. It will be readily understood that by shaping the ends of this core, as shown in Fig. 3, its core box can be used for any size of wheel.

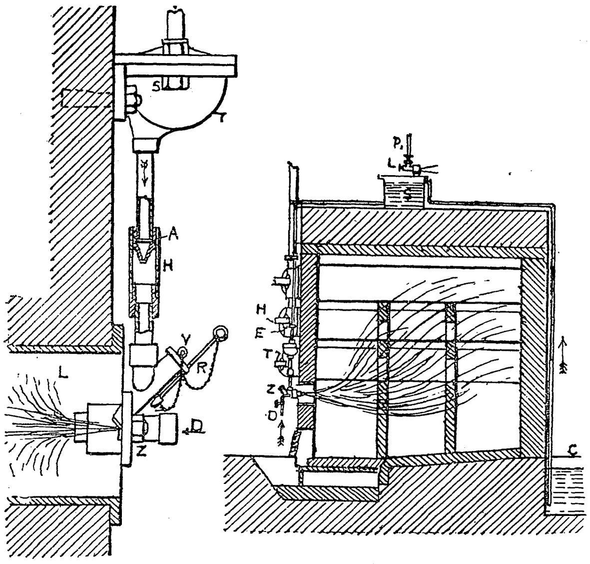
Fig. 4 represents a board used for holding the segment G in its place while ramming the inside of mould.

Fig. 5 represents a core iron, and is used in the arm core H. Its lugs are allowed to project beyond the core, so that the two parts of the core can be readily bolted together, which will be appreciated in moulding large wheels; for with this arrangement greater security will be obtained.

Fig. 6 represents the lower hub core before it is placed in position.

STEAM VAPORISER FOR BURNING COAL TAR.

IT is certain that we shall before long succeed in increasing the industrial yield of petroleum, and in reducing the cost of carriage in a large measure, through shipments in vessels provided with tanks. This fuel will then be able to compete with coal for the heating of boat and locomotive boilers. The residua from distillation espe-



erally will offer serious advantages over coal in certain applications, owing to their great heating power, the ease with which they can be used, and the small space required to store them. As well known, this question is analogous to the problem of utilising coal tar for heating, and so vaporising apparatus can, with a few slight modifications, be applied to either of these products. Now, in view of the extraordinary fall that has taken place in the price of tar, many gasworks have decided to return to the use of this substance as a fuel for retort furnaces, after having discarded it for a few years.

But, in order to get rid of the inconveniences due to the abundant production of smoke that the burning of tar is accompanied with, it is necessary, before combustion, to project the liquid in the form of a spray, and to make as perfect a mixture as possible of its particles with the air. Under such circumstances, it burns normally with a white flame, and a great advantage may be derived from the heat that it develops. In order to obtain such a result, the Messrs. Koerting Brothers have devised an arrangement which is distinguished for the simplicity and accuracy of its operation. The apparatus that serves for burning the tar is very strong, and is entirely of iron. As for the vaporiser, properly so called, that consists essentially of a pipe through which the tar descending from above is led to the front of the furnace, in order to be converted there into a fine spray through a jet of steam projected obliquely. The fuel reaches the furnace after being mixed with atmospheric air. With this apparatus, the vaporisation of the tar is very complete, and, owing to the peculiar escape of the steam, there is no loss of fuel.

The annexed figure shows in section a four-retort furnace provided with a tar firebox, whose vaporiser is represented on a larger scale to the left. The tar is raised to the reservoir S, by means of a pump or aspirator, L. The heat that prevails at the point where the reservoir is located keeps the tar continually in a liquid state.

From the pipe E the tar passes into the cap T, which is provided with a semicircular sieve that can be easily removed for cleaning. This sieve holds back all the impurities that the tar contains. The tar afterwards flows through the tuyere A, the size of whose orifice varies according to requirements. In case this orifice gets obstructed, despite the action of the sieve, and after a somewhat extended period of service, it can easily be cleaned without taking the apparatus apart. To this effect, the socket H is raised, and this frees the tuyere, which can then be cleaned with a needle.

From the tuyere D the tar enters the vaporiser Z, which is fixed, through a short sleeve, in an aperture in the front wall of the furnace. The jet of steam that enters the furnace through the conduit D makes a very fine spray of the tar coming from above, and, moreover, introduces into the furnace with great force the quantity of air required for the combustion. It results from this that the combustion proceeds under exceptional conditions. On each side of the vaporiser there are dampers for regulating the entrance of the external air at L, so that the draught may be neither excessive nor insufficient, and so that no smoke shall be produced. The combustion is further regulated by the steam valve. In cases of a choking up of the vaporiser, which would be shown at once by a complete extinction of the flame or reduction of its intensity, the orifice of the apparatus is cleaned with the needle R after removal of the cover V.—*Revue Industrielle.*

LUMINOUS PAINT AND PHOSPHORESCENT MATERIALS.

THE sulphate of calcium, which is remarkable for its violet phosphorescence, and forms the basis of some luminous materials, has been analysed by M. A. Verneuil, who finds it to contain monosulphide of calcium 37 per cent., lime 50 per cent., sulphate of lime 7 per cent., carbonate of lime 5 per cent., with traces of silica, magnesia, phosphates, and alkalies. He also finds that it is a *coquille* shell which furnishes the lime used. M. E. Becquerel has made extensive researches on these luminous powders, and M. Verneuil has more recently followed up the subject. He gives the following process for preparing what he considers the most beautifully phosphorescent matter known. Twenty grammes of lime from the *Hypopus vulgaris* shell, calcined, is pulverised and intimately mixed with six grammes of sulphur and two grammes of starch. To this mixture is added drop by drop a solution containing half a gramme of subnitrate of bismuth, 100 cubic centimetres of absolute alcohol, and some drops of chlorhydric acid. When the most of the alcohol is evaporated by exposure to the air for half an hour, the mixture is heated in a covered crucible for twenty minutes to a clear cherry heat. This temperature is obtained easily by wood charcoal or a Perrot gas furnace. After pulverising the mass, it is again calcined at the same temperature for a quarter of an hour. If not too strongly heated, the product obtained is small grained, lightly agglomerated, and easily crumbled. A new pulverisation is to be avoided, as it tends to diminish the phosphorescence. The addition of sulphides of antimony, cadmium, mercury, tin, copper, platinum, cranium, zinc, molybdenum, produces a variation in the colour of the light, which varies from yellow green to blue green. Manganese produces an orange tinge. Sulphides of cobalt, nickel, iron, and silver diminish the phosphorescence.

MR. WILLIAM MCKENZIE, general foreman of the New York, Pennsylvania, and Ohio Railroad machine shop at Meadville, has invented a device for ejecting water from the cylinder of a locomotive. It is described as follows:—"The steam ports on either side of the locomotive are connected with a small pipe, to which is attached an automatic valve directly at the back of the saddle. When the locomotive is under steam pressure this valve remains closed, and opens the moment the pressure is shut off, thus allowing every drop of water that has accumulated in the ports to escape.'

AT Jebel Zeit, Egypt, the boring for oil has gone down 215ft., and nothing valuable has yet been reached. At Jemsah there are three separate borings, from one of which, at 125ft., is spurting good heavy petroleum.

THE steam yacht *Chic* is being fitted up in Greenock harbour with a Brush dynamo, for the purpose of pearl fishing in the South Australian seas, and when the ocean bottom is thus examined by the electric light there will no doubt be some wonderful discoveries made. The steamer *Hyæna*, belonging to the Liverpool Salvage Company, has also been fitted with electrical apparatus for diving purposes.

THE Madras Government is about to engage in the cultivation of jalap. The demand this year from the Madras Medical Department was 1,300lb., and only 400lb. could be obtained from private growers.

SCIENTIFIC NEWS.

THE death is announced of Prof. Theodor von Bamberger, the Austrian astronomer, at the early age of 46 years.

According to Prof. C. A. Young, of Princeton, N.J., the rotation period of Jupiter's red spot is 9h. 55m. 40·7s. $\pm$ 0·2s. The determination was made from eight observations in the spring of 1886, and shows that the period is slowly increasing.

At the annual soirée of the Associated Societies of Liverpool, Mr. Isaac Roberts exhibited a photograph of a portion of the Orion Nebula, in which twenty of the stars are represented by lines. Mr. Roberts considers that these are not stars at all, but planetoids, and that the lines represent their amount of proper motion during the 67 minutes of exposure. A note in the *Journal* of the Liverpool Astronomical Society for January deprecates so hasty a conclusion, as there are signs that the stars had been allowed to "run," and that the plate had slipped.

We understand that in connection with Prof. Dewar's course of Christmas lectures at the Royal Institution, arrangements have been made for introducing into the theatre a powerful beam of electric light equal in intensity to a sunbeam. The lectures, it will be remembered, are on "The Chemistry of Light and Photography," and this electric light beam will be used for photographic experiments.

At the recent meeting of the Institution of Civil Engineers, Prof. A. B. W. Kennedy read a paper on "The Use and Equipment of Engineering Laboratories." Prof. Kennedy believes that it is essential for a young engineer to obtain his practical training in the ordinary sense of the expression, in a workshop; but he is also aware of the fact that the practical training of the workshop is incomplete on its own ground. In an ordinary pupilage a young engineer has not much opportunity of studying such things as the physical properties of iron and steel, nor the strength of those materials, nor the efficiency of the machines he uses, nor the relative economy of the different types of engines, nor the evaporative power of boilers. He requires such experience as might help him to determine for himself, or at least to see for himself, how other people have determined, all the principal engineering constants, from the tenacity of wrought iron to the calorific value of coal, or the efficiency of a steam-engine, or the accuracy of an indicator spring, or the discharge co-efficient of an orifice. Prof. Kennedy thinks that this kind of practical experience can be gained best in an engineering laboratory in connection with some institution where technical instruction is given, and he asserts that in the matter of engineering laboratories, as a branch of technical education, England has really taken the lead, instead of being, as is too often the case in such matters, in the rear. The paper enumerates the principal subjects on which experiments might be carried out in engineering laboratories.

The telegraphs of this country, if we may accept statistics published in a foreign paper, compare favourably with those of the Continental countries. As regards the number of offices and instruments, we compare favourably with France (the latter, however, having more offices but fewer instruments), while in the number of staff we exceed the total of all European countries put together.

A system of automatically lighting trains by electricity is undergoing experiment in Glasgow, the inventor being Mr. Carswell, assistant engineer of the North British Railway. A central rail is in circuit with a dynamo which is used for supplying current to light the goods' yard at Queen-street Station, and as a train enters the tunnel it makes contact, and the lamps in the carriages begin to glow, being extinguished as the train leaves the tunnel, and consequently loses contact with the rail. In connection with this question of lighting trains by electricity, the Brighton Company are about to extend their experiments largely, and will make comparative trials with colza-oil lamps.

MM. Becquerel, Berthelot, Cornu, Mascart, Lippmann, and Fizeau, commissioners appointed to inquire into the protection of buildings from lightning, have reported to the

Minister of Instruction that it is indispensable for complete safety to have all iron roofs, doors, pipes, sashes, &c., carefully connected with the apparatus usually attached to public buildings as protections against electric discharges.

Compound locomotives are evidently to have an exhaustive trial on the London and North-Western Railway, as it is stated that the large number already in existence is to be still further augmented by thirty more now in course of construction at Crewe.

Mr. Stretton's "Safe Railway Working," which is a treatise on railway accidents, their cause and prevention, has just been issued by Messrs. Crosby Lockwood and Co.

A locomotive on the Northern and North-Western Railroad, Canada, has made an aggregate mileage of 190,554 without undergoing general repairs. After running 45,179 miles as a freight engine, her wheel tires were turned, and she was used as a passenger engine, running 145,375 miles without having so much as a pin, a brass, or a flue taken out. The engine was made at the Brooks Locomotive Works, Dunkirk, N.Y., and has 5ft. drivers, and cylinders 17in. by 24in.

The Audubon Society, which has been established in the United States for the protection of birds generally, and plumage birds in particular, has a goodly roll of members, for although the certificates were ready only in April last, the society now numbers more than 17,000 members.

At the meeting of the Royal Society of Edinburgh last week, Sir W. Thomson, the president, read a paper on the "Ring Waves Produced by Throwing a Stone into Water," in which he commented on phenomena in regard to the waves which have not hitherto been noticed and analysed—how the waves proceeding from the stone constitute a series of different wave-lengths and of different velocities; how each wave as it advanced becomes longer and gains in speed. The point to which he directed attention was the law of that progress and the place where a wave-length had a given value, in connection with which he gave a mathematical analysis of the problem, the result of which was that the velocity of propagation was proportional to the square root of the wave-length. Another paper by the president was on the waves produced by a ship advancing uniformly into smooth water. The general results of his investigation showed that the rate of propagation of the waves was equal to the component of the ship's velocity in that direction, and that if a point be taken in the ship's wake in the line of her motion, and the distance between that point and the point from which the waves take their origin be bisected, the tangents from the latter point to the circle whose diameter is the line between the point of bisection and the point first mentioned will form the limits of wave disturbance.

The last experiment in sending ova of salmon to Tasmania has proved successful, the development having been checked by means of refrigerating machinery. The eggs were hatched out in the colony, and some of the fry have developed into smolts, which have been captured in the Mersey a river running into Bass's Strait. The attempts to transport the sole to the United States have also, it is believed, been successful, and the American Government have promised to forward large consignments of ova of valuable species of Transatlantic *salmonidæ* to the National Fish Culture Association, in order to assist in developing the inland fisheries of the United Kingdom. Supplies of ova will also be sent by various Fishery Boards and other bodies for incubation, under the condition that the fry, when hatched out, shall be returned to their respective waters. The Association have lately been engaged in collecting ova from various parts, so as to extend the scope of their operations as far as possible.

The Lettsomian lectures will be delivered by Dr. J. Langdon Down on Jan. 3rd, 17th, and 31st, the subject being "Some of the Mental Affections of Childhood and Youth."

An ingenious piece of surgical mechanism, designed by Herr Rosenthal, was exhibited at the last meeting of the Odontological Society by Dr. Cunningham. The ramus and condyle of the lower jaw having been removed on one side, the other side became dislocated, and could not be kept in position. To the last molar of each jaw gold bands were fitted, to the upper of which a thick, slightly-curved wire was soldered. The wire fitted loosely into a tube soldered to the band round the tooth in the lower jaw, and although the arrangement does not admit of lateral movement the patient can eat with some ease, and the jaw on the other side is prevented from slipping out.

At a recent meeting of the Linnean Society, Mr. G. J. Romanes read a paper "On the Sense of Smell in Dogs," in the course of which he related his own experiments with a setter-bitch. His conclusions are that in the case of this animal she distinguished his trail from that of all others by the peculiar smell of his boots, and not by the peculiar smell of his feet. "No doubt the smell which she recognised as belonging distinctively to my trail was communicated to the boots by the exudations from my feet; but these exudations required to be combined with shoe-leather before they were recognised by her." The experiments further show that although a few square millimètres of the surface of one boot are amply sufficient to make a trail which the animal can individually recognise, the scent is not able to penetrate a single layer of brown paper. Furthermore, it would appear that in following a trail this bitch is ready at any moment to be guided by inference as well as perception, and that the act of inference is instantaneous. Lastly, the experiments show that not only the feet, but likewise the whole body of a man, exhale a peculiar or individual odour, which a dog can recognise as that of his master amidst a crowd of other persons; that the individual quality of this odour can be recognised at great distances to windward, or in calm weather at great distances in any direction; and that this odour is not overcome by aniseed.

Popular Science.—In the *Saturday Post* of October 23, 1886, a Greenock paper, the following appears: "*The Pressure of Steam.*—Steam, as compared to water, occupies 1,728 times as much space. A cubic inch of water will make 1,728 cubic inches of steam at atmospheric pressure. Now, if this steam is compressed into half that space, it will give double pressure, or 15lb. above the atmosphere; and then it will occupy only 864 cubic inches. If reduced again to half its volume, it will occupy 432 cubic inches, and will give 30lb. pressure per square inch. Reduced again to half the volume, the steam will occupy 216 cubic inches, and will give 60lb. pressure to the square inch. We can go on reducing in this way until we find that a cubic inch of water turned into steam, and compressed into a space of 3 cubic inches, will give the enormous pressure of 3,840lb. to the square inch." Greenock occupies a high position in regard to the science of steam; it is the birthplace of Watt, and it has turned out a greater horse-power of marine steam-engines than any other town of its size in the world. Notes about steam served out in the Greenock papers on Saturdays for Sunday meditation ought therefore to be worth reading. Let us take the above extract bit by bit. "Steam as compared to water occupies 1,728 times as much space." . . . Only at one pressure is this true, and that is not at atmospheric pressure; the relative volume is then, say, 1,648. "Compressed into half that space it will give double pressure, or 15lb. above the atmosphere." If we could have steam at that pressure, but still at the temperature of "boiling water," 212° Fahr., then might the pressure be as stated, but steam at twice the pressure must be at its own higher temperature, and therefore its volume must be more than "compressed into half that space." "Reduced again to half the volume . . . 30lb. pressure to the square inch." In addition to the temperature objection there is now an atmospheric objection to this statement. Pressures are stated either as above the atmospheric pressure or as including the pressure of the atmosphere, but the writer of the Greenock note seems to have now forgotten the atmosphere altogether. The pressure he has now attained by doubling is 60lb. gross, or 45lb. above the atmosphere, and not by any way of looking at it can it be 30. The note goes on doubling and doubling in this way, getting

$$15, 30, 60, 60 \times 64 = 3{,}840\text{lb. per square inch,}$$

instead of

$$15, 45, 105, 120 \times 64 = 7{,}665 + 15$$

As this Greenock note contains quite unconsciously so many common errors, its correction may prove useful.—*Engineering.*

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

ORBITS OF SATURN'S SATELLITES AND MASS OF THE PLANET.—STELLAR PARALLAX. — VESICLES. — STARS VISIBLE FROM THE BOTTOM OF A WELL.—SOLAR PARALLAX.

[26630.]—I HAVE been reading—need I add with the greatest possible pleasure?—three of Professor Asaph Hall's masterly astronomical monographs which appear respectively as Appendix I. to the "Washington Observations for 1882," and as Appendices II. and III. to the volume for 1883—but which have only just reached this country. The first is on "The Six Inner Satellites of Saturn," and contains much that must be valuable to the students of the marvellous Saturnian system. Among the most popularly interesting details may be mentioned: that the five inner Satellites of Saturn move in sensibly circular orbits, and that their orbits are either actually in the plane of the ring, or so very close to it that they may be assumed to be in it; and that the mass of Saturn derived from the observations of Tethys, Dione, Rhea, and Titan $= \frac{1}{3478 \cdot 7 \pm 1 \cdot 10}$ (that of the sun being unity). In Appendix I. to the volume for 1882, the orbit of Iapetus, the outer satellite of Saturn, is discussed, and from the observations of its motion a mass of $\frac{1}{3481 \cdot 3 \pm 0 \cdot 54}$ for its primary is deduced. Perhaps I may note that the two previously best determined masses of Saturn are those of Bessel $\frac{1}{3501 \cdot 6}$ and of Le Verrier $\frac{1}{3529 \cdot 6}$. The last, but by no means the least, of Professor Hall's essays is contained in the second appendix to the "Washington Observations for 1883," and discusses the observations for stellar parallax made there. Four stars were observed to this end: 40 (o^2) Eridani, 6 B Cygni, α Lyræ, and 61 Cygni. Dismissing 6 B Cygni, which furnished a negative parallax! we have the parallax of 40 Eridani determined as 0·223″, which means that it is situated at a distance of 924,954 times the radius of the earth's orbit, a distance which light, travelling at the rate of 186,326 miles per second, takes 14·494 years to traverse. In the case of 61 Cygni its parallax would seem to be 0·270″, so that this star must be removed from us by 763,944 times our mean distance from the sun, and light must occupy 11·971 years in its journey. Lastly, in the case of Vega, Professor Hall found that its parallax was only 0·134″—in other words, that it is 1,539,290 times as far from us as the sun, or, say, 142,218,754,000,000 miles! and that the light by which we behold it to-night quitted it 24·121 years ago! It will be remarked that Mr. Hall's results are notably smaller than those usually given in tables in works on astronomy; but this does not shake his faith in their accuracy.

Let me thank Mr. Lecky for inviting my attention (in letter 26618, p. 368) to the solecism I committed in speaking of "vesicles" of water; when I meant what—for want of a better term, I may call—water-dust. "Vesicle" is, of course, the Latin *vesicula*—a little bladder—and used as I used it, a wholly misleading term. If Mr. Lecky has access to the *Transactions* of the Royal Society of Edinburgh, he will find in Vol. XXX. p. 337 a paper by Dr. Aitken, in which that gentleman maintains the thesis attributed by him to the younger Helmholtz.

In answer to the query with which the second reply (61101) concludes (on p. 373), the arc of the heavens visible from the bottom of a well depends simply upon its depth and diameter. Taking the first figures that come into my head, and supposing an imaginary well to be 40ft. deep and 3ft. in diameter, then would a circle of some 4°18′ diameter be visible from the bottom of it. Preserving the same diameter, and assuming the depth

to increase to 80ft., only 2° 9′ of the sky would be visible, and so on.

In reply to query 61276 (p. 377), the rule for finding the distance of the sun when his equatorial horizontal parallax is given, is of the most simple possible character. We have merely to divide the earth's equatorial radius by the sine of the parallactic angle. Here is the work. The earth's Equatorial radius, according to the latest determination of Colonel Clarke, R.E., is 3,963·296 miles; of this the log. is, of course, 3·5980565. First, let us take Gill's parallax, as given by Mr. Ford—8·783″, the log. sin. of this is 5·6292178. Then we simply subtract this log. sin. from the log of the earth's radius, thus—

3·5980565
5·6292178

7·9688387 the log of 93,076,210 miles.

Or let us use what I may term the Official parallax, or that given in the preface to the *Nautical Almanac*, 8·848″. The log. of which is 5·6524200. Then, as before, from

Log. of earth's radius	3·5980565
We take.................	5·6324200
And obtain	7·9656365

the log. of 92,392,450 miles.

Mr. Gill's parallax is certainly not at present preferred by astronomers to that of Newcomb, which is adopted in the *Nautical Almanac*, and given above. For myself, I regard the whole question as, to a certain extent, still *sub judice*, with a leaning in favour of the larger parallax. I really forget whence I derived the figures 92,359,000 miles. Quite possibly from some book that happened to be lying open on my table.

A Fellow of the Royal Astronomical Society.

HORIZONTAL WIND-POWER.

[26631.]—IF Mr. Vallance would send drawing, and you would be good enough to illustrate his windmill, it would be more understandable. I have long had a notion of the possibility of charging accumulators from a dynamo worked by wind power; but on ascertaining the average speed of the wind here on an average of 17 weeks, I find it is only seven miles per hour. The 14ft. diameter American mill shown at the Colonial Exhibition was stated to be 2H.P., with 18 miles of wind. Finding, therefore, that the average speed of the wind is so small, I have come to the conclusion that the game is not worth the candle. In America, also, I know that attention has been given to the question, and the conclusion arrived at is that the only practical way to use wind power for the purpose referred to is to let the mill pump water to a tank and then for the water to turn a wheel or turbine to actuate the dynamo. I need not say that this would involve great expense in the construction of tank, &c.. and I am sure it would be cheaper to employ a gas-engine to actuate dynamo than to rely on such uncertain power as is the wind. **B. Boothroyd.**

[26632.]—IF Mr. Brown will be so good as to read my letter on page 346 again, I think he will see that he has made the miscalculation, and not I. He will there see that I say "the sails are to be made of half a 14ft. yellow deal cut diagonally from ½in. on one side to ½in. on the other, which will make two sails, 2½in. thick on one side and ½in. thick on the other, and 9in. wide." Now, I did not say that each sail will be 14ft. long; because I thought every one who read and attended to what I had said would see that for a deal cut diagonally and making two sails would necessarily have the sail the length of the deal; so that the 600ft. I stated as the surface of sail exposed will be about right.

Now for the "strong resistance that has to be met on the side constantly pressing against the wind on the return side of the mill." The flat edge of each sail is about 2½ square feet, and this receives the full pressure of the wind when it is exactly at a right-angle to the arm, and going against the wind; *but only when in that exact position*, for when on either side of that, the wind is driving it in its course round the shaft. If not come up to that position the wind is pressing on the inside of the sail, and if beyond it, the wind is pressing on the outside, so that there is only one place in which the sail is doing no duty, but is driven against the wind. Now, the surface of the sail is about 2½ square feet, and if the wind presses 2lb. per square foot the resistance will equal 5lb. to be deducted from the duty of all the other sails. If Mr. Brown objects that there are five sails in a line, I reply that then all five only expose 2½ square feet, as they would be sheltered by the first sail of the five; in fact, the sails are so effective that if only one sail is on the mill it will run as if the whole were on it, which proves that the sails are efficient in almost every position of their course. In the portable mills we used for ploughing I have frequently put one sail only on to show spectators this.

With respect to the doubt as to the truth of my statement that the two mills have drawn seven ploughs at once, I think there are still alive a few witnesses who would confirm it; I know of two. But as this took place in 1844 or 1845, few are left who saw it, although I could give the names of 20 who did so.

I used the mills for six years on my farm at Bromich, between Lewes and Eastbourne, from 1842 to 1848, and I daresay there are many alive still who saw them. I also exhibited them at the Agricultural Show at Shrewsbury, and they were taken from the show yard to the trial ground, and set to work there in 1 hour and 10 minutes, proving their portability, and I then and there had one mill running with only one sail; I sold them there. Previously, in 1837, I drove an oil mill in Henfield Brooks by a large one, with sails 24ft. high and 6ft. wide, so that I think sufficient witnesses may be produced of the efficiency of the mill.

As to the staggering of Mr. Brown by the cumbrousness and ponderosity of the mill, I suggested what I believed to be a mill that will stand the effect of a violent storm, and I think this will do so; the weight is no objection. The cost of material is about correct, and as I have described it with as little labour bestowed on it as I could, I believe the total cost will not much exceed the estimate.

Mr. Brown seems to be very unfortunate in his endeavour to understand what he reads. Thus, in his letter on p. 303, he says (referring to Mr. Collingridge's account, p. 269), "The inquiries one would like to make of him are—What was the length of arm? what portion of it was occupied by the sail—length and breadth? and is it to be seen, and what did he drive with it?"

Now, each of these queries is distinctly answered by Mr. Collingridge on p. 346, where he writes: "Length of arm, 8ft.; sails, 7ft. high and 6ft. wide," and that his model gave off ½H.P. He then says that, not having room to put up a large mill, I have to be contented with steam power, its cost of fuel and attendance. And yet Mr. Brown says he has reluctantly *gone back* to steam. Why, he never departed from it—from want of room to erect a windmill. **Philip Vallance.**

SUGAR ANALYSIS.

[26633.]—WE are much indebted to Mr. Allen and Mr. Alf. W. Stokes for valuable notes on this question, and shall be glad if these gentlemen will favour us with further contributions. The subject is one of interest to readers—chemical, commercial, and medical.

To demonstrate the mere existence of grape-sugar is very easy, providing those "other substances" to which Mr. Allen alludes can be shown to be absent or can be excluded. Will Mr. Allen teach us the criterion by which these "other substances" can be shown to be absent or present in, say diabetic urine, and also the best means by which they can be excluded while the grape-sugar is left intact? Having often to examine for grape-sugar under these circumstances, I cannot but say that even Mr. Allen's book, which is the best we have on this subject, does not give us all the practical guidance we want. With regard to other sugars, Dr. Bodenbender says: "Many beets contain a substance which has the property of separating peroxide of copper from Fehling's solution as yellow hydrate of protoxide of copper, which, after being boiled some time with the reagent, becomes red protoxide of copper." What we want here to know is, What are these substances? How can we show them to be present or absent? How can we best exclude them when present, at the same time having our grape sugar intact? Then again, I do not find that by boiling it is always easy to separate the copper in any form that gives either a ready subsidence or a clear filtrate, or any colorimetric indication by which exact quantifications can be secured.

Some of these "other reducing substances" can be removed by adding a few drops of basic acetate of lead, shaking well and then filtering. To the clean filtrate add sodic sulphide so as to remove the whole of the lead added in excess, and then filter again. If we now quantify with Fehling's solution we have the reducing sugars plus other possible reducers which are not got rid of by the acetate of lead. Of these residual "other substances" some, again, are not destroyed by boiling with caustic soda, while the grape sugar is. If, therefore, we now boil a second portion of the filtrate with caustic soda, so as to destroy the reducing sugars, and then quantify again with Fehling's solution, it is clear that by subtracting this result from the previous one, we get the reducing sugars, apart from two sets of "other substances"—i.e., apart from those removed by basic acetate of lead, and those which survive after boiling with caustic soda. Unfortunately the dark colouration given by the reducing sugars under the destructive action of caustic soda, is a great drawback to the convenience of this process and the questions for our eminent analytical friends, therefore are. Can a better process be suggested? And how far do we, by our process, entirely free our grape-sugar quantification from errors introduced by other reducing substances?

I have been in the habit of preparing my own Fehling's solution with tartrate of soda and solution of caustic soda. Most books prescribe the potassio-tartrate of soda; but I understand Mr. Allen to lay down that whether the alkaline base be soda or potash, or a mixture of the two, makes no difference.

If Knapp's method be applicable in all cases, and his standard mercurial solution undergoes no change by keeping, while it is, at the same time, more delicate in its action, how is it that sugar chemists so very generally use Fehling's solution?

Mr. Stokes's letter upon the detection and quantification of grape sugar in diabetic urine by means of the ammoniacal copper solution, is very interesting. If he would favour us with the contribution which he so kindly offers, he would enrich the pages of our useful journal.

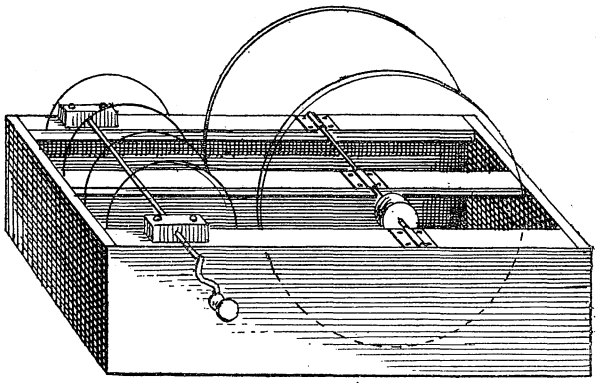
M. O. H.

NOTES UPON THE WIMSHURST ELECTRIC MACHINE.

[26634.]—THE following remarks may be of some use to those endeavouring to improve our knowledge of the properties of electric machines, as well as those of electricity, with relation to this particular phase of electric action. These notes having reference to a long series of experiments, I would just repeat, *pace* "Sodium" (see page 327, No. 60839), that any hole in a disc is extremely liable to end in a crack; but it is a great help to avoid this disaster that we round off the sharp edge of the hole with a nice fine piece of grindstone applied, say, cornerwise in the orifice, supposing that the piece of stone be right-angled. Also, why not turn the bosses with the lathe centres in the brass tube instead of going to the unnecessary trouble of fitting on an accurate mandrel? Memo.: An ordinary table leg and so forth wood-turner, is not competent to turn accurately, even if he tried; his lathe, so far as my observation goes, is not accurate enough; because if the ends are at all hollowed towards the centre, as there is a great temptation to do, then, when the cement which I have recommended dries in, the plate will be under a heavy pressure. Memo. 2: No wood-turner nor brass-finisher ever turns anything truly round, or flat, as far as my experience goes. I have hitherto used a washer of Drogheda linen, but intend to try a piece of the good upper leather from a lady's kid boot, as the real difficulty is that the disc usually has a bend somewhere in its circumference, and is rarely of a uniform thickness, which renders "Sodium's" proposed plan (see page 328, No. 60989) unavoidable. With reference to cracked discs, I always cover the crack with a strip of thin glass, say, 1in. broad, and Diamond Cement it; by this is meant the cement advocated by me in these pages. My reason for proposing a leather washer is that I think that by means of a thin and narrow chisel a wedge could be inserted to correct any slight inaccuracy. Now, then, I am of opinion that, seeing that the Wimshurst machine acts precisely the same in whichever direction it be turned (all the difference being that the electricity is not given off in the same place), Mr. Wimshurst is wrong in terming it a circuit from one side of the diameter to the other, and the way he fixes up his dischargers proves it, because he has to make one ball larger than the other to induce the electricity upon the superior one to strike at the little one first (same as the roughs do). Does he mean to assert that were I to shift the driving handle of his machine on to the opposite end of the spindle, and then to turn it in the opposite direction, that it would not work equally as well?—and this being so, what becomes of his imaginary circuit? Let us take and entirely cover the discs with tinfoil: we will then get no electricity; then divide this into sectors by narrow spaces, then it will be apparent upon working that we get little or none, because as these sectors recede from the brushes the electricity jumps back to the brush from whence it came. Next we widen the distance betwixt each sector, and thus succeed in carrying more away. Now, if we catch same by conductor or Leyden jar, as this accumulates it will reach a point of accumulation when it will jump from sector to sector "in the direction of the nearest brush," not necessarily back to where it came from. This being so, I maintain that the real circuit of this machine "is to the earth"; but the reason why it is advantageous to discharge as per Mr. W.'s design, is because advantage is taken of the simultaneous jumps of each side. Let anyone study a Leyden jar charging by placing two pieces of foil slightly pointed in connection with inside and outside, and, say, ½in. asunder; it will be observed that there will be a brush discharge from each to the other previous to the jump. All experiments with Leyden jars through various bodies show conclusively that there is a place of meeting

which is not at either inside or outside foil, but at a point somewhere between both. But this is enough for one dose, so I would observe that in order to obtain the longest jump it appears to me that we must use the smallest number of sectors which will work well without any preliminary charging, and this I would put at, say, 8 per disc, and in favourable conditions of the atmosphere, unless the machine be encased with glass. We cannot accumulate more upon a conductor or a jar than a quantity proportionate to the distance between each section as well as of the boss, nor can we use less than, say, 8 sectors, or there won't be a sufficient number of makes and breaks of contact with one sector whilst another one is passing same (which is absolutely necessary), as the speed cannot be increased to advantage presumably, because the rushing through the air carries off a large quantity, therefore it follows that increasing the diameter of discs is not attended with correspondingly good results, and reducing the number of the sectors lessens the quantity of electricity per revolution. Now, to lessen as far as I can see, at present, these defects, I have devised the following modifications as per diagram annexed; where A is an oblong box of pine, or any other kind of timber, to be dovetailed at the corners, and to have a central piece extending to the bottom as well. This might be all made of ¾in. stuff; the top edges to be thickened with pieces of some hard wood, say, boxwood, 2in. by 1in., from end to end, to be glued and sprigged securely in order to carry the bearings as before described at page 262, the object being to avoid—first, having any holes in the discs; secondly, any metallic body between the discs or in communication with them and the earth, the bosses being turned upon their own tubes, and a little shellac or vulcanite being dropped into the end of hole next the glass after being affixed so as to cut off the end of the axis from said glass. Say that the 4 discs as here drawn are 19in., I would make the bosses 2½in. long; then the driving-wheels would be 4, as shown; thus all could be easily got at when requisite, and a glass cover could be added by arranging four grooved standards attached to bottom pieces, also grooved, and an ornamental frame glazed and fitted on top, 4ft., to be left projecting, say, 1 or 2in. at bottom of standards to take into the corners of the box, so that it could be lifted on or off, and preferably the inside of said box to be cased with glass; but, if not, to have several coats of shellac varnish. I find it beneficial to use a larger area of conductor than any I have as yet seen upon any other machine.

There is another point to be considered as regards the behaviour of electricity, which I have not seen any allusion to in any work treating of these matters, but which must be carefully studied, more especially if one contemplates the making of a compound machine. I have already stated my opinion that the length of the spark is governed by the distance between the sectors as well as of these from the boss. Now, if a conductor and its points are in connection as usual, and we turn the driving handle, the electricity apparently accumulates upon the superficial area of said conductor. (Who gave the name of "Tensional" to electricity in this state, as it seems to me that it would be more correctly designated as "Compressed Electricity"?) If any body in connection with the earth be now brought close to a charged sector, of course it will give up probably the whole of its charge; but this by no means is the case if it be accumulating upon what is termed (curiously enough, it seems to me) a conductor or in a Leyden jar. We are accustomed to placing great reliance upon the attractive properties of "points" in connection with static electricity; but I conclude that I am making a point when I lay down this "apparently new to us law," that even with the aid of said points we cannot take away from any sector on to any insulated surface any more electricity than will leave upon the sector a quantity proportionate to its superficial area in an equal state of compression; therefore it follows that in order to increase the power we must look for a means of accumulating more upon a given area of sector in order to increase the compression of that upon the receiver. To make this apparent, we need only apply a knuckle below the comb during the process of accumulating, and when this reaches its limit the electricity will be seen jumping from sector to sector to the nearest brush. Thus I think that it follows that although a machine be made with numerous pairs of discs, unless the sectors be so separated as to insulate the increased quantity, as well as a largely increased area of receiver for the same, the desired result cannot be obtained, and I think that this is fully proved by the results as stated in connection with the powerful machine of Mr. Gray, and the (to me) disappointing result mentioned upon the last page of his book. As a step in the direction of increased energy of the electricity received upon the sectors, I have already pointed out in these pages that a fixed sheet of glass between the revolving discs as well as corresponding sectors upon the inside of "one" of the



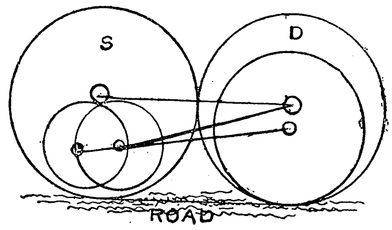
A

said discs (I have not as yet tried whether it will act well if both have sectors upon their insides, but can say that it won't answer to put any sector upon the central fixed sheet of glass.) I must again impress upon all experimenters my opinion that their receivers (conductors, as they are usually termed) are much too small for showing to advantage sparks therefrom—that is, if they are similar to those as shown in Mr. Gray's or Mr. Wimshurst's book. I find that in this arrangement the theory appears to be that there must be two metallic bodies passing each other having an insulating body which also possesses the property of developing electricity between them, one of these metallic bodies to be placed in communication with the earth. Now, I take it that as the one receives the one kind of electricity from the glass, so the other receives a proportional quantity by means of the brush from the earth. I also am aware that this electricity undergoes some change in its condition, which cannot so far be accounted for, seeing that it cannot be freely obtained off a sector in the neighbourhood of either a brush or a rubber; whereas, if the connection of either with the glass be broken, the electricity will fly to air from all parts speedily, unless, as in the case of a Leyden jar arrangement, the one condition of energy is balanced by the other. If this reasoning is correct, the following views ought also be so; but I have not yet had an opportunity to experiment in this direction. I take it that the glass between each sector is not so good an insulator as dry air, and that it does not contribute any appreciable quantity of electricity to the adjacent sectors, that being, in my view, a function confined to the glass immediately under the foils; therefore, I purpose to construct each disc as follows:—A in the diagram is to be a disc of, say, $\frac{3}{16}$ plate glass having a boss affixed as usual on its opposite side; B is one of the eight sectors (in this instance), cut of thin sheet glass; these may be firmly fastened on to the central disc by means of either strong paper and glue paste, or linen and the aforementioned cement, the foil sectors placed upon the surface as near to centre as the lines marked C. The outer dotted circle is merely to indicate the diameter, as all this intervening space is to be air. The proposed benefits would be that the difficulty from the liability of a disc to crack is much lessened, as any one of these can be readily replaced; it would be very much lighter, which is of great importance as we increase the diameter. It would allow of more suitable, thin and flat glass being selected, as well as of any part not possessing good electrical properties being rejected. Finally, even if it is found that the intervening glass is requisite, this method of making up discs by means of separate segments offers a means of making them much more balanced as to insure steadier running; and if a suitable template is made to run the diamond around, a defective one could be easily replaced. Although sheets of thin glass can be procured here as long as, say, 7ft., they cannot be got broader than, say, 40in., and vary much in the thickness of the different sides. If the air spaces are found to answer instead of the glass between these segments, then I would propose to substitute segments made of, say, stout tinned sheet iron; these would be well coated with shellac or other suitable insulator upon the edges and the inner faces. Upon working a disc machine quickly, it is clearly noticeable that there is a large quantity of electricity leaving the sectors before they reach the single line of points. When these are in the uusal position, it appears to me that it might prove advantageous to so arrange the receivers that they would either themselves or by means of their points take in more area of the circumference than this single line does; also, it would seem, judging by the strong odour pervading a room in which one of these machines is at work, that it ought to be a great improvement (independently of its use in keeping out damp air) to have the whole apparatus closely closed everywhere around its action with glass. Query.—Does its working purify the surrounding air, and is the odour healthy? I am inclined to think so.

Dec. 22. **A., Liverpool.**

TRICYCLES.

[26635.]—IN reply to "Gamma Sigma," page 347 (26603), if cycles ran on perfectly flat surfaces, it would make but little difference as to the size of wheels (excepting weight and rigidity); but most roads called smooth or "sandpapered" are simply a series of falls and projections, so that the larger a front steering wheel is compared to its driver, the less it strikes and jumps, saving loss of power by vibration. When a steering wheel is larger than its driver it simply runs in and out of the undulations, making but little vibration or loss of speed. The following rough sketch I hope will make it clear:—S steerer, D driver.



It will be seen by the sketch that although the front wheel receives its force from the tire of the back wheel in a line with the road, the weight of the rider on a 50in. axle makes the front wheel dig at projections more than if on a 40in. driver, unless, of course, the frame is made longer.

R. G. Bennett.

INDUCTION COIL.

[26636.]—I HAD the pleasure of seeing last week, at the Soirée of the Associated Scientific Societies at Liverpool, the famous coil which Mr. Marples recently referred to in your columns. With one bichromate cell (zinc immersed about 6in. by 3in.) it gave a 9in. spark! I hope that Mr. Higgs, the owner of the coil, will be kind enough to favour the readers of the "E. M." with a detailed description of this (as I believe) the most wonderful coil constructed.

Newport. **Benjamin Boothroyd.**

LIFEBOAT ANCHORS.

[26637.]—IT appears from the inquiry into the recent disasters at Southport, that lifeboat anchors pass over the stem head—I have seen several that do so—and that when a capsize occurs, the anchor, if suspended or on the ground, tends to prevent self-righting. May I suggest that if a strong eye were put on the stem, below water line, and the cable were rove through it from the head, and the bight then returned inboard ready for bending to the anchor, the anchor would then act as ballast, or tend to right the boat if capsized; and also the boat would ride easier to her anchor.

Vulcan.

ELECTROMOTIVE FORCE.

[26638.]—IN a query entitled "Accumulator" (61052, p. 311), "Torbay" made reference to a statement which appeared in the *Electrical Review*, to which that serial replied in the following manner:—

"ELECTROMOTIVE FORCE.—A correspondent to the ENGLISH MECHANIC quotes a passage from the *Electrical Review* as follows:—'When the external resistance approaches the internal resistance, the E.M.F. of the cells will be reduced, and if the external was made equal to the internal resistance, the E.M.F. would be but half that indicated when the external resistance was high. How is this? I thought that the E.M.F. of any cell depended solely on the materials composing the two plates, and the composition of the battery acid as representing electro-chemical actions of various kinds, each of which produced its own particular E.M.F.' The above statement is correct. 'Tor-

bay' confuses the full potential or E.M.F. on open circuit with the free potential when the battery is working. If he will measure the E.M.F. of a cell which is not connected up with any exterior circuit, he gets the full potential between its terminals; but if he joins the terminals up to a resistance equal to the internal resistance of the cell, he will find that only half the potential is free. If he proceeds still further, and short circuits the cell with a thick piece of copper wire, he will find the free potential between the terminals reduced to practically zero."

The *Electrician*, however, takes exception to this view, and in its number for Dec. 24th says:—"A Distinction *with* a Difference.—We were recently somewhat surprised to learn that in certain quarters which might have been supposed to be tolerably well posted up in such matters there exists a decided misconception as to the precise difference between the accepted significations of such everyday terms as 'electromotive force' and 'difference of potential.' We have always understood that electromotive force may be defined as *that which causes* a difference of potential; and this definition is not by any means a mere scholasticism, for the simple reason that in a closed circuit containing a single source of electromotive force, the latter has (or may have) only one fixed value, while the value of the 'difference of potential' depends upon the position in the circuit of the points between which this difference is measured, and may therefore have any number of different values from zero up to that of the E.M.F. itself; while at the same time all values of potential difference are caused by, and are proportional to, the E.M.F. Hence in a dynamo we speak of the 'difference of potential at the terminals,' or at the lamps, which is caused by 'internal electromotive force.' That an attempt should at this date be made to upset an established convention of so useful and convenient a character is, we think, decidedly to be deprecated. The following paragraph, which appears in a contemporary journal, has induced us to enter this protest:—'A correspondent of the ENGLISH MECHANIC quotes a passage from the *Electrical Review* as follows:—"When the external resistance approaches the internal resistance, the E.M.F. of the cells will be reduced, and if the external was made equal to the internal resistance the E.M.F. would be but half that indicated when the external resistance was high. How is this? I thought that the E.M.F. of any cell depended solely upon the materials composing the two plates, and the composition of the battery acid representing electro-chemical actions of various kinds, each of which produced its own particular E.M.F."' On this the journal referred to subjoins, 'The above statement is correct. The querist confuses the full potential, or E.M.F. on open circuit, with the free potential when the battery is working. If he will measure the E.M.F. of a cell which is not connected up with any exterior circuit, he gets the full potential between its terminals, but if he joins the terminals up to a resistance equal to the internal resistance of the cell, he will find that only half the potential is free. If he proceeds still further, and short circuits the cell with a thick piece of copper wire, he will find the free potential between the terminals reduced to practically zero.' For ourselves, we beg leave to assert that, in accordance with the views which we had thought to be universally accepted, the correspondent of the ENGLISH MECHANIC is perfectly correct in his assumption that the E.M.F. of the cell is a constant quantity, subject, however, to the influence of such secondary chemical reactions as may take place in the cell, and also to a certain slight extent depending upon temperature, but otherwise quite independent of the resistance of the circuit, both external and internal. The 'difference of potential' at the terminals of the cell is, upon the other hand, a function of the E.M.F. and of the external and internal resistance, and there is nothing in the correspondent's query to show that he was not perfectly well acquainted with these elementary facts. We trust that it is not proposed to speak in future of the 'free potential' of a dynamo machine."

Now, who shall decide when doctors differ?

E. M. F.

THE VALUE OF THE MICROSCOPE IN TRADE.

[26639.]—WE have all no doubt been struck with the amount of learning and research embodied in the papers by Dr. Royston-Pigott, and marked how well he illustrates the advances that have been made, from time to time, in microscopical knowledge; but in this short paper I purpose to dwell on another side of the question, and to show what infinite value the microscope is in trade; and of trades I venture to select that of brewing, because it will be apparent to all readers that a brewer without a microscope is almost analogous to a peacock without a tail.

To begin with, I will roundly assert that since the remarkable revelations of M. Pasteur, the brewing trade has been completely revolutionised, and that a man nowadays who does not know how

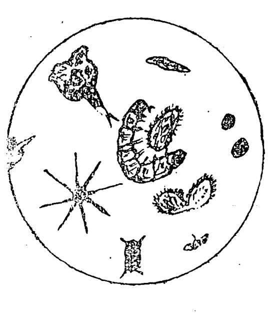


Fig 1.

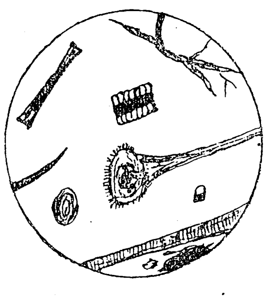


Fig II

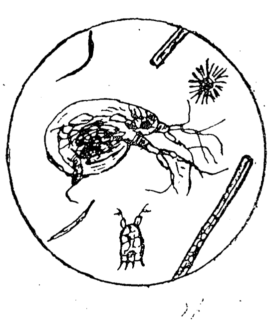


Fig. III

to use the microscope, and, in fact, is not an able manipulator of that fascinating instrument, does not come within the definition of "master brewer," and further, that science has so beautified the labours of the brewers, that they have been elevated above the level of empiric soupmakers to that of, at least, semi-professional men; and I doubt not but that "time's effacing fingers" will ere long entirely sweep away the old ignorant class of men who perhaps knew well how to wash a barrel, but had no idea of the influence of certain salts and organisms on the character of their malt extract.

Firstly, let us mention the value of the microscope in determining, indirectly, the purity of the air in the fermenting rooms, &c., and the important part it plays in the analysis of water; indeed, it is the custom in well-regulated breweries to examine the water frequently to detect any organic impurities, which play sad havoc with the produce. Figs. 1, 2, and 3 are specimens of some of the impurities that are often met with in water, and though probably well known to most of the readers of this article, yet there may be those to whom these minute forms of life, with such tremendous names (I will spare the reader these at least), are comparatively unknown. Fig. 1 represents some animalcula, Fig. 2 some vegetable organisms, and Fig. 3 the appearance of a drop of water containing both animal and vegetable organisms.

But by far the most important use of the microscope to the brewer is its value in determining the quality of his yeast, as it is all important that *Mycoderma cerevisiæ*, the type used, should be pure. The presence or absence of certain bacteria is of vital importance, as it is these foreign organisms that cause the unhealthy fermentations that used to perplex brewers so much; but which (thanks to such men as Pasteur, Huxley, Tyndall, Lister, Budd, and others) they are now learning to detect and remove. The germs most frequently found contaminating yeast, have already been described by me in these columns under the names of Bacterium lactum, B. aceti, and B. amylo-bacter, and it is these three that are familiar—too familiar—to most brewers. We now know that a healthy yeast cell should not be larger than $\frac{1}{2000}$in. in diameter, and as a micrometer is an indispensable adjunct to every brewer's microscope, the size is easily measured. We know that the absence of any vacuole in the cell denotes the plant to be too young, and not fit to induce a vigorous fermentation, and that the presence of more than three vacuoles and a shrivelled cell, at once points out the yeast to be too old. We learn from the presence of an undue amount of lactic and other ferments, when it is time a change of yeast was sought, and the "change" having arrived, we can examine it before using, and determine the age and quality of the purchase.

As this is intended for non-professional readers, I will not enter into any lengthy detail, but shall be happy to do my best to satisfy any correspondent. This is merely to show that, whilst the microscope affords a most pleasing recreation to many men, and a deep, life-study to others, its value to a trader is not the least of its uses. The growing taste for microscopical research amongst men is a sure sign of the intellectual age in which we live; and now that a good instrument can be purchased for such a small outlay, it behoves all men to get as deep an insight as possible, into "the wonders of the world around us." **D.**

TINNING A SOLDERING IRON—SALT IN THE LECLANCHE.

[26640.]—HOW do you tin a soldering iron? The simplest way is to make a hole, or cavity rather, in a brick, into which the beak or nose of the bit can enter, and then put the hot bit into the mixture of rosin and solder with which the cavity can be filled. Instead of rosin, the common chloride of zinc soldering fluid answers every purpose; but the copper should be filed clean before inserting. In America, I learn from one of the papers, this method is productive of great waste of time, though the writer who mentions it went "slowly downstairs" thinking of what a friend had shown him above—that is, a "new method" of tinning a copper bit. The hot "iron" was put in the vice (I beg pardon, "vise," the Americans know how to spell English so much better), and one side had two or three rubs with a mill file. The filed side was then touched with a bit of rosin held in one hand, while immediately following it came the solder, held in the other. The result was one side perfectly tinned. The process was repeated on the remaining sides, and the job reported done in less than 30 seconds. That is quick work, even for a Yankee; but did anyone ever experience any difficulty in tinning a copper bit—that is, I mean, anyone who knew the simple principle that the copper must be hot enough and clean.

Not long ago I saw in an American journal of popular science the extraordinary announcement, made editorially, that a correspondent had discovered that salt and water will excite a Leclanché combination, and that there is no necessity to use sal ammoniac. It will, perhaps, be "news" to this journal of popular science that the discovery was made years ago, and that in the first edition of Mr. Sprague's "Electricity" (1875) a paragraph commences, "Either common salt or sal ammoniac is employed, though others will answer." In Niaudet's cell common salt is used as a matter of course, but the ammonium salt is preferred in the Leclanché.

I have lately noticed a curious mistake in a well-known almanac, in the scientific summary of which it is stated that "the application of telegraphy for everyday purposes as a motive, *heating*, and speaking agent is coming more into use almost daily as fresh discoveries, inventions, or adaptations are constantly being brought out." After that we are told that Mr. G. Westinghouse has patented a new system which will reduce the cost of electric lighting by 95 per cent. That is good news. I hope I shall live to see it actually demonstrated. Jules Verne is not in it with some of his contemporary teachers. **Regel.**

MICROSCOPIC APPEARANCE OF GLASS AFTER PASSING OF INDUCTION DISCHARGE.

[26641.]—TWO years ago, when making some experiments with a large induction coil, I found that when a thin microscopical cover glass was placed between the secondary electrodes it was very quickly pierced by the calorific discharge. On looking at the glass a small roughened spot was seen around the point where the discharge had passed. When this is examined with the microscope (50 diameters and polariscope attachment), small blue crosses are seen over the field, and generally a few of larger sizes are to be made out. Is there any theory with regard to the formation of the above, or are they simply caused by air bubbles carried through the heated glass by the force of the discharge? **A. Beauchamp Northcote.**

CONCERNING THE LUMINIFEROUS ETHER.

[26642.]—AT page 310 our valued electrical correspondent "Sigma," while replying to a question concerning Ampère's theory of magnetism, indulges in an attack on the luminiferous ether, of which he writes in an exceedingly disrespectful manner. It is my purpose in this letter briefly to summarise the evidence in favour of what "Sigma" terms a "precious jelly," partly to see if "Sigma" can really attack the reasoning, and partly for the information of our readers, who might be misled by the remarks in reply to query 61033.

Excepting tidal energy, and the energy of such things as native sulphur, &c., all the energy at present existing on earth is due to the sun, and has come to us from that luminary. The energy which propels our trains, which drives the machinery in our factories, which warms us in our houses, which gives us power to act and think, all is due to the sun. In no merely figurative or poetical sense, but in the most rigid scientific truth, are we children of the sun; and thus curiously does modern science

show some slight foundation for what is probably the oldest form of religion in the world—the worship of the great ruler of the solar system.

The sun and earth are distant from each other 92 millions of miles, and hence the energy which we receive from the sun must have crossed this distance somehow. Two kinds of motion are known to us—motion of translation, in which matter itself travels, as when a bullet goes from a rifle to a target; and wave motion, in which there is no actual transference of matter, but where a state or condition travels. We have examples of this kind in water waves. The energy, then, must reach us by one or other of these two kinds of motion. Sir Isaac Newton imagined that light was an actual transference of matter, and upheld this view to the last, as also did Laplace. The phenomena of polarisation, however, and still more those of interference, finally overthrew the theory of luminous corpuscles, and rendered it evident that light consisted of waves of some kind. If waves can be sent from the sun to the earth, there must be some medium in which these waves travel; and we have next to find the properties of this medium as best we can. The velocity of transmission of light has been investigated in three different ways. Roemer determined the rate of transmission by observations on the eclipses of the moons of Jupiter. Fizeau measured the velocity by means of a toothed wheel, the distance traversed being about ten miles, and Foucault, by means of a contrivance which was a marvel of experimental ingenuity, managed to measure the velocity in an ordinary room. A very close agreement exists between all three determinations, and the velocity is three hundred millions of mètres per second. The rate at which a substance can transmit wave motion has been shown both by theory and experiment to be equal to $\sqrt{\frac{E}{D}}$, where E is Young's Modulus, and D is the density of the medium (a small correction has to be applied in the case of gases). In order to transmit wave motion at the rate of three hundred millions of mètres per second, it is evident that the elasticity of the medium must be enormous, and that D must be very small. The smallness of D can, moreover, be proved in another way, for astronomical observations show that the medium between us and the sun does not sensibly retard planetary movements, although it may have an influence on comets. The highest value of E in any ordinary material is $2{\cdot}139 \times 10^{12}$ dynes per square centimètre for steel; and even if in steel the density were only equal to that of hydrogen gas, the resulting velocity of wave motion therein would not nearly reach the known velocity of light. Hence we are compelled to conclude that the medium which transmits light and heat must be enormously more elastic than steel, and that its density must be very much less than that of hydrogen gas. This medium, then, whose properties are rather those of a solid or jelly than of a gas, is the luminiferous ether; it fills all space, it pervades all ordinary matter, no doubt packing itself away among the molecules, as sand in a heap of cannon balls. I do not by one iota underrate the difficulty of forming a definite conception of this substance which no human eye ever saw or ever will see, and which no human hand ever felt or ever will feel; but I am ready to go unfalteringly wherever scientific reasoning from experiment may take me; and the evidence for the ether is as strong as that for gravitation itself.

Not only has the theory enabled us to explain the most complicated cases of the interference of polarised light; but in at least one case it enabled Sir William Hamilton to predict the result of an untried experiment in double refraction, and the prediction was verified by Lloyd. Now "Sigma," I wait your reply, wishing you and all our correspondents and readers a very Happy New Year.

Wm. John Grey, F.C.S.

Christmas Day, 1886.

BALANCING A PULLEY.

[26643.]—WHAT are the best methods of balancing a pulley, or what practice do your readers recommend? There seems to be much diversity of opinion about the matter, and I should be glad of opinions on the following: Suppose the pulley is to be put in good standing balances, if a spirit level is not at hand, the balancing bars may be roughly tested by laying the mandrel on in the centre; if it rolls with the same apparent ease in either direction the bars are about level. After placing the pulley on, hold it still for an instant, and let go; but instead of letting it roll back and forth until it stops, check it a little until you get the oscillations down to about 4in. travel of the rim; hold the chalk in readiness, and as it rolls toward the right and stops, dash a small mark on the edge of the rim plumb over the centre; as it returns to the opposite stopping point mark as before. Make a central mark between these two, and that will be the light spot. Now attach the weights and test it by rolling down to a position horizontal to the centre, and let go. If it stands still, roll it to the opposite side, and if it will stand there also it is correct; but if it rolls *down*, the bars are low at this end. If you use cast weights, and find that of two sizes, between which there is very little difference, one is too light while the other is too heavy, give the preference to the light one, as it makes pulley nearer in balance when running.

T. P.

VACCINATION A PREVENTIVE OF SMALL-POX.

[26644.]—SEEING letter 26625, I should like to call your attention to one fact, and that is that you have not stated how many had the small-pox, because, if equal numbers took it, then the vaccinated must have died in greater numbers than the unvaccinated. One thing is quite certain, that those that were protected by vaccination were protected to such an extent that they died of small-pox.

There is another thing. The Government returns are just what doctors think fit to send in, which I know are always the truth, because they do get something out of it, and on that account are not likely to say anything against it.

Then, again, you say the vaccinated to the unvaccinated are as 19 to 1. Now, if there were 19 to 1 protected against small-pox, how is it that out of 899 that died 569 were vaccinated? What good was vaccination for them, and ought they died a little easier of it? You also state that 351 are not stated, 330 unvaccinated, taken together make 681; so that 681 taken from 899 leaves 218 vaccinated. If, then, out of 899 deaths 218 only are vaccinated, where do you get your proportion of 19 to 1?

There is only one way to tell what vaccination does for mankind, and that is to note how many cases of small-pox occur both of vaccinated and unvaccinated, and then if 19 times as many persons take small-pox that are vaccinated to those that are unvaccinated, and then only 1 dies out of each class, then I can understand that they are protected 19 times as much.

The fact is that if vaccination was in any way a preventive there would be no deaths from small-pox. I know this, I would sooner run the chance of small-pox than the chance of what might follow vaccination.

You say that you have seen it making very terrible work. I think that it makes no less in this country, when there is an epidemic, as well as in other countries. As to how many will die depends on the strength of the constitution and attention they get.

W. H.

TEMPERING AND DOCTORING STEEL.

[26645.]—ALMOST since the discovery of a method of convering iron into what is known as steel, those who are engaged in working it or in utilising it have had so-called "secrets," and much mystery has surrounded the subject. That there are different qualities of steel is well known; some require to be treated in one way, some in another, according to the nature of the metal and the purposes for which it is to be used; but for all practical purposes the art of hardening and tempering remains very much as it was. Much depends on the heat to which the steel is raised previous to quenching—very little on the solution into which the red-hot iron is dipped—water, oil, and mercury respectively serving all purposes when used with brains. A search through the back volumes, and in other treasures of applied science, will reveal the existence of a number of special tempering compounds, for which wonderful properties are asserted, but which as a rule fail to give the promised results, or if they yield them, do no more than can be done with others, more simple in their character or composition. The following "certain method" of tempering steel appeared recently in an American paper, and as whatever may be its merits it cannot fail to interest your readers, I send it for insertion: "Mr. James A. Peck, of Brewster, N.Y., mechanical engineer of the N. Y. Condensed Milk Co., gives the following method discovered by him, and which he uses with great success for tempering all kinds of tools, knives, razors, steel dies, and other implements. Take a suitable quantity of muriatic acid, dissolve all the zinc the acid will take. Prepare a tempering bath composed of one part of the above zinc acid, and one part water. Heat the steel according to its hardness. If high or hard steel, heat until just red, and then temper in the acid bath. If low steel, heat it as hot as you would to temper in water, then temper in the acid bath. After immersing in the acid bath, cool off in water. For lathe and planer tools draw no temper; but for other tools draw temper. Unlike water tempering, the colours that appear under this method give no clue to the hardness. By this process, steel is readily hardened to any desired degree, and may be made to cut glass like a diamond. If desired, an acid bath composed of two parts of muriatic acid and one part water may be used. Mr. Peck, however, prefers the zinc acid, as being more dense. A prominent advantage of this method of tempering is the certainty and excellence of its results. It never fails to yield the temper required. It can be relied upon for every description of steel or tool."

I do not think the use of chloride of zinc (the well-known "soldering fluid") is novel; but its value can be readily tested. Another method of treating steel, which has been reported on recently by S. L. Wiegand to the Franklin Institute, may also interest your readers, though details are wanting. It has reference to Adam Schaefer's compound for improving the quality of steel, which compound forms the subject of letters patent granted in the United States, No. 341,173, May 4th, 1886. The compound consists of rosin, linseed-oil, glycerine, and powdered charcoal, heated and intimately mixed in the proportions stated in the specification. It is used by heating the steel to a clear red heat, and immersing and coating it in the compound, and the steel is afterwards re-heated and hardened in the usual manner by quickly cooling it. Burnt cast steel is restored to its original condition, and the softer grades of steel acquire the properties of cast steel by being treated as above stated. Tools made from Bessemer steel, which is incapable of being hardened, are, after treatment with this compound and hardening, capable of cutting cast steel. Tools so treated possess a greater durability than before, and are capable of cutting castings which resist the best of ordinary cast-steel tools. The grain of steel exhibited by fracture of tools so treated as compared with the same material before treatment shows a difference analogous to that between fine cast steel and coarse or blistered steel. The compound applied to grey castings and malleable iron-castings imparts a degree of hardness to them superior to case-hardening. It is not attended in use with the unpleasant and deleterious fumes incident to case-hardening compounds, containing hydrocyanic acid, and is much less expensive. Specimens of different materials in their normal state and also as treated with this compound and hardened were submitted, properly labelled, which conveyed a clearer conception of the effect than could be stated in language. In order that the facility of application and its effect may be seen, a forge with fuel and bars of steel and other metal and a supply of the compound were submitted, by means of which the members who felt inclined, personally tested it after the close of the meeting. The compound has been introduced into practical use in many manufacturing establishments in this city (Philadelphia) with uniformly satisfactory results.

If any of your readers experiment in the directions indicated, a record of the results obtained would be useful to a wide circle of mechanics and others interested, if published in your columns. It is with the hope that such records may be forthcoming that I trouble you with this rather lengthy communication.

Nun. Dor.

PASSENGER TRAINS AND PARTING COUPLINGS.

[26646.]—I AM very glad to find that "Nun. Dor." is, like myself, in favour of some automatic indicator by which goods drivers may know when any part of their train breaks away. The plan he suggests is certainly simple, but is to my mind open to the following objections:—

1. Its efficiency depends entirely upon human intelligence, which is apt to fail.

2. The driver would have no reliable check upon the efficient coupling of his waggons.

3. Its adoption would impose additional work upon the already overtaxed guard and shunter.

4. The neighbourhood of every siding and junction would become far more intolerable than at present, and should the cord prove stronger than the whistle lever (and on goods engines all sorts and conditions of whistles exist) the driver would —but "Nun. Dor." can imagine.

I am not particularly in favour of an electrical device for accomplishing the end in view; but it has these great advantages: that if any waggon be uncoupled no line exists, and that the act of coupling completes the required check without extra labour.

Francis M. Rogers, F.C.S.

21, Finsbury-pavement, E.C., Dec. 23.

[26647.]—NO doubt the appliance suggested by Mr. F. M. Rogers (letter 26608) in your issue of 17th inst. would apprise the driver of a train of the fact of the vehicles breaking loose; but of what earthly use would that be in preventing the occurrence of an accident such as that on the Underground referred to by Mr. Rogers? The fact of the driver knowing his train had parted wouldn't prevent the hindmost part of it from running back when on an incline. Of what service, then, is the apparatus alluded to?

W. F.

PASSENGER TRAINS PARTING COUPLINGS.

[26648.]—Allow me to point out (see letter 26627, p. 370) that "an electrical contrivance" to warn a driver when his train has parted, is of no practical use. What is wanted for safety, is an efficient automatic continuous brake which will at once bring each portion of the train to rest.

Clement E. Stretton.

Consulting Engineer Amalgamated Society of Railway Servants.

306, City-road, London, E.C., Dec. 23rd.

G.W.R. EXPRESSES.

[26649.]—On Thursday, the 23rd December, I happened to be at G.W.R. Ealing Broadway Station, and I send a few notes on the running of some of the G.W.R. expresses, between 2 p.m. and 4 p.m., if you can find room for them.

(1) 2.15 p.m. n.g. express, ex Paddington, due Westbourne Park 2.18 p.m., arrived 2.25 p.m., dep. $2.32\frac{1}{2}$ p.m., passed Ealing 2.44 p.m. Load, equal to 9 coaches. Engine, 472.

(2) Up b.g. express, due Paddington 2.45 p.m., passed Ealing 3.17 p.m., arrived Paddington $3.22\frac{1}{2}$ p.m. $5\frac{3}{4}$ miles in $5\frac{1}{2}$ minutes, including the slowing into the terminus. Load, equal to $9\frac{1}{2}$ coaches. Engine, Sultan.

(3) 3.0 p.m. b.g. ex Paddington, passed Ealing 3.11. Load, 10. Engine, Warlock.

(4) N.g. up express, due Paddington 3.30 p.m. and Westbourne Park 3.25 p.m., passed Ealing 3.45 p.m., arrived at Westbourne Park 3.51 p.m. and Paddington 3.57 p.m. Load, 11 coaches. Engine, 570.

(5) N.g. down express ex Paddington 3.45 p.m., passed Ealing 3.53 p.m. Load, $12\frac{1}{2}$ coaches. Engine, 658 bc. goods. **G. W. R.**

RAILWAY SPEEDS AND MYTHS—TIMING OF TRAINS.

[26650.]—I may be asked with some acerbity what right I have to assume that the timings of trains at 80 and 90 miles an hour are all erroneous, what right I have to say that such speeds may not have been run on some particular occasion? It may be said, "Because you have no records of such speeds, it does not follow that somebody else may not have attained them. If a credible witness states that he has timed a train at 80 or 90 miles an hour, it is absurd for you to assert on mere theoretical grounds that it could not be done." And I may have quoted against me the old saying that "an ounce of practice is worth a ton of theory."

The answer is, however, very simple. I disbelieve the occurrence of such extreme speeds because I know that the same engines as those with which these apocryphal speeds are said to have been done—or others precisely similar—have been specially tried over and over again under the most favourable possible conditions, *and have invariably failed* to reach 80 miles an hour. I might remark that a year's constant travelling by all the fastest trains in Great Britain with the express object of testing extreme speeds, such as was my experience last year, could hardly fail to have brought out one or two instances if such extreme velocities are really run. But it was not so.

I had the opportunity of testing the swiftest and most powerful engine in the kingdom in highly propitious circumstances, and always found that 75 miles an hour (or a trifle over once or twice) was the *maximum possibile*, and that was only attained or approached, even with light trains, on sharply-falling gradients.

But I prefer to put my own experience—large though it be—on one side, and to take that of others. Mr. Clement Stretton has stated over and over again in these columns that no engine, excepting the Bristol, of Exeter (9ft. single), has ever been authentically proved to have reached 80 miles an hour. I have the best authority for saying that when Mr. Brunel and Sir D. Gooch tried the G. W. 8ft. engine down a track of 1 in 100, and with every preparation for getting the utmost possible out of the engine, the highest velocity attainable was 78 miles an hour, or slightly less with any load. Some of your correspondents talk about a "load being needed to keep the engine steady." No doubt; but that steadiness is obtained at the expense of velocity. The more weight you put behind an engine, the less speed, other things being equal, you will get out of her. Theory and practice both prove this conclusively. The experimenters with "Iron Duke," "Great Britain," and "Courier," down the Wootton Basset bank, found that back-pressure effectually prevented any excess of speed over 78 miles an hour, and hitherto that obstacle has not been removed. That higher speeds might be run I do not doubt; but it would only be by increasing the diameter of the cylinder and driving-wheel, while retaining relatively short piston stroke and sacrificing the pulling power of the engine. On the G.N. I know that a number of careful experiments by the authorities proved the highest speed of the 8ft. engines to be about 75 miles an hour. A statement, made originally under a misapprehension, that a G.N. 8ft. took 16 coaches at 75 miles an hour, has been often quoted, and it has been logically argued that if this were accurate, surely the engines would take five or six coaches at 80 or more. Probably they would; but it was subsequently shown that the *distance* was incorrectly estimated, owing to the removal of a mile post in some repairs, and that the *time* was only taken with an ordinary watch, without even a seconds hand. On a repetition of the feat being attempted, it proved impossible, and it was not until the load was reduced from 16 coaches to 6, that the engine was able to attain 75 miles an hour down 1 in 200.

I was struck, during my experiments, with the uniformity of the maximum which different classes of engines were able to realise. You could get the time for a mile down to a fraction over or under 48 seconds, but there you stuck, and it was exceptional to get much below 49 seconds. As for the extraordinary speeds alleged to have been run by the Americans with their small-wheeled coupled engines, their impracticability is self-evident to any one having a knowledge of the subject. To talk about an engine, with 5ft. or $5\frac{1}{2}$ft. four-coupled wheels, going 80 or 90 miles an hour is to talk flat nonsense, if I may be pardoned the expression. Be it observed, I do not exempt myself from the list of those who have believed themselves to have recorded a speed of 80 miles an hour. When I was a small boy, I used always to time the speed of trains by which I travelled, and I once distinctly believed myself to have timed a G.W. train of four coaches at the rate of a mile in 44 seconds (or 81·8 miles an hour) down 1 in 1,320. Although juvenile, I was very careful, and I cannot even now say how the error arose. But that there was an error I do not for a moment doubt, because I know now that it was not within the power of the engine to run four coaches at that speed on a nearly level line.

I believe I mentioned this run some years ago in these columns. I give up my own timing as completely as I discredit others of a like character, and it seems to me idle and mischievous—as tending to promulgate and perpetuate erroneous notions—to treat such impossible records as genuine. So my fellow correspondents cannot justly complain, seeing that I treat my own records as stringently as theirs. I confess I am not satisfied about that of the quoted run of "Great Britain" from Paddington to Didcot, 53 miles in $47\frac{1}{2}$ min. (By the bye, it is usually quoted now as "$53\frac{1}{4}$" or "$53\frac{1}{2}$" miles in "47 min.," once even "41 min.") I should like to see it tried nowadays. I strongly suspect that if it could be really tested, it would turn out to be from what is now Westbourne Park to the place where steam was shut off for stopping at Didcot (or, say, the distance signal), and that the time may have been only a second or two under 48 min. (or more likely just under 50 min.); if so, we should get a far more probable result. The number of different versions of that run that have been published seem to me to throw considerable doubt upon it. I question whether any engine in the present day could run 53 miles in $47\frac{1}{2}$min., including stopping and starting, and upon a slightly rising gradient all the way. At all events, none ever does so, even when extreme speed is most desired. Then there is that remarkable run of 15min. 10sec. from Slough to Paddington ($18\frac{1}{2}$ miles), said to have been done in 1841, long before the 8ft. engines were built. We shall never know the truth of that now; but there is no engine of the present day that could do it, or, at least, that does it.

I am sorry to damp the zeal of those who believe in "90 miles an hour," but no good end can be served by believing in what is at present a myth. **Charles Rous-Marten.**

Wellington, N.Z.

RECENT WORK OF OLD LOCOMOTIVES.

[26651.]—During my railway wanderings in 1884 and 1885, I had several opportunities of noticing the good work done by old "single" engines of various once-famous classes. In a recent letter, I mentioned some runs with L. and N.W. 173 Cornwall. I shall have occasion another time to refer to the 7ft. 6in. "singles" on the same line, and to that G. W. 8ft.; but these engines are being still kept up, and may be deemed practically modern. The classes I refer to are S. E. R. 7ft., G. E. 7ft., G. N. 7ft. (229—240 class, outside driving-bearing), L. and N. W. 7ft. (Bloomers), and Midland 6ft. 8in.

With each of these classes excellent work was done, but I have no record of the coal consumption, which may have been disproportionate, although I have no reason to suppose so. The S. E. 7ft. single (cyl. 16 × 22) No. 204, on the 7.40 a.m. down mail, took 15 coaches from Cannon-street, and slipped two at Ashford (55 miles) in 74 min. Now this may not seem at first sight a great feat; but when the ascent of the Halstead and Sevenoaks banks is borne in mind it will be seen that the work was not at all to be despised. The 12-mile ascent (1 in 120 to 1 in 140) from New Cross to Halstead summit, was surmounted in 21 minutes, or at the average rate of nearly 35 miles an hour. The 7ft. and 6ft. coupled bogie engines generally took a similar time to ascend the bank, notwithstanding their superior tractive force. Of the G. N. 7ft. singles (cyl. 17 × 24, formerly 17 × 22), on the fast Leeds express (down), starting at 1.30 p.m., and timed to reach Peterborough in 88 minutes, No. 229 kept time exactly, with 13 coaches, weighing in all over 159 tons, exclusive of engine and tender. The Potter's Bar bank was ascended in 19 minutes, the speed never going below 45 miles an hour after Hornsey, and rising to 70 down the Hatfield and Abbot's Ripton banks. The same engine on the up midday Cambridge express, with 6 coaches, did the 58 miles in 69min. travelling time, stopping at Royston and Hitchin, and attained a speed of 73 miles an hour downhill near Baldock, doing the $9\frac{1}{4}$ miles from Ashwell to Hitchin (stopping at the latter station) in $8\frac{3}{4}$min. No. 235, on the 3 p.m. down Cambridge express, ran, with 7 coaches, to Hitchin in 40min., including a stoppage of 1min. at Finsbury Park. The $29\frac{1}{2}$ miles from Finsbury to Hitchin, including starting and stopping and the ascent of the Potter's Bar and Welwyn bank, occupied only $34\frac{1}{2}$min. But perhaps the best performance of all was with No. 234 on the 8.21 p.m. up express from Peterborough, with a heavy train of 16 coaches. The time allowed for the $73\frac{3}{4}$ miles to Finsbury Park was 91min., and the distance was done exactly in that time, in spite of a special stop of nearly 2min. at Huntingdon. The run of $56\frac{1}{4}$ miles from Huntingdon took only 66min. This seems to me most admirable work, especially when it is recollected that a seven-mile bank of 1 in 200 has to be climbed past Hitchin, and a six-mile bank past Hatfield.

As an illustration of the fast travelling of the G.E. 7ft. singles with light trains, I may mention that on one occasion No. 290, with the "seaside train," which was allowed 47min. for the $38\frac{1}{2}$ miles from Spalding to Lincoln, made up *seven minutes* on that fast time, and maintained an even speed of 60 to 65 miles an hour for 35 miles continuously, doing the $38\frac{1}{2}$ miles in 40min., starting and stopping. The L. and N.W. "Bloomers" (7ft. single, cylinder 16 by 22) were little used on expresses while I was last in England, but occasionally ran as substitutes or on duplicate trains, and were usually put on the very fast 2.10 a.m. Birmingham up express when that was run in advance of the 12 noon from Liverpool, the times then allowed being only 41min. Rugby to Bletchley (36 miles), and 48min. Bletchley to Willesden ($41\frac{1}{4}$ miles), about the smartest timing on that line. The "Bloomers," Archimedes 989, Medusa 999, and Rowland Hill 1,008, ran it with seven coaches, and kept time excellently; indeed, Archimedes once gained a minute between Rugby and Bletchley, and attained over 72 miles an hour on part of the way. I was sorry to notice that at the beginning of last year the fast remaining "Bloomers" were deprived of their regular numbers, and placed in the condemned class (1800-1900) and that more recently their names have been transferred to new engines. They have been excellent servants in their day, although they lack power for modern loads and slip excessively at starting.

My experience with the Midland 6ft. 8in. singles was mostly in "short" expresses between Leicester, Derby, and Nottingham. In one instance, No. 31, with eight coaches, started from Trent, and covered the first nine miles in 11min. No. 4 (formerly No. 130, Stephenson's build, date 1852) took a heavy train of 15 coaches crowded with passengers from Derby to Trent ($9\frac{1}{4}$ miles) in 12min., starting and stopping, and attained a speed of 60 miles an hour near Draycott.

All these are highly respectable specimens of locomotive work; and as these fine old engines will soon be mere memories of the past, I feel sure that those correspondents who have at various times championed them even against their modern rivals will be glad that their more recent achievements should be placed on record.

Wellington, N.Z. **Charles Rous-Marten.**

DIETETIC FALLACIES.

[26652.]—There is a paragraph on p. 342 which, taken as a whole, seems generally accurate and common-sense, but in which I am surprised to find the extraordinary statement made that it is a fallacy to regard arrowroot as nutritious: "it is simply starch and water." Unless some occult meaning attaches to "nutritious," I should like to ask what proof there is that starch is not a food? If it is not, what about potatoes, rice, maize, sago, tapioca, and the cereals generally, which are mainly

starch? Perhaps it is meant that in the form of arrowroot the starch is not assimilated; but that can scarcely be, because it is acknowledged in the same sentence that it is "restorative," and if "restorative," why not nutritious in the sense that nutriment is food? In an adult, the actual amount of nitrogen required is small compared to the quantity of heat-giving or force-producing food that must be taken, and even much of that is thrown out by the system unutilised, so far as physiologists can possibly say. Can any of your readers tell me of experiments which would go to show that starch is not nutritious, or explain on what ground the statement is made? Many assertions of a similar kind are made nowadays, according to the hobby of the utterer or writer; but it seems to be considered unnecessary to offer an atom of proof. Some little time ago I saw it stated that tea is adulterated with salts of iron; but surely if that were so, the infusion would be so nauseous as to be undrinkable, for, according to my chemistry, it would be a sort of black ink. Perhaps your able chemical writer, Mr. Allen, can tell us whether he ever found a sample of tea adulterated with salts of iron.

A Grocer.

RANGE OF BAROMETER.

[26653.]—WITH reference to the low reading of barometer on December 8th mentioned by "R. S. T." (letter 26622, p. 369), it may be interesting to state that the extraordinary low reading of 27·39in. was recorded here at 1.30 p.m. on Wednesday, December 8th, when the centre of gale must have passed very near to us, but slightly north, as the wind veered from south-south-west round by west at 2 p.m. We only felt the violence of the wind here at from 3 to 4 o'clock on that morning, when heavy rain squalls were experienced; but we had very little wind—comparatively —from that time until after midnight of that day, with wind from W.N.W., when the centre had passed over to Scotland. The cyclone had evidently been retarded after it passed here, as it had been deflected to the north-east by a subsidiary depression which had slightly preceded it over the south of England on same morning, and the two depressions had apparently mixed up. On Tuesday evening, at 9.30 the mercury stood at 29·27in., and in twelve hours it had fallen to 27·87in., being 1·4in. in that time. The following are the readings taken by a local optician, as indicated by a Kew standard barometer, reduced to mean sea-level and 32° temperature:—

December 8,	9.30 a.m.,	27·87,	falling.
"	" 10. 0 "	27·83	"
"	" 10.30 "	27·76	"
"	" 11.15 "	27·70	"
"	" 11.30 "	27·67	"
"	" 12. 0 noon,	27·59	"
"	" 12.15 p.m.,	27·54	"
"	" 12.30 "	27·46	"
"	" 1. 0 "	27·44	"
"	" 1.15 "	27·41	"
"	" 1.30 "	27·38,	lowest.
"	" 2. 0 "	27·39,	rising.

I am informed by a friend who was in Carlow, in the south of Ireland on that day, that his pocket aneroid (a fine one, by Beck) indicated 27·40in. between 12 and 1 p.m., so that the depression must have been an extended shallow trough, and not a steep and deep centre of limited area, such as the centre which passed about 60 miles north of here on January 26, 1884, when the mercury fell to 27·5in., and the wind from 4 to 5 p.m. showed a velocity of 72 miles per hour. The highest reading of barometer here for some years was recorded on January 18, 1882, when the mercury stood at 30·91in., so that we had a range of 3·53in.—probably as great as shown anywhere on the globe.

I understand that a reading of 31·125in. has been recorded in Boston, U.S.A.; but I am not aware that the exceptionally low reading of 27·38in. has been known there.

Belfast, Dec. 27. **I. W. Ward.**

LONDON is at present supplied with water from the Rivers Thames and Lea, and from certain springs in the valleys of the Thames and Lea, supplemented by Chadwell springs, and from eleven wells in the north of London, and ten wells in the south of London, all down to the chalk. The proportions from each of these sources for the month of October, 1886, were nearly as follows:—From the River Thames and certain chalk springs in the Thames Valley, about 52 parts of the whole: from the River Lea and certain chalk springs in the Lea Valley, about 36 parts of the whole; from the eleven chalk wells in the north of London, about five parts of the whole; from the ten chalk wells on the south of London, about seven parts of the whole.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60432.]—**Architecture.**— Undoubtedly architecture has suffered much from archæology, though I doubt whether university societies, if indeed such exist, have had much outside influence. My reference to Oxford architecture referred entirely to work of the 16th and 17th centuries, and not to modern revivals. But I go further, and condemn Classical archæology no less than Mediævalism, and contend that if the Americans, in designing a many-chambered, irregularly planned building for their Capitol, chose for model the Pantheon, which is a single circular apartment, they showed themselves as far from that union of common sense with artistic perception, which should be the architectural ideal, as some self-styled practical people nearer home. Mediæval Gothic was, as a style, admirably adapted to Mediæval requirements and resources. Much of it was, and still is, artistically admirable, and capable of giving the beholder the highest pleasure. Modern Gothic usually deserves all that is said against it. In Greece a score of centuries ago architecture had reached an astonishing perfection in certain directions; but to-day, in London or Manchester, the characteristic forms of Greek architecture—a portico or pediment—are at least as unsuitable as lancet windows. Architecture, like all things else, must develop—"evolution" is the fashionable word for the process, and architectural forms must adapt themselves to altered circumstances or become mere fossils for the archæologists. Now, for nine-tenths of those who have to do with building, Capitols and palaces are but of secondary importance, the vital question being the structure of our homes of humble brick and timber. Success in this art will be a better preparation for more grandiose architecture than the most scholarly study of Vitruvius or the Pantheon.—W. A. S. B.

[60530.] — **Lens Grinding.** — Amateurs are likely to attempt to polish the first lenses they grind before they are ready for polishing; the result is more than double the work and a very inferior lens. The last emery I use is the finest flour, obtained by putting a quantity of the emery I had used for grinding into a bowl and mix with plenty of water, and then filter it through two thicknesses of muslin. By this means I am sure no coarse or gritty particles are mixed to spoil my work. Before polishing, I wash and dry my lens, and carefully examine the surface with a good glass to see that there are no scratches or roughness, especially at the centre. To polish, I first heat the "tool" until it will melt yellow pitch. I rub the surface over with a lump of pitch, and thus obtain a nice even coating of it. Over this I put a piece of good thick silk, press it down evenly, and let it cool; on the silk I put the putty powder and water, and keep up the supply as required. By attending to these particulars, I find no more trouble in polishing a lens than in grinding one. I grind and polish in the lathe by attaching a horizontal table on which the "tool" is screwed; it is much quicker than the hand.—BRIAN BORU.

[60868.] — **Numbering Stamps.** — Do away with the ink, and substitute a ribbon of carbonic paper as follows:—Fix a roller a little distance behind, and on a level with the stamping cushion. On this roller, which has a long slit for the purpose, is wound the carbonic ribbon, and the end of the ribbon is passed through a very narrow slit, fixed somewhat below level of stamping cushion. In order to print a number you simply draw your carbonic ribbon forward on top of the paper, and then obtain an impression. By having different coloured manifold papers you can obtain different coloured numbers, and you can even take two or more impressions at the same time.—T. D.

[60920.]—**Mangel Wurzel.**— There are some good papers, by the late Dr. Voelcker, on the sugar-beet in the "Transactions of the Royal Agricultural Society"; but, unless your correspondent wishes to dive very deeply into the matter, the following may be sufficient for his purpose. Any given beet-root contains its maximum of sugar just at the time it reaches maturity —that is, when the early leaves begin to decay— say, in September. If warm, rainy weather prevails, the roots will begin to send out new leaves, and every one of those will be produced at the expense of the sugar. As a rule, the small and medium-sized roots are richer in sugar than the large ones, and loss of sugar goes on during the whole of the time the roots are kept. Therefore, feed them to the cattle as fast as the latter want them. If you want more particulars, write again. —SAML. RAY.

[60925.]—**Violin Query.**—No advantage, except with certain kinds of wood—e.g., beech.— E. W.

[60948.] — **Electrical Replacement Indicator.**—I am an admirer of Mr. Conry's answers to queries and general information, therefore I trust he will not think it rude or out of place my referring to his electrical replacement indicator (p. 327). Will he kindly look again at his diagram?—and I am sure he will then see his error. I presume the diagram was planned under pressure for time, or otherwise he must have noticed it. I have waited a week thinking he would have corrected same, and, seeing another query relative to it this week asking dimensions, &c., I thought it would not be out of place to draw Mr. C.'s attention.—JULIUS.

[60963.]—**Terracotta.**—If I wanted such a furnace as "Architect" indicates, I should write to Mr. Fletcher, of Warrington. I think he has them large enough in stock; but at any rate would tell the querist whether he had or not.—SAML. RAY.

[60977.] — **Ventilation of Sewers.** —"Surveyor" may possibly find what he wants in Latham's "Guide to Sanitary Engineering"; but there is nothing satisfactory about ventilating sewers anywhere. The only feasible plan seems to be to run up pipes at intervals above the house-tops, or to adopt the free ventilation by street grids. —NUN. DOR.

[60979.]—**Polishing in the Lathe.**—See a reply (60845) on p. 349, and the indices of back volumes. For ornamental work, you cannot do very much in the lathe, but must use wire brushes, and little rubbers and burnishers. What is known as "Sheffield lime" is the finishing powder, and that is used with dollies made up of discs of calico to a thickness suitable to the work.—NUN. DOR.

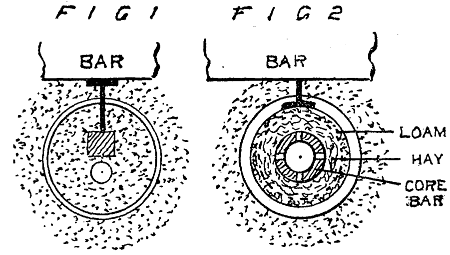
[60987.]—**Organ Query.**—The following would be a very nice specification, and would suit your room very well:—

Stopt. diap. bass...	C C to ten. F...	18 pipes
" " treble	ten. F to C ...	43 pipes
Dulciana............	ten. F to C ...	43 pipes
Principal............	C to C	61 pipes

The above specification is taken from an actual organ, the dimensions of which are as follows:— Height, 7ft. 3in.; width, 4ft.; depth, 1ft. 10in.— T. D.

[61000.] — **Pipe Moulding.** — I am not acquainted with the practice of the Glasgow shops, nor with the special apparatus employed in the manufacture of hot-water piping, which is quite a distinct occupation by itself. But I can tell you how to cast thin pipes. There are two ways of making the cores. One is to have an iron core box hinged and bored out, and to ram the green sand cores in this on a solid square iron bar; venting as is usual with green sand cores by means of a rod laid down the centre, which is afterwards withdrawn, leaving a vent hole throughout. The chaplets are rammed up in the core, resting against the iron bar, and projecting through certain holes in the core box, to a definite distance, or far enough out to touch certain bars in the moulding box, whose position corresponds therewith. Since the bars in the moulding box and the holes in the core box must correspond, this is suitable only for repetition work, which will pay for the special apparatus. There is thus no mass of metal in the body of the actual pipe, Fig. 1;

FIG 1 FIG 2



but the stop effectually prevents the rising of the core. When the pipes are cast the chaplet head is cut off. The core sand must be free and open to give readily to the shrinkage of the pipe when very thin, say, ⅛in. With $\frac{3}{16}$in. or ¼in. thickness loam cores can be, and are, used, the core bar being of the usual perforated form, wound with *loose* hay, spun on (i.e., not made into bands), and covered with loam. The chaplets are of *cast* iron, very small, and press against the core in the usual way, Fig. 2. They become partially fused and soldered before the metal sets. The metal is soft iron, and run as hot as possible. As soon as the pipe is cast, the core bar is pulled out endways to allow the shrinkage to take place freely. I do not know if plumbago is used in Scotland for thin pipes; but should think not—first, because the pipes are not so smooth and glossy as one expects to see when plumbago is used; second, because unless laid on very thin, it would be apt sometimes to wash up into the top, and produce inequality of

surface. Besides, pipe-making is a rough and cheap class of work, and plumbago, being expensive, is reserved for the better kinds of castings. —J. H.

[61006.]—**Length of Belting.**—To the correspondents who replied to the above. Please examine the formula inserted with it. I think the cosine should *not* be employed in finding the length of the straight parts. The belt being a tangent to the pullgys at the extremities of contact, the lines drawn to the centres of pulleys are parallel to each other, and consequently the sum of the straight parts is $= c =$ 24ft. 2in.—MILLER.

[61055.]—**Varnish for the Bright Parts of Bicycles.**—I have used an American lacquer called "lustrine" for the bright and nickel-plated parts of my bicycle, and it answers admirably well. It is transparent, and is removed at once by a little spirit of wine. It will preserve any steel-work from rust.—F. RICHARDS.

[61057.]—**Steam Launch.**—Thanks to "Engineering" for taking up this query. The dimensions given are correct, and I may mention that the yacht was built from a design in Dixon Kempe's "Handbook of Yacht-Sailing." Her speed under canvas with a moderate breeze is about 6 knots.—ITCHEN.

[61070.]—**Lathe.**—There is a stud tapped into the lathe-head a few inches below tail of spindle, and on this stud the quadrant plate pivots, and also on same stud runs a pinion having a sleeve, on which another pinion as required is placed. The quadrant plate carries a pinion on one side, and two pinions on the other side of the first pinion, and gearing with it. He will now understand, if quadrant-plate is moved up, one pinion gears with mandrel pinion and drives one way, and if down, the reverse. The quadrant has a slot and set screw tapped into head for fixing it, as desired in either gear, or out of gear entirely.—T. C., Bristol.

[61071.]—**Planing-Machine Tools.**—I think your difficulty with planer is, perhaps you have cranked your tools so as to throw point behind pivot of tool-box.—T. C., Bristol.

[61092.]—**Hot-Air Motor.**—TO MR. SEAL.—I have not the drawings by me small enough to be inserted in these columns, but I will get them out as soon as I can spare the time. I will send drawings of ½ man-power, then you can make allowance either way, if you wish to make one of ¼ or 1 man-power.—J. SEAL.

[61096.]—**Organ Building.**—I have seen an organ of the kind you inquire about. The stopt. diapason bass is permanently open, and consequently requires neither slide nor stop knob.—T. D.

[61099.]—**A Rule of Grammar.**—I have waited to see what further criticisms this query would produce, and find that my reply was not so "blindly copied" as "Doctor Medicinæ" would wish to be believed. Take the following example: —Query, Who is there? Would you reply I, or me, remembering that the reply is meant for I or me "am here"? Which is right? Custom may favour the expression "me" somewhat; but if it is correct, for what earthly reason is the opposite cited in modern grammars and taught in all schools worthy the name? Can any reader of the "E. M." give a reliable instance where an English scholar is taught that the verb "to be" does not take the same case after it as before it? "D. M." would do well to read the first period of the reply in the issue of December 17th of "What is sauce for the goose is sauce for the gander."—W. C. HALL, Newport, Mon.

[61099.]—**A Rule of Grammar.**—Much, perhaps too much, has already been said about the question of "Doctor Medicinæ." It is not at all a specially English question. The fact at which the question points is a very plain one: a grammatical error, admitted by common, tacit consent. Numerous instances are to be found in many languages, and the same discussion, started by the doctor to-day, may arise again after another error has crept in, which will not be accepted so readily by everyone. It may be admitted that the correct form, "It is I," or any other expression, will be upheld by those who have a more keen feeling for correct language; but, finally, they must submit to the majority, and, as happened in French, adopt the erroneous form "C'est moi." In English, it appears, the grammatical error is neither generally adopted nor rejected; everyone chooses according to his taste, without the least care for, or knowledge of, correct language or logic. The grammatical error of "It is me," has been pointed out by Mr. Hall and Mr. Bottone, and I fully agree with both of them.; but "Weald's" answer will leave the impression that "It is I" and "It is me" are both equally correct, and what is worse, he suggests that "It is I" may "possibly" be an erroneous way of expressing oneself. He will allow me to say that both his arguments to justify the English "It is me" are wrong. "Es ist mich" is not German: it ought to be "Ich bin es"; and "Moi" is not and never was a nominative; it is, and always has been, an accusative, only employed erroneously as a nominative since the 14th century. In the time of Froissard (1337-1410) and even in Marot's days (1495-1544) one still said "Je qui suis." The confusion of cases is of very general occurrence, not only with the verb "to be"; for instance, in English, "He told me himself." In Italian, though the subject is seldom the accusative, one very often says, lei for ella; lei sa, you know; che dice lei? what do you say. One ought to say: Sono io—it is I (litt., am I); but in the dialects one generally says, "Son mi," mi accusative; and here and all along the Riviera one always says: Mi non so, I do not know, instead of Io non so. The accusative for the subject is, however, an exception, and only used in common conversation; but when the personal pronoun is the predicate, then the erroneous form, the accusative, must be used: S'io fosse lui (and not egli), if I were him.—W. VAN EYS, San Remo, Dec. 1886.

[61101.]—**Stars Visible from Bottom of Well.**—I can transfer my question now to "B. A., Handsworth," and accordingly beg to ask him why he thinks that Gamma Draconis would be "about the only star likely to be seen in the latitude of London" in the daytime from the bottom of a well. I have not been able to find any mention of the subject in Ball's "Story of the Heavens," in Newcomb's "Popular Astronomy," or in Lardner's Astronomy; while all that Sir J. F. W. Herschel says (para. 101, "Outlines") is "Indeed, from the bottoms of deep narrow pits, such as a well, or the shaft of a mine, such bright stars as pass the zenith may even be discerned by the naked eye." It seems to me that the querist asked for a list of such stars visible in these latitudes, and if Gamma Draconis is the only one, I ask why that is so? Do not Phecda, Mizar, Merak, Chaph pass as near the zenith as Etanin?—E. D.

[61131.]—**Electric Cautery.**—I am obliged to "Ohm" and Edward Conry for their replies. I am sorry I cannot comply in this letter with "Ohm's" request for diam. of cautery wire, and whether resistance given was hot or cold; but I will obtain and forward it. I am a surgeon, and have to depend on others for my electrical appliances, and have, in consequence, suffered much. I may tell Mr. Conry that I had six bichromate cells ($K_2Cr_2O_7$ and H_2SO_4 in Aq) with 4in. by 4in. of immersed zinc—no porous cell—and they no more than made the platinum point so hot that it could not be retained in the grip of the fingers. The zincs certainly were not all of a size; there were four, as stated (zinc and two carbon plates), one with two zinc, and carbon between, perhaps 3 by 4, and one a large zinc rod. There was ample solution round them all. Of course, the making of any instrument for measuring current cannot be undertaken by me, as I have neither tools, nor appliances, nor skill to use them. But if "Ohm" or Mr. Conry will kindly give fuller details, I could get an instrument made. I have been told that not less than 14 ampères is necessary for surgical work. My own cautery is worked at present from a hired accumulator; but not satisfactorily.—A. DUNLOP STEWART, M.B., &c.

[61131.]—**Electric Cautery.**—TO MR. E. CONRY.—Excuse delay in replying. I have been laid up with a hurt hand, and could not write. I have found two formulæ for finding what you want; but they are both so intricate, and would require for their application so much trouble, that I really think they would not help you. However, I give them as they stand. For myself, I prefer in such small matters as the making of an electric cautery to rely rather on experience and experiment than on such nice calculations. Three good Leclanché jars will bring to a bright red about ½in. of platinum wire, No. 30, or thereabouts. If you will give the exact size and length of the wire you require heated, I could tell you better aud more practically than I could do by calculation. (1) Let c = current in ampères, R = resistance of wire in ohms, W = weight of wire in grammes, S = specific heat of metal (T, heat of platinum = ·0355), H = rise of temperature per second in °C., also ·24 calories = 1 ampère. Then $H = \frac{\cdot 24 \times c^2 \times R}{W \times S} = \frac{66\, c^2 R}{W}$ = copper °F. The melting point of platinum = 2,100° C. (2) The heat generated in time T (seconds) by a current C, through a wire of resistance R, is $\frac{C^2 R T}{J} = \frac{E C T}{J}$ gramme degrees, where $J = 4{\cdot}2 \times 10^7$, and $C_1 R_1$ and E are expressed either in absolute electromagnetic or electrostatic units. For practical use when C is ampères, R ohms, E volts, and T seconds, the heat generated in time $T = C^2 R T \times 0:24$ or $E C T \times 0{\cdot}24$ gramme degrees.—EDWARD CONRY.

[61139.]—**Chromic Acid v. Bichromate.**—The statement that chromic acid is twenty times as strong as bichromate is an expression devoid of meaning. The amount of work, or the depolarising power of the solution, depends upon the quantity of CrO_3 dissolved. Diluted acid saturated with bichromate contains about 8 per cent. CrO_3, and if you substitute chromic acid in equivalent quantity you gain no electrical advantage whatever. Chromic acid is, roughly speaking, about ten times as soluble as bichromate, and, therefore, at first sight it would appear possible to manufacture a solution having ten times the durability. Now, according to the equation—

$$\underset{65}{Zn} + \underset{392}{4H_2SO_4} + \underset{201}{2CrO_3} = Zn\,SO_4 + Cr_2 3SO_4 + 4H_2O + O_2.$$

For every 201 parts CrO_3 we require 392 H_2SO_4, 294 of which act on the CrO_3 and 98 on the Zn. 100cc. of solution containing 8gr. CrO_3 must contain at least 15·6gr. H_2SO_4, or, by volume, 8·5cc.; therefore, 100cc. of solution containing 80gr. CrO_3 must contain 85cc. of H_2SO_4. I have never tried working with such strongly acid solutions, so cannot say what would be the result. I should think the zinc would be dissolved with rather greater rapidity than would be agreeable. At the same time, it must be remembered that I have quoted the minimum amount of H_2SO_4; it is customary to use more than is required by theory. Another reason why one ought to avoid the use of a large quantity of H_2SO_4 is that the $ZnSO_4$ would separate in the solid form through want of water in which to dissolve. Zinc is not soluble in concentrated H_2SO_4, but it becomes superficially incrusted with a film of sulphate.—A. PERCY SMITH, F.I.C., Rugby.

[61145.]—**Does it Boil?**—Surely "Weald's" query can hardly be called quite bonâ fide when it concealed a "presumed belief." Would it not be wiser, before starting any hypothesis of his own, to read up what is to be found on the subject in any elementary treatise, such as "Deschanel's Physics," for instance, and then if difficulties still present themselves, he will be in a better position to frame an intelligible query, and one which could perhaps be answered without writing a complete treatise. However, I rejoice at his protest against being put off with the substitution of polysyllabic ebullition for simple boiling as an explanation.—W. A. S. B.

[61156.]—**Battery for Lamps.**—TO "ALBO-CARBON."—The factor for judging lasting power of bichromates, which I promised in 61156, 17th December, is as follows:—10oz. of saturated solution of bichromate of potash, in a double-fluid cell, outer containing sulphuric acid and water 1 to 10, will give a current of 16 watts for one hour, or a less amount of energy for a longer period, in proportion. Watts = volts × ampères. With cells of one pint and over, and well made, without unusual space between zinc and carbon, this standard holds good without much variation whatever may be the relative proportions of volts and amps. making up the watts. Cost would be for 10oz. about 3d.—EDWARD CONRY.

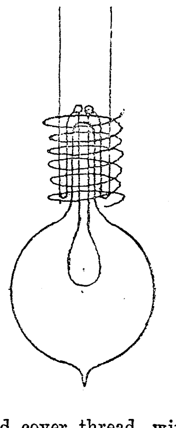
[61175.]—**Removing Scale from Boiler.**—I am pleased to note your query *re* sugar for this, but should like to ask if you have only recently taken charge of the boiler, and consequently have treated it somewhat different to former attendant. The reason I ask is: Some few years since I had an 8-horse vertical which used to throw off its scale, and which heaped up between vertical tubes and nearly choked the sides above mud-holes in a few weeks, and the water used was principally the heated water returned from some heating pipes, no composition used of any kind. Anyhow, you can safely remove all present scale, and then let a crust as thick as this paper grow to protect plates, and keep it at that.—T. C., Bristol.

[61175.]—**Sugar for Removing Boiler Scale.**—I do not consider that sugar, under the conditions of its use as a disincrustant, would materially corrode boiler plates, although, with free exposure to the air such a corrosion would be material enough. I question if there is in the market a boiler liquor of which it could be confidently asserted it was entirely innocent of solvent action on iron, and on iron particularly at the temperature and pressure of ordinary boiler work. At least, I assume so from the fact that most of them have caustic soda, and therefore more or less carbonate of soda, as their essential constituent. We find in Watts's "Dictionary of Solubilities" an assertion to the effect that iron dissolves in carbonate of soda with evolution of hydrogen. Doubtless the efficacy of boiler-liquors as anti-incrustants is in part due to their minute solvent action on the face of the plates.—NORMAN M'CULLOCH.

[61176.]—**Wimshurst Machine.**—Cement the broken plates by means of Kay's coaguline. I cemented in this manner two of my plates about a year ago, and they are still holding.—T. D.

[61178.]—**Electric Lamp.**—File glass away till imbedded platinum wire protrudes. Pierce a fine hole in a narrow strip of very thin copper (or flatten end of copper wire and then pierce it); place hole over projecting platinum; bend wire or strip of copper down the narrow part of lamp, and securely tie it there with thread. Put on the hole

a drop of soldering fluid; now a bead of solder, and hold bit on till it runs; bring up liberated end of copper wire or thin strip, and tie to some small



part of lamp, and cover thread, wire, solder, &c., with sealing-wax (or, preferably, thick gum), and you should succeed so well as—J. W.

[61183.]—**Engine Details.**—You can't cut off satisfactorily at $\frac{1}{2}$ stroke with a single valve; be contented with $\frac{3}{4}$. If $\frac{3}{4}$ will do, you will require $\frac{7}{16}$ lap on valve, and a consequent travel of $1\frac{1}{8}$in., and throw of eccentric will be $\frac{5}{8}$in. I have no lap on exhaust edge. The area of ports is usually $\frac{1}{20}$ to $\frac{1}{25}$ area of cylinder, and width and length are varied by different makers; but in all cases the travel of valve must equal twice the width of port, added to amount of lap. The above amount of lap rather cripples exhaust, so you had better have $\frac{1}{16}$ less, then travel need only be $1\frac{3}{8}$.—T. C., Bristol.

[61183.]—**Engine Details.**—The following are dimensions of slide-valve, &c., to cut steam off at half stroke:—Length of valve, $2\frac{11}{16}$in.; width $2\frac{1}{4}$in.; exhaust cavity, $1\frac{1}{8}$in. by $1\frac{3}{8}$in. by $\frac{3}{8}$in. deep. When the valve is in the middle of its stroke or travel it will have $\frac{13}{32}$in. outside lap, and $\frac{1}{16}$in. inside lap; the lead may be $\frac{1}{32}$in.; steam ports to open, $\frac{7}{32}$in.; throw of eccentric must equal travel of valve, which is $1\frac{1}{4}$in., being twice the amount of lap and port opening. It will be seen by the above figures that to cut steam off at half-stroke, the valve must have a lap equal to twice the amount of port-opening required, and the travel of valve will be about three times the lap. The ports in the cylinder under notice have not been proportioned for a high speed and a cut-off at half stroke with full port-opening ($\frac{5}{16}$in.), but are about right for a $\frac{3}{4}$ cut-off, which requires a lap equal to the port-opening and travel of valve four times the lap. Taking $1\frac{1}{4}$in. for the travel, we get a $\frac{5}{16}$in. lap, and $\frac{5}{16}$in. port-opening—viz., the full width. We now come to the question of area of steam ports. As a general rule, they should be for a moderate piston speed one-twentieth, and for high speeds one-tenth the area of piston. Your steam-ports are about one-sixteenth area of piston, and if the engine is to be run at a high speed I should advise you to lengthen them as much as possible. To find at what portion of stroke the steam is cut off when lap, lead, stroke of valve, and stroke of engine piston are given, the rule is, to twice the lap, add the lead, divide the sum by the stroke of valve, square the quotient, and multiply it by the length of stroke of piston. The product is the distance of piston from end of stroke when steam is cut off. —E. L. P.

[61188.]—**Storage Cell.**—To "A READER."—You would want four cells if your lamp is actually as low as 8 volts, and with most lamps sold as such you would require five cells. I should not advise you to try painting the plates with anything. You will do better if you "form" them from the plain lead, especially as you want a small cell. The acid for the cells is a mixture of sulphuric acid and water in proportions to give a specific gravity of 1·150, i.e., about 1 part acid to 10 water. If by your expression "I want to carry it about" you mean in the pocket, you certainly will not get any storage battery to give 10 ampère hours (that is about what you would require) of size small enough to be carried in any garment. You would want in each cell 200 square inches of peroxide plate, which you could obtain by plates 5in. by 10in. each—two + three—being in each cell, or any other adjustment of sizes convenient to your resources. You could make it a "dry" battery by filling the spaces between the plates with clean, fine sawdust, or coarse white felt or flannel, the last for preference, and keeping such material saturated with the battery acid; but in that case you would need several more cells, probably three more, as you would very much increase the internal resistance of the cells, and consequently the total resistance of the circuit, by making them in the dry form. If you start to make such a battery you will much increase the readiness of formation by soaking the plates in equal parts nitric acid and water for about 12 hours.—EDWARD CONRY.

[61190.]—**Differential Feed.**—With a right-hand screw the revs. of screw must usually be greater than that of the bar. I think "Goodeve's Mechanism," page 207, will supply all you require, with a little thought. Briefly, it is driving wheels divided by driven; this gives rate of screw as compared to bar. It is the difference of their motion that gives the feed, so that if screw makes 5 and bar 4 revs. the screw makes $\frac{1}{4}$ turn more for each turn of bar—that is, $\frac{1}{4}$ of $\frac{1}{3} = \frac{1}{12}$in. cut, and for same thread as screw it must travel twice the speed of bar, so that in your case $\frac{A \times G}{B \times D} = 2$ for 36 threads per inch—that is, 12 times No. of leading screw; value of train must equal $1 + \frac{3}{36} = \frac{13}{12}$. Use any wheels, as in screw-cutting, that will gear to this value, and each pair of wheels that gear must be of the same total number of teeth if of the same pitch. Thus number of teeth in A + B must equal number in D + G. It is here where the difficulty creeps in, and the simplest way is to get the ratio with A and B, and then put a pair of equal wheels any pitch that will gear on C and D. Of course, C D may always be the same if the sum of the teeth of wheels A and B is always the same. For 35·8 threads the nearest wheels are 129 and 119 on A and B.—T. C., Bristol.

[61194.]—**E.P.S. Secondary Batteries.**—Charging these in series with an arc lamp circuit is an unusual method, but I do not know of any reason why it should not answer; you should connect them, however, all in series, instead of in two lines as you have drawn—by the latter method you halve your charging current. You could not, however, expect a battery of that size to hold very much. Allowing $\frac{1}{2}$in. space for each plate, and that is under rather than over the best working allowance of room, you would be doing very fairly if you got 10 amp. hours out of the battery after one hour's charging in series with 15 amps. current. Are you sure that the cells do not run themselves out by internal short-circuiting. This is the constitutional plague of all small storage batteries; and are you careful to keep the acid always above the tops of the plates? Such small cells would need filling up with water several times in the course of an hour, charging with a current of 15 ampères, which is heavy charging for such small cells—much more than advisable at all. How are the plates separated from each other? I should suggest charging them for one exact hour at the above current (since, under the circumstances, you would not be able to diminish it), keeping them carefully filled up all the time, adding water only, and at the end of the hour run them out through 1 ohm resistance—i.e., about 25yds. No. 22 copper wire B.W.G., and a low current ammeter, or through a lamp of known resistance, and notice accurately the time, in hours or fractions of an hour, for which they keep up the light without its beginning to fail markedly. Then, by the formula $C = \frac{E}{R}$, you can reckon what current has been going through the lamp, and see if your cells give 10 amp. hours or what. If they do not give anything like that, as, for instance, not more than one or two amp. hours, take all the plates out and thoroughly wash and clean them and the cells and separators, and try again with fresh-made battery acid. Before you start a trial, however, at all, you should take a galvanometer and battery (one of the cells detached will do if it has any current in it) and test each cell to see if there is any contact between the + and − plates. If you get a distinct deflection of the galvo. needle, that cell is short-circuited internally, and that would account at once for your trouble. In that case, you must wash clean and remake, test again with galvo., and, if all is right, proceed to another trial. —EDWARD CONRY.

[61197.]—**Motor and Coil.**—I am afraid it would be difficult, if not impossible, to answer accurately your first question, as the average cost of working any electro-motor depends so much on the particular battery used, and the construction of the electro-motor itself. Perhaps, however, the following figures may be of use to you. They represent, as nearly as I can say without actual experiment, the cost of working various electro-motors from $\frac{1}{4}$ to 3H.P., as you specify, assuming the loss of power in the motor to be 20 per cent. The figures are deduced from what I have found to be the cost of working several electro-motors of different sizes—viz., 1l. per hour for a 1-watt current, the battery being a good form of cell which I always use for such work, and well kept (no wet boards to stand on, or external leakage of current from slopping, and no internal short-circuiting, and no added resistance from dirty connections). From my experience with this battery, with cells of 1 pint size and upwards, it does not make much difference in cost how the watt is made up, whether of high volts and low ampères, or vice versâ; but this must not be taken as applying to batteries generally. Theoretically the cost would be the same in proportion for a small motor as for a large; but practically the cost becomes relatively less, as the larger motors are more economical than the small ones.

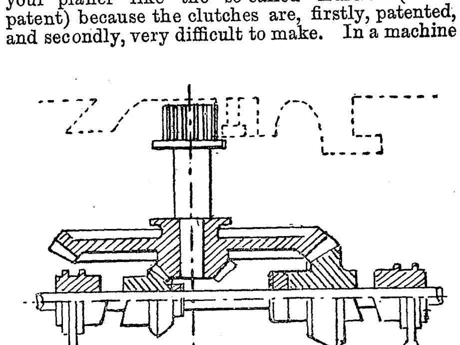
	For 1 hour's maintenance.
(1) $\frac{1}{4}$H.P. takes 223 watts, costing ...	2s. $0\frac{1}{2}$d.
(2) $\frac{1}{2}$H.P. " 447 " " ...	4s. 1d.
(3) $\frac{3}{4}$H.P. " 671 " " ...	6s. 2d.
(4) 1 H.P. " 896 " " ...	8s. $2\frac{1}{2}$d.
(5) $1\frac{1}{4}$H.P. " &c., &c., as above.	

From this cost may be deducted, as the sizes rise, a percentage as follows: (2) $2\frac{1}{2}$ per cent., (3) 5 per cent., (4) $7\frac{1}{2}$ per cent., (5) 10 per cent., &c. As to induction coil, No. 26 would do for a secondary coil, if none other were obtainable, but it would not be the proper gauge. For most coils, No. 36 would be nearer the mark. No. 26 is an unfortunate size; too small for a primary, and not large enough for a secondary. If you are obliged to use it, I should say, as a guess, that you would want about 4lb. to get a 1in. spark; but am not at all certain that you could readily get a 1in. spark with wire of that gauge for the secondary. Coils made in sections have the advantage of being less likely to short-circuit in the secondary than those of ordinary make, besides rendering it easier where the connections are arranged for this to localise and remedy such a fault. Working details would be rather too long and difficult to give here; but if you bear in mind that the principle of the affair is to avoid putting parts of the secondary between which there is a high difference of potential near each other or lying on each other, you may be able to work out an arrangement of section winding for yourself. If you can, look up subject in Mr. Sprague's "Electricity," where you will find full details. The platinum points for contact breakers for all ordinary coils may be as small as you can make them.—EDWARD CONRY.

[61205.]—**Mechanics.**—The lift of bar is 4in., and in 100 revs. this will be equal to $\frac{4}{12} \times 100$ft., and the resistance is 10lb., so that amount of work is $\frac{4}{12} \times 100 \times 10 = \frac{4000}{12} = 333{\cdot}3$foot-lb. The horse draws the cart at the rate of $\frac{2 \times 5280}{60}$ feet per minute, and in one minute performs $\frac{29216}{3}$ ft.-lb., so it must pull with a force of $\frac{29216}{3} \times \frac{60}{2 \times 5280} = \frac{29216}{528} = 55{\cdot}3$lb.—T. C., Bristol.

[61205.]—**Mechanics.**—Neglecting friction, the work done in 1 revolution of the plate $= \frac{10}{3}$, or $3\frac{1}{3}$ units or foot-pounds. Work done in 100 revolutions $= \frac{10}{3} \times \frac{100}{1} = \frac{1{,}000}{3}$, or $333\frac{1}{3}$ units or foot-pounds. (2) The horse, at the rate of 2 miles per hour, goes the distance of $29\frac{1}{3}$ft. in 1 minute. $\frac{88}{3} = 29\frac{1}{3}$ft. $\times 3 = 88$ft. distance drawn in 3 minutes. The work performed by the horse as given = 29·916 foot-pounds. The pull in pounds on the cart multiplied by the distance travelled = work performed = 29·916 foot-pounds. Let x = pull. $x \times 88 = 29{\cdot}916$. $x = \frac{29{\cdot}916}{88} = 340$lb. nearly.—DUD DUDLEY.

[61211.]—**Planing Machine.**—You can't make your planer like the so-called Eureka (Haas' patent) because the clutches are, firstly, patented, and secondly, very difficult to make. In a machine



I have in progress I shall use the appended arrangement, which will, I think, answer as well, if not better, than the Haas patent, as there is no spring. I have used Haas' No. 2 machine, and have found that it sometimes fails to reverse, from the cam sticking on the spring. In my machine I have no cam or spring to stick. A vertical lever

weighted at the upper end and connected with the striking gear in falling past the centre pushes the plate R right or left, according to the movements of the table. The rack on my machine stands with its teeth sideways. I prefer this way, as there is no tendency to spring the table either upwards or downwards. You will have to make your rack slip stiffly an inch or an inch and a half; otherwise you must expect broken teeth in the driving gear and many jolts. In Germany machines planing up to three-quarters of a mètre long are sometimes driven with a gear similar to that used in shaping machines. This arrangement is, however, very cumbersome. The teeth in sketch are as follows:—Forward motion, 24 and 77; return motion, 22 and 30. For power machines my arrangement could be as equally well outside instead of underneath; but then dirt is liable to get into it. I have drawn ordinary clutches, as the form of clutch is still an open question with me.—A. F. SHAKESPEAR, Lüttichaustr. 14 III. Dresden.

[61212.]—**Oilcloth.**—The bulk of the block is of deal in several thicknesses, and glued up with the grains crossing; the face of block should be of pear tree, but is frequently of holly or sycamore, and best of all of box. You will only find scattered reference to the subject in encyclopædias.—T. C., Bristol.

[61217.]—**Improved Pocket Barometer.**—Replying to your correspondent "Towers," he appears to have very happily grasped one of the many facilities with which the possession of the variety of markers endow the instrument, and the want of which has, as he describes, hitherto made the results obtained by carrying an ordinary pocket barometer far less satisfactory than the wearer could have wished. The several recording motions shown in the engraving which you so successfully transferred from the photograph of the inst. to page 304 of December 3, are quite independent of each other, and although the markers overrun both the English and French scales simultaneously, the latter might, no doubt, be omitted for a non-traveller, when economy is of more importance than the corresponding return from the additional outlay. But, in view of the increasing interest now taken in the barometrical readings now so frequently telegraphed from abroad to the daily papers, I would suggest to "Towers" that he might perhaps preferably retain the French scale—which serves for not only the French, but for the reports from almost all European countries—and rather exercise the desired economy by substituting silver cases instead of gold. Lastly, on the important question of size in point of thickness, which "Towers" inquires about. I feel with him the strongest repugnance to carrying anything in the shape of a tub in my waistcoat pocket, and I made it a *sine quâ non*, on giving the order to the maker, that the improved barometer, utterly unlike those which he describes, should be in every respect the facsimile in diameter, thickness, and make of the gold pocket chronometer which I carry in the fellow-waistcoat pocket. The instructions were faithfully followed, with entire success, and I can assure "Towers" that the result was a really handsome and shapely instrument of under 12 millimètres in thickness, whilst the diameter (which is the exact size of your engraving) gives ample space for reading the many tales it has to tell. I shall be happy to show it or give further details to "Towers" or other of our readers who may like to communicate at 23, Park-crescent, Portland-place, W., with—MONTMARTRE.

[61218.]—**Lighting Lantern.**—We have heard a good deal during the last few months about the Bernstein low-resistance lamps. You might get a 40c.p. among these, but any of the ordinary lamps of so high a c.p. would take an E.M.F. that nothing short of a little army of battery-cells in Indian file would produce. You might make a hand-dynamo to do, but I should strongly suggest your contenting yourself with several 10c.p. lamps of about 25 volts or less. You can run all these in parallel, and with only about 14 or 15 cells, according to the sort of battery you use. With chromic acid you would want 14. The number of nights the battery would run would depend on the size of it.—EDWARD CONRY.

[61222.] — **Electric Indicator.** — TO MR. CONRY.—Excuse delay in answering. I have been debarred from writing for a week by a hurt finger. Wind the bobbins with five layers No. 28, and make the cores a clear 1in. between the flat ends of the bobbins. The distance between the N. and S. points of the permanent magnets depends a good deal on the size of the electro-magnet bobbins. When one horn is touching one side of the bobbin, the other should be about $\frac{1}{8}$in. from the other side of it. The usual size is a semicircle inclosing 1in. or a trifle less between the extremities, and for the bobbins $\frac{5}{16}$in. for the core, between the points of a pair of calipers; the rest of $\frac{1}{2}$in. or $\frac{9}{16}$in. diameter being wire.—EDWARD CONRY.

[61232.]—**Bracelet Snaps.**—These must be either fastened with soft solder or, what is better secured by rivets or rings. A small plate is previously soldered to the bracelet, and the catch riveted on. The exact manner in which this is done depends altogether on the make of bracelet and the ingenuity of the workman.—OS.

[61234.]—**Bursting Pressure.**—As a 1in. shaft will bear 4cwt. acting on a lever 1ft. long, a $1\frac{1}{4}$in. shaft will just bear $4 \times (\frac{5}{4})^3 = 8$, nearly; but your lever being 4ft. long, you can only apply 2cwt. at the end without breaking off the screw. The power of the combined screw, lever, and wedge are, in proportion to distance moved by end of lever to that of the opening formed by movement of wedges —that is, in one revolution of handle $= 8 \times 3{\cdot}1416 = 25{\cdot}132$ft., the wedge advances $\frac{1}{4}$in., but the side movement $= \frac{1}{12}$ of $\frac{1}{4}$ of an inch; the power is, therefore, $25{\cdot}132 \times 12 \times 12 \times 4 = 14{,}476$ times power applied at end of lever, or $14476 \times 2 = 22952$cwt. This, however, is theoretical bursting power, and must be reduced to one-half or one-third, to allow for the great friction between surfaces of wedge and of screw, which is also a wedge.—T. C., Bristol.

[61235.]—**Telegraph.** — Probably one of the earth wires is broken beneath the ground, or has become detached from the plate. Nothing smaller than a No. 8 (B.W.G.) wire should be used for such a purpose; and the soldered joint should be several inches long, to insure a perfect connection. It may with advantage be painted over, or coated with some damp-resisting compound. — E. E. BAUGH.

[61235.]—**Telegraph.**—TO MR. BOTTONE.—I can only say that there must be a defect in connection somewhere. The following modes are adopted to insure good connection to earth:—(1) A ton of good, hard coke or retort scurf (graphite) is buried at a depth of about 6ft. in the ground; interspersed with the coke there being galvanised iron wires about $\frac{1}{8}$in. diameter, joined above into a cable, which connects to the earth-line; (2) In other places galvanised iron plate one yard and a quarter square is placed upright in running water or a spring well. If water is not available, then the plate is also connected to all the water pipes (leaden) in the vicinity. Gas-pipes must not be connected, as, in case of a thunderstorm, explosions might ensue.—S. BOTTONE.

[61235.]—**Telegraph.**—The fault *may* lie in the peculiar arrangement of the earth between the two plates, some particularly non-conducting substance as dry sand being interposed like a wall between the earth plates; but this is rare. I have only met with it in two instances, one at Aldershot, where the soil is notoriously gritty and poor, and once at Weybridge, where I learned on inquiry that a broad belt of dry gravel extended between the two earth-contacts from about 1ft. below the ground to a considerable depth, when the same fault as the one you remarked was present—a deflection of the galvanometer, but not sufficient current to ring a bell, and it had to be remedied by the same means —a second wire. I should think your difficulty was more probably caused by your having used galvanised iron for the earth-wires and plates. The zinc and iron being in contact in presence of acids in the damp earth, would set up a local action between them, which would probably make hay of your battery current. You have, in fact, made a sort of "Callan's battery" at both ends of your earth return. Dig up your plates and wires, and substitute plain iron wire and plates, or, better still, copper for both, and then see.—EDWARD CONRY.

[61237.]—**Lathe.**—You should be able to turn safely as great diameter as will clear saddle and bottom slide of rest, say 11in. for sliding; but for a pulley, for example, it is somewhat a question of speed, which must not be such as to heat the tool on a diameter of 20in., which is about as much as the lathe should have to do. Some lathes would do more if they had a greater variety of speeds. For example, I have used a 10in. lathe and turned 2ft. diam. on it, but had trouble with the speed being too great, and so spoiling the tools. If I had had a slower speed, the lathe was plenty stiff enough for the job.—T. C., Bristol.

[61241.]—**Climate for Chronic Catarrh.**—No need to leave England. Try Babbacombe, in Devon; it is mild and bracing. What with exercise, patience, and a course of Turkish baths to be had here, there is no reason why you should not gradually recover the health you have been losing. BABBACOMBE.

[61242.]—**Canvas for Diagrams.**—Here is one way of preparing what you require. Size the canvas well, and let it dry. Then paint over it with a mixture of glue and lampblack, and dust on very finely-pounded and sifted coke. If preferred, the canvas may be painted with oil and turps as the media for the black.—NUN. DOR.

[61243.] — **Failure of Amalgamation.** — I should say that the difficulty is most likely in the zinc. If cast, it is very difficult or impossible to protect, even if moderately pure; but it is very apt to contain tin and lead. Has the querist tried the addition of oil, as mentioned in my second edition, p. 126?—SIGMA.

[61247.]—**Hot-Air Motor.**—TO MR. J. SEAL. —You do not give the size of your cylinder; if it is the same size as my small models—viz., $\frac{7}{8}$in. by $1\frac{1}{4}$in., the air passage should $\frac{1}{4}$in. by $\frac{1}{8}$in., or larger if you can make it. The best proportions I have found the cylinders should have is, the heater should have about double the capacity of the working cylinder.—J. SEAL.

[61251.]—**Boiler.**—Height 3ft., diameter 2ft., firebox 1ft. 8in. high, and 1ft. 6in. diameter, and chimney 5in. diameter, made of $\frac{1}{4}$in. plate and worked to not more than 80lb. Heat with coke and small coal.—T. C., Bristol.

[61252.] — **Windmill.**—A windmill so constructed would work, but it is not a good shape. One modelled on the principle of the revolving shutter cowl for chimney pots would do better—i.e., with about six times as many "shutters" as you have drawn, each making an angle of about 45° with the outer circle of the frame holding them, and if they were curved to form each a quadrant of a circle, so much the better.—EDWARD CONRY.

[61252.]—**Windmill.**—If this be made as shown in diagram, it would certainly revolve in the opposite direction to that indicated by the arrow; the power would be increased by adding top and bottom ends to each of the sails. The best shape which I have tried is long cones like a candle extinguisher. I have a model working at this moment in which there are four sails similar in shape to the diagram, save that each measures, say 1ft. long by $2\frac{1}{2}$in. each side, with triangular end-pieces, and the edge marked E in diagram is parallel to each arm. There was the figure of a man attached, who apparently kept turning it by a crank handle, and my object was to make a mill which could not revolve at a violent speed with any pressure of wind. But the power to be obtained from this or any other possible arrangement of horizontal windmill, is very inferior to that given out by the usual vertical one, because in this latter the thrust is (assuming, of course, a steady wind) constantly kept up, and there is not the same resistance of sails coming up against the wind; and, finally, all the sails are always equally in action. I may say that I fully endorse R. Browne's opinions *re* P. Vallance's statements on page 369, and not feeling bound to believe in any horizontal mill, or the inventor or rather arranger of the same, intend to wait till I see.—A., Liverpool.

[61253.]—**Electrical.**—It is just possible that Deprez's galvanometer (illustrated in the same number as that in which the query appears) would suit this correspondent.—OS.

[61253.]—**Electrical.**—Certainly; a brass arm or pointer, pivoted near one end, kept in a normal position by a fine spring, or weights, and having attached to it at the short end a cylindrical armature sliding in a solenoid coil of wire thick enough to carry your current without heating, while carrying at the long end a small pencil just touching a moving slip of paper, will do what you want. You would have, of course, to calibrate your instrument for the first time in order to see how much stroke on the paper represented a difference of 1 ampère, or whatever fraction of an ampère you wished registered; and you would have to arrange some mechanism to keep the paper moving —either weights on the Dutch-clock principle, or a drum worked by a coiled flat-spring and train of wheels, like a clock. A "Watt-meter" was patented some year or so ago by Mr. Frederick Walker upon this principle, automatically registering as "watts" the electrical H.P. expended.—EDWARD CONRY.

[61254.] — **Combination Machines.** — Some time this year I saw, in the *Engineer*, I think, illustrations of a milling machine for roving machine frames. It appeared to be essentially a planing machine; but had several headstocks carrying milling cutters. These headstocks were on both upright frames and also on cross slides, four or six in all, and were driven by means of gearing—there being a spindle in each vertical slide and also in cross slide; these spindles being grooved to drive the gear by a sliding feather as in a driller. The headstocks could also be set to various angles.—T. C., Bristol.

[61257.]—**A New File.**—About seven years ago I read a paper before the Society of Arts, on J. and W. Kirkwood's patent file for soft metals and wood. I may also state that the two files exhibited then have been in daily use ever since, and that they have done an enormous amount of work, having filed up the top of several thousand zinc baths. The blades were originally $1\frac{3}{4}$in. by $\frac{3}{8}$in. by 14 wire gauge; they are now about $1\frac{3}{8}$in. by $\frac{1}{2}$in. We do not recommend this file for iron or brass; but for zinc, lead, or hard wood nothing can equal it. Its cutting qualities are far more than double that of an ordinary cut file. I may also state that this file was invented forty years before

us, and was described by Montufel as White's perpetual file. While writing allow me to state that zinc can be hardened or softened; but cast zinc is as soft as it can be made. Two curious things which we constantly observe is that zinc which has been exposed to quite a low heat for a few weeks becomes quite soft, and if it is immersed in water, and then pour a few drops of vitriol on it, allowing it to remain a few seconds, and wash off, it will be seen that it has become crystalline. Again, if unannealed zinc is for a number of years exposed to the action of hot water, as in an old bath, it becomes almost as hard as iron, and much harder than any zinc can be rolled.—JOHN KIRKWOOD.

[61259.]—**Induction Coils.**—TO MR. BOTTONE AND "BOBADIL."—My experience is that one may reasonably expect to obtain $\frac{1}{16}$ of an inch spark for every 424ft. coiled on the secondary up to about 6,740ft. Beyond this, unless the coil is specially built, it is difficult to increase the spark in proportion, owing to greater difficulty in insulating so high a tension, and also owing to the greater distance of the wire from the core. Hence, while 1lb. of No. 38 will easily give 1in. spark, 2lb. will not readily give 2in. A condenser must not be used with the secondary coil.—S. BOTTONE.

[61259.]—**Induction Coils.**—The length of spark obtainable from an induction coil depends on the length of the secondary, and the battery-power employed. It is usual to expect 1in. spark from every mile of secondary, in small coils. The length of a certain quantity of wire is stated in several tables. Thus 1lb. of 36 is about one mile long, and when we know how much is used the approximate length of spark is obtained. However, the real secret of maximum efficiency is insulation. Bad insulation of a secondary of any length whatever, means a very small spark in proportion to the length of wire. The sizes of the parts of a given coil are not strictly absolute; but between all the working parts there must be due proportion. The laws of electro-magnets, slightly modified, determine the size of the core. The size and number of layers of primary depend on the power of battery to be used so as to get the greatest current. The balance of experience, however, is in favour of the well-known rule, "two layers of primary." Regarding condensers in the secondary circuit, I may say that I have tried them in various ways, and the result has always been a very bushy spark; but never an increase in length.—BOBADIL.

[61260.]—**Dip for Brasswork.**—Put into half-gallon spirits of salts 6oz. arsenic, 4oz. iron scale (from a smith's anvil), 2oz. sulphate of copper, have the latter crushed before using. Either shake or stir occasionally; it will be ready for use in two days. Shall be glad to give you any practical information how to use above if you have not done bronzing before.—IGNORANT.

[61261.]—**Mirror Galvanometer.**—Brass will do, but you must be careful that it is well insulated from the coils. What do you mean by "capacity"? If you mean "farads," see my answer to 61253 in this number; but if you only refer to ampères, as seems probable, then the essential features of a galvanometer to measure this are in one form low resistance, and the movement of a needle either by the action of a solenoid on an armature, or its movement against the tension of a spring, as in the Siemens dynamometer.—EDWARD CONRY.

[61262.]—**An Electrolytic Estimation.**—This query, as it stands, is almost unanswerable. Unless the resistance of generator and electrolyte is given, the volts cannot be calculated. Again, without knowing what metal, and how much is deposited per hour, the ampères cannot be calculated from the data given. The following may assist "R. T." to solve his query. Each ampère of current working through the electrolyte will deposit (per hour) the following weights of different metals, viz.:—Copper 17·3gr., gold 37gr., silver 62gr., nickel 17·2 grains, zinc 18gr. (nearly). Of the mixed gases, about 5·1030gr. will be evolved per hour. To facilitate the reduction of the latter to cc. I may say that 5·1030 grains is equal to 0·3405 gramme, nearly.—S. BOTTONE.

[61262.]—**Electric Units.**—In reply to "R. T.," it is unfortunately true that a committee appointed at Paris have made certain alterations in the values of the electric units, to which they have tried to give validity by calling the new values "legal," and asking some of the Governments to recognise them as standard. The result is that they have utterly confounded all knowledge, and nowadays the terms "volt" and "ohm" convey no meaning to anyone. Some engineers adopt the proposed units, while the Post Office authorities repudiate them; and unless the value of the units is stated in each case, no one can tell what is meant by them. Notwithstanding the use of the word "legal," and the partial acceptance of these new values, it is impossible for them to be finally adopted. It may seem disrespectful to the distinguished committee to say so, but the basis of the new units is so childishly absurd that common sense must revolt. The absurdity can only be equalled by the fact that the same committee coolly adopted melting platinum as the standard measure for light. On p. 233 of my "Electricity," I have shown the wide range of values experimentally found for the original B A unit or "ohm." The latest generally-accepted value is represented, I think, by a square millimètre of mercury 106·2 centimètres long; so this committee agreed, in order to avoid fractions, to make the ohm value 106 centimètres of such a column. Now, no human being ever made, or ever will make, a true tube of one square millimètre section. It is a pure matter of calculation and of adjustment of a column as near the size as can be got; so the committee have in pure pedantry wilfully adopted a known wrong value as a standard, and that wrong standard is to be used in working out calculations of course to half a dozen places of decimals. Then they have been pleased to define the volt as that E.M.F. which will send an ampère current through this erroneous ohm. When we reflect that there is no means of measuring an ampère with exactness, and that its chemical value is varied about every three months, one is struck with admiration when one reads elaborate calculations about exact measurements of E.M.F. My standard puzzle to my electrical friends is the question, "What is a volt?"—SIGMA.

[61264.]—**Safety Valves.**—Area of valve $= (1\frac{7}{8})^2 \times \cdot7854 \; 2\cdot761$ sq. inches. Blowing off pressure $= \dfrac{28 \times 13\cdot5}{2\cdot76 \times 2\cdot5} = 55$lb. nearly. This would probably be increased by weight of lever to, say, 57lb. It would begin to blow earlier than that, say 50lb. to 52lb.—T. C., Bristol.

[61265.]—**Loss of Magnetism.**—Probably there is a loose connection somewhere in the shunt circuit, through which by vibration of the machine the electrical contact is maintained sometimes and not others. Examine carefully all connections on this, especially the coupling where the wire of one F.M. is joined by that of the other.—EDWARD CONRY.

[61268.]—**Soldering Lamp.**—I think I should prefer a soldering bit, to be heated by a small portable furnace made of sheet iron, as this is often used for similar purposes.—OS.

[61268.]—**Soldering Lamp.**—I do not know of any better one than the single or double-jet lamp where the flame of a lamp in the bottom is blown outwards by the heated vapour from a little boiler on top, with a curved pipe leading down from the top to just above the flame of the bottom lamp, and terminating in a fine hole. This, though it lights instantly, requires to burn for a few minutes before it begins to "blow," unless it is hot already, but it is the best I know of.—EDWARD CONRY.

[61271.]—**Electric Bell Circuit.**—This circuit is entirely wrong. The zinc in every case goes to earth, which is the return wire. Connect zinc to earth, carbon to one terminal of push, other terminal of push to one of bell, other terminal of bell to earth. With an earth circuit, the connections must be particularly good.—BOBADIL.

[61271.]—**Electric Bell Circuit.**—The carbon pole should be attached to the wire or overground part of the circuit, and the earth or underground part made the "return" to the zinc. I should not trouble about what the treatise says on the other matter. The consideration of such a question is not of any practical use, and is only likely to lead to mental confusion.—EDWARD CONRY.

[61273.]—**Saddle Boiler.**—You can do no possible harm by letting off any air; but your best plan is to connect a small-bore pipe at the highest point in pipes, and carry it up to same height as feed tank; then the pipes will get rid of their air as it tends to accumulate.—T. C., Bristol.

[61274.]—**Cell.**—I can give you the recipe of a very good and cheap dry cell for testing if you like to advertise your address and apprise me of having done so; but it is really too good a thing to be given away by general publication, being a private and patented matter.—EDWARD CONRY.

[61274.]—**Cell.**—The most suitable thing for this querist's purpose will be a chloride of silver cell (E.M.F. 1·45 volt). These cells can be obtained in sealed ebonite cases, measuring about 3in. by 1in.—E. E. BAUGH.

[61275.]—**Coppering Carbons.**—A muddy deposit is often the result of too strong a bath of sulphate of copper. Try diluting yours with two or three times its bulk of water.—BOBADIL.

[61275.]—**Coppering Carbons.**—Don't attempt to put a thick coating of copper on carbons, as a very thin coating is best and sufficient. I find that a thick deposit is more likely to peel off after it is tinned and soldered. This (the coppering) does not require a length of time at all approaching a few hours, and I prefer to use a separate battery. Coppered carbons are not used as a rule for Leclanché cells, they will not keep in order so long as the ordinary lead-capped carbons. Ammonia in any form acts very strongly on copper. It is, of course, the cheapest and most easy method. If it were better than the lead it would have been long since generally adopted.—OS.

[61277.]—**Multiplex Copying Ink.**—As you suggest, the proper mode of cleaning the preparation is by rubbing with a wetted sponge; but with tepid water if cold fails. As this rubs it away to a certain extent, a good plan is to heat it till liquid, and allow to set again. I have heard that if the ink remains on the graph for some time it is harder to remove; but how far this is true I cannot say.—W. C. HALL, Newport, Mon.

USEFUL AND SCIENTIFIC NOTES.

Almanacs, &c.—Amongst the useful works published annually we have to acknowledge the receipt of *Transit Tables* for 1887, by Latimer Clark (London: E. and F. N. Spon), which give the G.M.T. of transit of the sun and of certain clock stars for every day in the year, and enable any one with a transit instrument (Mr. Clark's patent in particular) to obtain accurate time in any part of the world without calculation. These tables have been found very useful, and are looked for, as a new year approaches, by a gradually-increasing circle. *Whitaker's Almanack* (London: 12, Warwick-lane, E.C.) is increased to no fewer than 632 closely-printed pages, and although the price has been raised to 2s. 6d., it is a wonderful compilation for the money. The Colonial section has been thoroughly revised and greatly extended, and there are several special articles to which frequent reference will be made in the course of a year. *Whitaker's Almanack* is, in fact, an indispensable occupant of the library table and the office desk. *Calvert's Mechanics' Almanack* is, as usual, practical and interesting, and this issue contains special articles on "Lever and Spring Safety-Valves," and the "Proportions of Crane-Hooks, Pulley Blocks, and Shackles." The sheet almanack, also issued by Mr. Calvert, is a useful addition to the workshop.

Purification of Coal-Gas.—At a recent meeting of the Birmingham and Midland Section of the Society of Chemical Industry, Mr. C. W. Watts read a paper on the "Claus Process for the Purification of Coal-Gas." Mr. Watts first pointed out that the process had for its object the complete purification of coal-gas in closed vessels. It was founded on the processes invented by Mr. F. C. Hills some years ago, which had the same object in view, but did not completely succeed. The material used to combine with the impurities of the gas was ammonia, employed in the form of gas. As all the impurities of coal-gas were, with the exception of ammonia itself, of an acid character, they were removed in combination with ammonia dissolved in water. The first treatment was to pass the cold spent liquor through the series of five scrubbers, gradually dissolving the impurities of the gas. The second part of the process consisted of the decomposition by heat of the carbonate and sulphide of ammonium contained in the liquor—a process invented by Mr. Hills. The essential point of the system was that it effected a complete purification of coal-gas by a perfectly continuous operation carried out in closed vessels, so there was no possibility of nuisance arising from the opening of purifiers and the exposure of purifying material to the air, nor any loss of gas or admixture of air from the former cause. The illuminating power of the gas was not reduced by the process; indeed, the average of a large number of tests showed a slight excess of illuminating power over that of the same gas purified by the ordinary process. The by-products — sulphur and ammonia—were obtained in a more valuable form. The ground covered by the plant was considerably less than that required for dry purification, being about 10·12ft. per ton, as against 20·30ft. He was hardly prepared to give a statement as to cost of working, as the cost of a small experimental plant would be proportionately greater than that for regular work. The cost of the fuel for raising steam had been about $2\frac{1}{2}$ per ton of coal, but with a larger plant it would undoubtedly be much less. A vote of thanks was passed to Mr. Watts for his paper, and the proceedings terminated.

Welding Steel.—In the *Genie Civil* Mr. Paul Herzog, of Peterswalda, has given the following as a special composition discovered by him for use in welding steel to steel or to iron: 500 grammes borax, 70 grammes sal-ammonia, 70 grammes prussiate of potash, 35 grammes unrusted iron filings. "This compound is to be pulverised in a mortar, and then turned into a sheet-iron pot or crucible; water is added until a thick paste results, and then the crucible is put over a wood fire and the contents constantly stirred. The resulting mass resembles pumice-stone with green and grey streaks; this is cooled, pulverised, and is at once ready for use."

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

60709. Electro-Metallurgy, p. 182.
60712 M.R. Engines, 182.
60719. Balance.—To "Fellow Workman," 183.
60712. Push.—To Mr. E. Thornton, 183.
60739. Continued Fractions, 183.
60749. Chamber Organs.—To "G. S.," 183.
60755. Prof. Trusses' Valves.—To P. J. Davies, 183.
60760. Boehm Flute Making, 183.

60926. Hokey-Pokey and Coker-nut Candy, p. 269.
60931. Bicycle Making, 269.
60946. Locomotives, 270.
60974. Steering Apparatus, 270.
60976. Arithmetical Question, 271.
60980. To Mr. Striffler, 271.

QUERIES.

[61280.]—**Link Motion.**—Will any of your kind readers inform me to what extent the lap and lead of the slide-valve are affected by the various portions of the slide-valve rod with regard to the link in (1) Stephenson's link motion, (2) the stationary link, (3) Alban's link motion? I cannot find the complicated motion resulting from an intermediate position at the slide-valve rod in the link explained in any work to which I have access.—LINKUM DODDIE.

[61281.]—**Worm-holes in Violin.**—I shall feel thankful if someone will suggest a method of stopping the ravages of the small woodworm. I have a violoncello, also a violin, each of good quality; but the worms are boring in all directions, and little will be left of either instrument in a year or two. I have tried corrosive sublimate and benzoline; but to no purpose. Anything containing fixed oil would injure the wood.—ONE WHO IS BORED.

[61282.]—**Length of Belting.**—Two pulleys 10ft. and 6ft. in diam., respectively, and with their centres 15ft. 6in. apart; find the length of open belt for the same.—MILLER.

[61283.]—**Hot-air Engine.**—Would someone kindly give me particulars of the displacers generally used in hot-air engines, and what they are made of? Is the displacer more area than the working cylinder?—HOT AIR.

[61284.]—**Electro-Magnet.**—With two medium-size Leclanché batteries, I wish to make as powerful electro-magnet as possible. What size core do I want, and how much wire, and what size? If it would lift a piece of iron of a certain weight by being in contact with it, what would be its power if the armature was 1in. away? Is there any rule which will give me the power of electro-magnets on the armature at different distances from it?—G. S.

[61285.]—**Screw Tool.**—I have some brass castings. I want to put threads on with screw tool. I put on slow speed and cut a clean thread, but cannot get them to fit. Will any reader kindly inform me on the subject?—ELBON.

[61286.]—**Heating by Means of Paraffin.**—I shall be extremely obliged by any information in regard to heating steam and hot-water boilers by means of paraffin. I am aware that this substance has been used both on locomotives and some steamboats; but cannot ascertain what kind of furnace is employed. My principal object is to arrive at some simple means of heating by means of paraffin the hot-water boilers of small greenhouses, and so obviate the need for constant attention, and also the uncertainty attaching to all small furnaces in which coal or coke is burnt.—AN OLD SUBSCRIBER.

[61287.]—**Tempering Gun-lock Springs.**—Would you kindly kindly inform me through your valuable paper how to temper main springs of gun-locks? I have made several attempts, but always a failure. They were either too hard or too soft. Any information on the subject will be received with thanks. Also the process of tempering ordinary lock springs?—JOHN FAULKNER.

[61288.]—**Carmine.**—Among the numerous recipes for the preparation of this pigment which have appeared in encyclopædias, technical journals, and receipt books, I have not yet met with one which gives satisfactory results, some of them having been copied haphazard from earlier publications. Moreover, every ingredient prescribed as essential in some of these recipes has been omitted from others. Equal confusion prevails in the details of the manipulation. Should any of my fellow-subscribers be able to give or refer me to a reliable formula, I am sure an obligation would be conferred on others as well as myself.—P. O. V.

[61289.]—**Object Glass.**—To "PRISMATIQUE."—In your articles on "Object-glass Working," in relation to correction for colour, do the terms "red" and "blue" indicate that these are the true colours seen when the correction is complete, or will it be the mixed light inclining towards these tints—that is, in test on bulb in sun? When the rays are brought to parallelism, will the cone of rays within and without the focus show blue rings with a narrow corona of red, and red disc with equal margin of blue respectively, the colours being prismatic "red" and "blue"? Will you kindly add this information to your already generous contribution on the subject?—HARD CROWN.

[61290.]—**Mediæval Outlines.**—I am interested in the progress of modern art ornament of a Mediæval character, distinct from the ancient art of illuminating. Can any of your correspondents refer me to any exceptionally intricate modern outlines of borders, capital letters, and even title-pages (like the title-page to the *Graphic* newspaper)? I am informed that excellent specimens of such Mediæval design and ornament can be found in the circulars and trade catalogues of many manufacturers.—DRAUGHTSMAN.

[61291.]—**To Impart the Appearance of Age to Delicate Wood Carvings.**—I have lately repaired some delicate wood carvings of Swiss and Russian origin; but have been unable to impart to my work the appearance of age, although I have tried many stains. Whilst I was in Switzerland, I learnt that the appearance of age could be imparted to delicate carved wood by chemical fumes; but what chemicals were used I was unable to ascertain. Can any of your correspondents kindly oblige me with this information?—NAWS.

[61292.]—**The Serious Accident at Carlisle.**—Wanted, the cause of the failure of the vacuum brake on the North-Western train. What was the number of the Midland engine that was knocked off the road?—ANTI-VAC.

[61293.]—**Compound Loco. on Cal. Ry.**—Will any reader oblige by giving the result of the grand trial trip on the Caledonian Railway with engine 124 last week? It is Mr. Drummond's new compound that was at the Edinburgh Exhibition.—LOCO.

[61294.]—**Octave Coupler.**—I should feel much much obliged if any of our organ correspondents would give me particulars how to make an octave coupler for a chamber-organ—one that will take up little space being preferred?—T. D.

[61295.]—**Turning Slate.**—Can any of our readers tell me the best way to turn slate in the lathe? The pieces I require to turn are about ½in. thick and from 1in. to 5in. in diam. I find that in turning across the grain the tools wear out very fast.—SLATE.

[61296.]—**Gas-burners.**—TO MR. FLETCHER.—Having occasion to extemporise a gas fire, I used a star burner to ignite a loose heap of asbestos, &c., piled over it. The burner soon became heated to a cherry red, and then the flames, which were at first of the well-known almost invisible blue tint, became luminous and yellow while remaining clear and smokeless. The burner had not lighted back, for when it did it gave off dense smoke. What is the explanation of this change in the character of the flame?—W. A. S. B.

[61297.]—**Pepper Mill.**—Would any brother-reader of "ours" kindly give illustration of mill? Also say the best stones for grinding pepper?—A. W. G.

[61298.]—**Armature.**—Can any electrician describe a "Cabella" armature?—KENT.

[61299.]—**A Capricious Dynamo.**—Can any reader give some plausible reason and remedy for the following freak which my dynamo (Mather-Platt) has twice played me? The machine is compound wound, and is used for plating. It ran six weeks right off without a hitch, when all of a sudden it ceased to give current, and on examination it was found that both pole-pieces had become north. The most powerful current I could send through the coils from a 6-cell bichromate would not permently effect any alteration in this extraordinary polarity. Temporarily, the polarity became as it ought to be—viz., N. and S.; but directly the battery current ceased the two poles flew back to the N. condition. The poles are remarkably soft iron. Any assistance will oblige.—SELIM.

[61300.]—**Saccharine.**—(See p. 367.) If this new and wonderful substance passes through the "organism" (by which is meant, I suppose, the human system, stomach, and all) "unchanged," what is it that causes (1) its high antifermentive property, (2) its antiseptic property? What authority is there for these statements?—R. S. T.

[61301.]—**Amateur Workshop—Brass Foundry.**—(See page 362, second column.) "Advantage being taken of the fact that the melting points of alloys are lower than those of their constituents." In asking the question, I am not doubting; but may this be taken as an axiom without an exception? It is true of iron and aluminium (see Mitis Castings). Is it true of all alloys? It is notably of the alloy called "fusible metal."—R. S. T.

[61302.]—**Billiard Table.**—Will any correspondent kindly give me the exact measurements from inside to inside of cushions, both length and breadth, of a champion billiard table, and also the width of the pocket openings, and say in what respect the champion table differs from those in ordinary use?—FINEM RESPICE.

[61303.]—**Chemical.**—The scullery in my house is supplied with rain water made hot by the usual process of back-boiler heating, and is conveyed through wrought-iron piping from a supply tank of galvanised iron (6ft. by 3ft. by 3ft.) to the sink. This tank is replenished from a cistern underneath the scullery through leaden piping 1½in. diam. by 30ft. long by a force pump in the usual way. The lead suction of a common pump also dips into the cistern, which, by test, is quite impervious. Silver spoons washed in this water take a frosty appearance afterwards, and glasses look very cloudy indeed. What is the probable cause of this?—EARNEST ENQUIRER.

[61304.]—**Emery Wheel.**—Will any fellow-reader kindly inform me what quantity of emery and what quantity of glue I should require to make an emery wheel 5in. in diam. and 2in. thick, and the best way to make the wheel?—EMERY WHEEL.

[61305.]—**Dental Composition and Aluminium Solder.**—TO MR. FLETCHER AND DENTISTS.—Wanted, formula for preparing the dental composition, for impressions of the mouth, known as "Stent," "Godiva," or "A 1 modelling composition," &c. Has a really satisfactory solder been found for aluminium, and, if so, how used and made? If it can be soldered as easy as gold or dental alloy, it will be very useful, not being subject to oxidation.—STORY.

[61306.]—**Question in Mechanics.**—The following question is given in Twisden's "Theoretical Mechanics": "A rod of beech wood (A B) 12ft. long, with a small uniform cross section, floats on the surface of still water. By means of a thread tied to it, the end (A) is lifted to a moderate height out of the water, so that the rod floats obliquely; find how much the rod will be immersed. Why must the thread take a vertical position?" The answer given in the book is 5·43ft., and the specific gravity of beech is taken as ·7. Is not the answer given wrong? I have been quite unable to get it to come to this amount, and should therefore be obliged if some of your readers will work it out for me.—J. C. E.

[61307.]—**Occultation of Aldebaran.**—Will any of your astronomical readers kindly say whether the occultation of Aldebaran on Jan. 7th next can be observed with an ordinary telescope, such as is used by the Coastguard, with sufficient exactness to give the correct time? Also whether any, and what, allowance for longitude should be made between the time stated in *Whitaker's Almanack* for an observation at Greenwich and one at Bridlington Quay?—A. W.

[61308.]—**Amateur Workshop.**—In No. 1135, under this heading, is a chapter on Brass-founding. I have all the requisites for moulding; but find great difficulty in getting the moulding sand—that is, in a small quantity, say 6lb. or 7lb. If you could give a hint to me, and, no doubt, to others also, you will greatly oblige—HAYWARD.

[61309.]—**Photographic.**—Will one of your readers kindly answer the following? (1) What is the best way to remove the varnish from old negatives? I have tried strong alcohol, but it seems to have but little effect. (2) Which brand of Isochromatic plates is the most sensitive to yellow?—J. G.

[61310.]—**Electricity.**—Would one of the electricians be kind enough to tell me whether an electric machine exists powerful enough to kill a dog, and not too expensive for the generally limited means of the societies for protection of animals?—W. VAN EYS.

[61311.]—**Water Resisting Cement.**—I am in want of a cement which will resist water, and at the same time dry thoroughly hard. Can any reader tell me of a recipe?—SELIM.

[61312.]—**Steel Furnaces.**—Can any of our numerous correspondents give me a description of the most improved steel furnaces? If the description is accompanied with illustrations or drawings, so much the better.—GLASGOW.

[61313.]—**Making Cotton Fabric Fireproof.**—Can anyone kindly inform me how cotton or woollen fabrics can be rendered fireproof?—W. R.

[61314.]—**Footpaths.**—Is a farmer allowed to plough up a footpath which traverses his field?—G. F. O.

[61315.]—**Joints in Water-pipes.**—Will some of our able and experienced readers kindly answer the following? I have to replace some 5in. water-pipes from reservoir to mill with 8in. ones. What is best material to make joints with for permanance, as they will be covered with very great depth of earth? They are ordinary faced flange joints. Vulcanised indiarubber rings objected to.—A POOR MECHANIC.

[61316.]—**Turning Bowls for Calenders.**—I shall have paper and cotton bowls for calenders to turn shortly. What is best shape and form of tool to use? Also speed of surface of bowl at cut. I have heard of, but never seen, metal bowls being turned off their own journals. Please give description, with sketch, if possible, of stays required and mode of driving bowl (I understand that they are not held in the centres of lathe at all). I shall also have wooden bowls, 10ft. long, 26in. dia., to turn and bore through for centre hole about 4in. dia. Give description of auger or other tool required. Should bowl or tool revolve, and at what speed? What speed per sec. is best for wood turning, and what is the best form of slide-rest tool required? Send sketch, if possible.—A POOR MECHANIC.

[61317.]—**Gilding on Glass.**—Will any reader give a description of the process worked by several London firms (patent process silverers) of gilding on glass with a liquid?—J. FORREST, JUN.

[61318.]—**Tricycle.**—Would any reader kindly give me a little information as to making a small tricycle suitable for a boy twelve years old? I want to know how to make the bearings of the wheels and the framing of the machine.—AMATEUR.

[61319.]—**Photographic.**—TO "BOBADIL" AND G. EDWINSON.—Thanks for your previous answers. Mr. A. Watt states in his last publication: "If cyanide of potassium has accidentally been added in excess, a little more chloride of gold must be added to neutralise it." I wish to know if it is necessary to leave enough acid in the chloride of gold to cause a chemical action to take place, still keeping the red mass apparently dry?—IGNORANT.

[61320.]—**Static and Potential Energy.**—What are the correct terms for describing the following conditions? Suppose I take an indiarubber door-spring, connect one end to a hook in the ceiling, and, pulling with a force of 10lb., attach the other end to a weight resting on the table. As the force of 10lb. is still there, I imagine that will be a case of potential energy. Suppose, then, I attach a string to a similar weight, strain it with a force of 10lb., and then twist it round a hook in the ceiling, will that represent static energy, or what? I can see that in the case of an elastic spring the force used to stretch it remains; but what becomes of the strain put on the string?—JEHU.

[61321.]—**Brake Failure.**—Why did the Midland express on the 16th inst. run right past Appleby? What brake was in use, and what engine?—ANTI-VAC.

NOTICE TO SUBSCRIBERS.

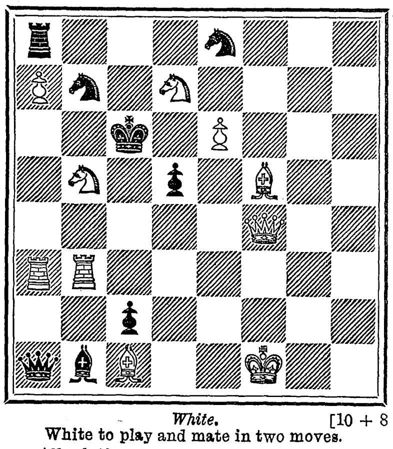
Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXIV.—By G. J. SLATER
(First Tourney Problem.)

Black.



White. [10 + 8

White to play and mate in two moves.

All solutions must be *received* by Jan. 12.

SOLUTION TO 1,022.

White.	*Black.*
1. Q-Q R 6.	1. Anything.
2. Q or Kt mates.	

(Four variations.)

This problem requires a Black Kt at Q 8 to prevent 1. P-Q B 4 (ch), &c.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,022, by A. Bolus, G. T. Stringfellow, F. Krasser, W. Duff, J. Mackenzie.

J. P. AND A. R. B.—If 1. P-Q B 4, P takes P *en passant*, but 2. Kt-Q B 3 is mate (see solution above).

A. BOLUS.—Many thanks for the problem, and for the compliment.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 29, and unacknowledged elsewhere :—

W. GRUGGEN.—W. McCartan.—S. M. Hopkins.—J. H.—J. Williams.—S. Bottone.—Clement E. Stretton.—Unsuccessful.—A. Bedford.—Wm. Young.—Urtica.—Brass Finisher.—Pneumatic.—A Novice.—Three Dimensions.—T. Griffiths. — Anxious.—W. F. D.—William.—Improver.—Chemical.—Dr. Ussher.—Puzzled.—Lanternist.—Box 4, Northallerton.—Drofsidde.—R. Bennett.—A Country Miller.—Electric Light.—C. H. F. C.—Holland.—Brian Boru.

P. HOLLAND. (The Act prescribes that a trade mark must consist of the name of an individual or firm printed or impressed or woven in some particular and distinctive manner, or of a written signature of the individual or firm applying for registration thereof as a trade mark, or a distinctive device, mark, brand, heading, label, ticket, or fancy word or words not in common use. Hence, it would seem that "Jones's sensible boots" could only be a trade mark so far as the word "Jones" is concerned, and anyone could use "sensible boots.")—TINTO. (Tinman's solder, 2 parts tin 1 part lead; plumber's solder, equal parts of tin and lead. If for blowpipe, use 3 tin to 2 lead.)—GALVANO. (By its colour and weight, and by its infusibility. See indices. You merely want a spark to pass over the gas-jet when the circuit is closed, or a little spiral of platinum wire made red-hot by the passage of the current from a battery.) — B. LOCKHART. (Bed the pipe in ashes, the finer the better, and use plenty of them. Failing ashes, sand will do.) — AMPERE. (You should procure Munro and Jamieson's "Pocket-book of Electrical Tables," published by C. Griffin and Co., 12, Exeter-street, Strand. Messrs. W. T. Glover and Co. publish a useful table of wires. Their address is Booth-street, Manchester. Macmillan and Co. publish Prof. S. P. Thompson's book on "Electricity and Magnetism.")—SLANEY. (It cannot really be called "tanning" when the hair is left on: "curing" is the term. Rub in the flesh side a mixture of powdered alum 2½lb., salt and coarse wheat meal 1lb. each, and sufficient sour milk to form a paste. Having rubbed the compound thoroughly into the hide, spread a layer of it on the skin, and fold up the hide with the flesh side touching, and put away into a cool place for a day. Repeat the process several times, washing well at each. Finally wash thoroughly, and dress the flesh side with a strong solution of alum, and hang up to dry. When nearly dry, roll and pound the hide in every direction, and generally do anything that will tend to render it soft. 2. For dyeing sheepskins, see No. 992, p. 74.)—A POOR MECHANIC. (Thanks, but we think we have given enough electrical alarms, at all events, for the present.)—B. ROLSTON. (If the numbers are in print, they will be forwarded to you; but they will almost of necessity contain general directions only, as we have not given dials for all sorts of localities. 2. Mix ivory black with best copal and draw the lines with a fine camel-hair brush. Probably the best paint of the kind is, however, fine lampblack ground up with oil of spike lavender and mixed with a little good spirit varnish.)—T. WALKER. (We do not understand your query as written; but if you mean gilding by the battery process, see the indices of back volumes, or Nos. 1013, 1014, pp. 569, 591, Vol. XXXIX.) — J. FORREST, JR. (Merely a varnished colour print attached to sheet zinc with paste or glue containing an acid. 2. As you say that none of the answers which have appeared in reference to liquid gilding are satisfactory, we will insert the query.)—DECORATOR. (Presumably you mean a liquid glue or a "mouth glue," the latter being simply glue which has been soaked well, the water poured away, the glue melted, and about half its weight of sugar stirred in.)—ELLIOTT. (For painting the slides, procure Sable's "Manual" from Mr. Hughes, Brewster House, Mortimer-road, Kingsland, London, E., or refer to No. 946, p. 226. There is no book on the construction; but Chadwick's "Lantern Manual" will be useful. It is published by Warne and Co., Bedford-street, Covent-garden, W.C. Unless you have had some experience, you had better purchase a lantern.) — A NEW READER, Dover. (It would be almost impossible to find all the necessary details in any one number, although they have often been given. You should read the papers by Mr. Wassell, which have been given in recent volumes. Grinding a glass specula requires a high degree of mechanical skill, and there is no "simple method.")—INQUISITIVE. (Most likely they took a negative from it, and printed in the usual manner.)—G. M. S. (Do you not think it would be more reasonable for you to procure some textbook of astronomy, than for us to occupy space with such queries, and replies to them?)—JUST OUT. (Use the ordinary bichromate solution, or any of those recommended in recent numbers for use with zinc and carbon couples.)—B. (The information has been given several times, and you can obtain it on application to the Registrar, University of London, Burlington-gardens, W. There is a matriculation examination to pass.)

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[*Continued on page* vi.]

The English Mechanic
AND WORLD OF SCIENCE AND ART.

FRIDAY, JANUARY 7, 1887.

NOTES ON THE CHURCH ORGAN.
III.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

BEFORE proceeding to pass a few remarks on the speaking stops most desirable and suitable for the Church Organ, it is, perhaps, expedient that I should first allude to the question of wind pressure—a question of not a little importance in the present epoch of organ building. It must be freely admitted, I venture to think, by all true admirers of the organ, outside a certain class of interested builders, that there has been of late years, in this country at least, a decided tendency to over-blow the organ—to produce as much sound (I cannot say tone) as possible from the pipes, without much regard to its quality, by a system of heavy-pressure blowing and, of necessity, strained voicing. That all organs built on this system have lost immensely in the elements of refinement and true beauty, cannot be questioned by anyone endowed with musical taste and possessed of some knowledge in matters connected with the organ. It is simply painful to listen to many of the instruments which have been placed in churches during the last twenty years, and one yearns for a return to the true and good old style of voicing, in which the early masters of the art displayed both their skill and musical taste. Let any doubting individual compare an unspoiled Diapason by Father Smith, Renatus Harris, or Snetzler, with one of the modern screaming affairs, and judge for himself. It is much to be regretted, this modern practice of over-blowing organ pipes; but it is a necessary outcome of cheap organ building and the desire to get as much sound as is practicable out of pipes of insufficient scales. Pipes of small scales weigh less, and accordingly cost less, than those of large and adequate scales, and the temptation to use the former, and cover their weakness by the means which cost nothing, is too great to be resisted by builders who desire large profits or work at any price.

There can be no question that the tones produced from large-scaled and substantial metal pipes blown by a copious supply of wind at a moderate pressure are in every way vastly superior to those produced from small-scaled pipes blown with high-pressure wind. For Church Organs, there can be no comparison between the two; for the tones yielded by the former are characterised by richness, volume, and great travelling power—just the qualities required for choral accompaniment, while the harsh, thin, and unimpressive tones of the latter utterly fail to satisfy the conditions of a true and sympathetic accompaniment. I could enlarge on this important subject, and bring forward proofs innumerable in support of the above simple statement; but here I must rest content with making the statement: those who question its accuracy may statisfy themselves by a careful study of organs built on the different systems, and a slight acquaintance with the science of acoustics.

There is some diversity of opinion with reference to the lowest wind pressure suitable for the manual departments of a church organ, that is to say, when only one pressure is adopted throughout them. In large instruments it is usual and generally desirable to adopt different pressures. An extreme example of the latter method is presented by the fine organ in the parish church of Leeds, which has no fewer than five distinct pressures, as in the following list:—

Pedal organ	3¾	inches
Great organ (generally) ...	3¾	„
„ „ Tuba only ...	7	„
Swell organ	3	„
Choir organ	2½	„
Echo organ	1½	„

While it is, as a rule, advisable to adopt a medium pressure, say 3in., for organs of small or ordinary size, I am strongly in favour of the more frequent use of a lower pressure, say 2½in. or 2¾in. If such a pressure is adopted, in combination with large-scaled pipes and copious windage, the richest and roundest qualities of tone can be obtained—the tone which best blends with and supports the human voice in the dignified music of the Church. In the preceding article I mentioned the remarkable *Diapason* in the Leeds Parish Church organ; this is probably the finest stop of its class in England. It is of very large scale and very copiously winded at 3¾in. pressure. The tone is dignified and round beyond description; indeed, as I have already said, the stop is a Great organ in itself. Stops of this class are, however, hardly suitable for Church Organs of the ordinary size, although there can be no question as to their impressiveness and sustaining powers. What is really required in the average Church Organ, so far at least as the chief *Open Diapason* is concerned, is a stop of similar scale and windage, but voiced on a much lower pressure.

It may interest some readers to have an idea of the scale and windage of the Leeds Diapason, above alluded to:—

	CC-8ft.	C-4ft.	C-2ft.
Inside diameter	6¼in.	3⅝in.	2½in.
Width of mouth	5¼ „	3 3/16 „	1⅞ „
Height of mouth	1½ „	15/16 „	½ „
Diameter of wind hole in foot	1¼ „	1 „	9/16 „

In instruments of medium size, which can be supplied with wind of two pressures, I should advise the Great organ to be voiced on 2½in. and the Pedal and Swell organs on 3in. wind. Large scales being used for the Great and medium scales for the Pedal and Swell departments. A quiet grandeur should characterise the general tone of the Great, and brilliancy that of the Swell. This is a fact sometimes disputed and almost invariably ignored at the present time. It is now extremely difficult to get low pressures of wind properly tested by professional organ-builders; and one experiences a hopeless feeling when one has a 3in. wind pressure advocated for such an instrument as a *chamber organ* on the sole ground that such a pressure is necessary for the *pneumatic action* employed. For my part, I would sacrifice everything in the shape of pneumatic appliances to obtain that grand and refined volume of tone which places the organ on the throne, and gains for it the title of "the king of instruments." It is unnecessary to pursue this subject farther in this place; but I may recommend those who doubt the efficiency of low pressure winds for the Church Organ, to go and listen to the Choir and Echo departments of the Leeds organ, which are respectively on winds of 2½in. and 1½in.

Speaking Stops.

The selection of the speaking stops is, for all classes of organs, a matter of the greatest importance; and one which in all cases should be governed by the purposes for which the instruments are designed, and the demands which are to be made, in the proper order of things, on their musical resources. It is either from a total misconception of the matter, or an equally serious neglect of the problem it involves, that so many modern Church Organs have been spoiled or rendered insufficient instruments.

The most important stops, and, indeed, those upon which the whole tonal structure of the organ is based, are commonly classed under the general appellation of *foundation-work.* The name is appropriate, and expressive of the dignified office fulfilled by the registers in question. In the manual departments such stops are of open metal pipes, yielding tones, peculiar to organ pipes, of great volume and richness. Chief among them are those of unison (8ft.) pitch, called *Open Diapasons;* and subordinate are those, derived from the unisons, yielding octave and super-octave sounds. There can be no question that upon the scaling and voicing of the *Diapasons* the Church Organ stands or falls as a worthy instrument. First of all, therefore, it is imperative that they should receive the greatest consideration in every stage of their manufacture. The best quality of "spotted metal" should alone be used, and of sufficient thickness to stand the most copious windage, and to produce a perfectly firm tone. It is impossible to obtain the tone required in a true *Diapason* from pipes made of inferior metal, or from those of insufficient thickness in any metal.

The following table of suitable scales for the *Open Diapason*, according to the system of Prof. Töpfer, may not be out of place or uninteresting here. The figures give the diameters in inches.

	CC-8ft.	C-4ft.	C-2ft.	C-1ft.	C-6in.	C-3in.
SCALE I.	7·51	4·50	2·67	1·59	0·95	0·57
„ II.	6·94	4·12	2·45	1·45	0·87	0·52
„ III.	6·36	3·78	2·25	1·33	0·80	0·48
„ IV.	5·83	3·47	2·06	1·23	0·73	0·43
„ V.	5·35	3·18	1·88	1·13	0·67	0·40

Under no circumstances should a smaller scale than No. V. be adopted for the *Open Diapason* of a Church Organ; while scales Nos. III. and IV. may be accepted as those most generally useful. The larger scales are only required for the instruments placed in cathedrals and very large churches; or for those to be heard under very unfavourable acoustical conditions.

When two or more *Open Diapasons* are planted in one organ, it is imperative that their scales should be as widely different as practicable, and that their voicing should be dissimilar. Attention to these matters prevents loss of sound through sympathy, and secures desirable variety of tone in these all-important registers.

To retain the requisite domination of the unison sounds of the foundation-work, it is necessary to select scales for the octave and super-octave *derived* stops considerably smaller than those of the *parent* unisons. Instead, therefore, of the *Octave* CC-4ft. being similar in diameter to the octave or thirteenth pipe of the *Open Diapason,* it should not exceed the diameter of the nineteenth (F sharp) pipe. Thus, if the parent unison is of scale No. I., its CC-8ft. pipe will be 7·51 inches in diameter; while the corresponding CC-4ft. pipe of the derived Octave should be 3·17 inches in diameter. The following table gives the scales for the *Octave*, in relation to those already given for the *Open Diapason.*

	CC-4ft.	C-2ft.	C-1ft.	C-6in.	C-3in.	C-1½in.
SCALE I.	3·47	2·06	1·23	0·73	0·43	0·26
„ II.	3·18	1·88	1·13	0·67	0·40	0·24
„ III.	2·91	1·73	1·03	0·62	0·37	0·22
„ IV.	2·67	1·59	0·95	0·57	0·34	0·20
„ V.	2·45	1·45	0·87	0·52	0·31	0·18

The *Super-octave* should be slightly smaller in scale than the *Octave;* the CC-2ft. of the Super-octave being equal in diameter to the thirty-third pipe of the parent unison. The relative scales of this acute stop are given in the following table.

	CC-2ft.	C-1ft.	C-6in.	C-3in.	C-1½in.	C ¾in.
SCALE I.	1·88	1·13	0·67	0·40	0·24	0·14
„ II.	1·73	1·03	0·62	0·37	0·22	0·13
„ III.	1·59	0·95	0·57	0·34	0·20	0·12
„ IV.	1·45	0·87	0·52	0·31	0·18	0·11
„ V.	1·33	0·80	0·48	0·28	0·17	0·10

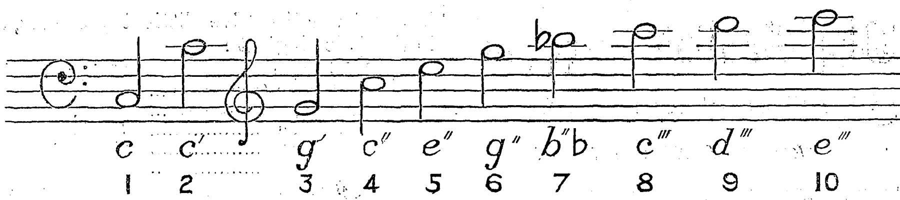
Of the mutation and "harmonic corroborating" stops I do not propose to speak at any length here. It is sufficient to remark that, although mutation registers are useful, and even desirable in large organs, they are by no

means indispensable in Church Organs of small size, or in those containing less than twenty speaking stops. When introduced, they should be of much smaller scale than the foundation work, and be voiced to yield full, quiet tones, which, instead of asserting themselves in the tonal structure of the instrument, simply enrich the natural harmonics of the unison tone. The most important mutation stop is, of course, the *Twelfth* (2⅔ft.), producing sounds which reinforce the second upper partial tones of the unison registers.

Although I do not lay much stress on the introduction of the simple harmonic or mutation stops, I strongly advocate the introduction, in all Church Organs, of the *Mixture* or compound harmonic stops. As I have already said in my "Notes on the Chamber Organ," without a *Mixture* of some kind it is impossible to secure that quality of tone which contributes so largely to the glory of the organ. I feel quite satisfied in my own mind that the early organ builders and their followers erred in making their *Mixtures* far too assertive, by adopting inordinate scales and loud voicing; and, sometimes by introducing too many of them in their organs. For instance, Father Smith inserted in his Temple Church organ, which contained in all only twenty-three speaking stops, no fewer than five *Mixtures*. These comprised 713 pipes out of the total number of 1,715 pipes in the instrument. Again, in the Great department of the organ built by Renatus Harris for the church of St. Sepulchre, Snow-hill, London, three *Mixtures* were included in the list of fifteen stops. As I have said elsewhere, loud *Mixtures* introduced in such numbers are more than "*harmonic-corroborating*" stops; they are, in truth, *harmonic-creating* registers, and accordingly go entirely beyond their province in the tonal structure of the organ, and upset the acoustical conditions which guarantee their introduction in proper form and proportion.

Erring on the other extreme, organ builders of to-day are introducing too few, or altogether omitting *Mixtures* from their organs. Such a practice can only have originated in the desire for cheap organ building. A *Mixture* of four or five ranks, with, respectively, 232 and 290 pipes, is both a costly and a troublesome affair; yet it makes but one stop, and is represented by a single draw-knob. When an organ is competed for, and its contents are left to be suggested by the competing builders, there is a very strong temptation to omit stops requiring so much skilled labour in their construction. Their argument is, if they are questioned, that such compound stops are neither necessary nor desirable in a Church Organ. But, again, I say it is impossible to obtain that rich and ringing quality of tone which is characteristic of the perfect organ without a proper proportion of harmonic-corroborating tone supplied by well-balanced *Mixtures*.

In scheming the compound stops for the Church Organ, the proper office which they have to fulfil in the general tonal structure of the instrument must be steadily held in view. On this subject Helmholtz remarks: "It is well known that the union of several simple tones into one compound tone, which is naturally effected in the tones produced by most musical instruments, is artificially imitated on the organ by peculiar mechanical contrivances. The tones of organ pipes are comparatively poor in upper partials. When it is desirable to use a stop of incisive penetrating quality of tone and great power, the wide pipes (*principal register* and *weitgedackt*) are not sufficient. Their tone is too soft, too defective in upper partials; and the narrow pipes (*geigen register* and *quintaten*) are also unsuitable, because, although more incisive, their tone is weak. For such occasions, then, as in accompanying congre-



gational singing, recourse is had to the *compound stops*. In these stops every key is connected with a larger or smaller series of pipes, which it opens simultaneously, and which give the prime tone and a certain number of the first upper partials of the compound tone of the note in question. It is very usual to connect the upper Octave with the prime tone, and after that the Twelfth. The more complex compounds (*cornet*) give the first six partial tones, that is, in addition to the two Octaves of the prime Tone and its Twelfth, the higher major Third, and the Octave of the Twelfth. This is as much of the series of upper partials as belongs to the tones of a major chord. But to prevent these compound stops from being insupportably noisy, it is necessary to reinforce the deeper tones of each note by other rows of pipes, for in all natural tones which are suited for musical purposes the higher partials decrease in force as they rise in pitch. *This has to be regarded in their imitation by compound stops.* These compound stops were a monster in the path of the old musical theory, which was acquainted only with the prime tones of compounds; but the practice of organ builders and organists necessitated their retention, and when they are *suitably arranged and properly applied, they form a very effective musical apparatus*. The nature of the case at the same time fully justifies their use. The musician is bound to regard the tones of all musical instruments as compounded in the same way as the compound stops of organs."

To make this matter still clearer to the reader—and it is desirable he should clearly understand it—I give a further quotation from the learned writings of Helmholtz: "On exactly and carefully examining the effect produced on the ear by different forms of vibration, we meet with a strange and unexpected phenomenon, long known indeed to individual musicians and physicists, but commonly regarded as a mere curiosity, its generality and its great significance for all matters relating to musical tones not having been recognised. The ear, when its attention has been properly directed to the effect of the vibrations which strike it, does not hear merely that one musical tone whose pitch is determined by the period of the vibrations in the manner already explained, but in addition to this it becomes aware of a whole series of higher musical tones, which we will call the *harmonic upper partial tones*, and sometimes simply the *upper partials* of that musical tone, in contra-distinction to that first tone, the *fundamental* or *prime partial tone* or simply the *prime*, which is the lowest and generally the loudest of all, and by whose pitch we judge of the pitch of the whole *compound musical tone*, or simply the *compound*. The series of these upper partial tones is precisely the same for all compound musical tones which correspond to a uniformly periodical motion of the air. It is as follows:—

"The first upper partial tone is the upper Octave of the prime tone, and makes double the number of vibrations in the same time. If we call the prime *c*, this upper octave will be *c'*.

"The second upper partial tone is the Fifth of this Octave, or *g'*, making three times as many vibrations in the same time as the prime.

"The third upper partial tone is the second higher Octave, or *c''*, making four times as many vibrations as the prime in the same time.

"The fourth upper partial tone is the major Third of this second higher Octave, or *e''*, with five times as many vibrations as the prime in the same time.

"The fifth upper partial tone is the Fifth of the second higher Octave, or *g''*, making six times as many vibrations as the prime in the same time.

"And thus they go on, becoming continually fainter, to tones making 7, 8, 9, &c., times as many vibrations in the same time as the prime tone. Or in musical notation where the figures beneath show how many times the corresponding vibrational number is greater than that of the prime."

From the above particulars the true office of the *Mixtures* in the organ can be clearly realised, as well as the necessity for their introduction. I consider the advisability of keeping them soft in tone, so that they may simply corroborate the natural harmonics of unison sounds, is also satisfactorily proved by Helmholtz. Much more might be said in favour of the introduction of one or more *Mixtures* in every Church Organ; but space prevents a longer treatment of the subject here.

(*To be continued.*)

REVIEWS.

The Gas Engine. By DUGALD CLERK. London: Longmans.

NO one has done more than Mr. Dugald Clerk to explain in theory and practice the gas-engine, and no one has written a better book on the motive-power engine which is steadily coming to the front as the best of motors where only a moderate amount of power is required. The work opens with an historical sketch of the gas-engine from 1690 to 1885, the earlier date referring to the experiments of Huyghens and Papin; but, as Mr. Clerk says, the gun-powder-engine cannot really be classed as a gas-engine, which dates its invention from Robert Street's patent, No. 1,983, 1794. In that we have a motor-cylinder with a piston connected to a lever, which drives a pump. The bottom of the motor-cylinder is heated by a fire, and a few drops of turpentine are vaporised, when air is admitted to the cylinder, and a flame applied—the result being an explosion. The idea is correct, and was not improved upon until lately; but the inventions of Samuel Brown in 1823 and 1826 are of more importance, for his vacuum gas-engine was the first which is certainly known to have done actual work, and in some important points it has attained a measure of success not yet equalled. The first practicable engine was that of Lenoir, in 1860, since which date great advances have been made. In his first chapter Mr. Clerk discusses the gas-engine method, in his second he classifies the gas-engines, and in the third he considers the laws of thermo-dynamics as applied to the gas-engine, quoting Rankine, Schöttler, and Witz. This last-named chapter will be skipped by many readers; but the reader who wishes to thoroughly comprehend the subject will endeavour to understand the formulæ, and will be well repaid for his trouble. Chapters IV., V., and VI. deal with the causes of loss in gas-engines, with combustion and explosion, and with explosion in a closed vessel, and if the reader has followed the author with care and attention, he is prepared to comprehend the illustrated descriptions of the different types of engines which occupy nearly 90 pages, and include,

amongst others, the Otto, the Clerk, the Atkinson differential, and the Brayton petroleum engine. These are described as fully as need be; but the chapter which will most interest those conversant with the general construction of the gas-engine is that in which the igniting arrangements are described. As Mr. Clerk pithily says, "quite a number of witnesses, in the shape of unworkable gas-engines, in many engineers' workshops throughout Britain attest silently but emphatically the difficulties of the igniting valve." Mr. Clerk has done his best to remove these difficulties by means of illustrated explanations of the successful methods adopted, and while expressing the opinion that the flame methods are best suited for small gas-engines, he suggests that probably a combination of the flame and incandescence methods will remove the risk of extinction from draught. As regards the electrical methods, he is clear that they give too much trouble and are at best uncertain. Next to the igniting arrangements, the governor and starting gear are the most important details in connection with gas-engines; and Mr. Clerk devotes considerable attention to the devices already in existence, and does that in such a manner as to render his remarks useful to future inventors. Chapter X. deals with the theories of the action of the gases in the modern gas-engine, by which it will be understood that the subject is not clearly comprehended at present; while the concluding chapter refers to the future of the gas-engine, and in that Mr. Clerk takes the opportunity to say that the position of the gas-engine, as we know it, is mainly due to the patience, energy, and commanding ability of one man—Mr. Otto. We have not attempted to do more in this brief notice than give an idea of the contents of this book, and we can conclude with the statement that it is the best work on the gas-engine that has been published.

The Age of Electricity from Amber-Soul to Telephone. By PARK BENJAMIN, Ph.D. London, Paris, New York, and Melbourne: Cassell and Co., Limited.

THE author of this work, Dr. Park Benjamin, a well-known American writer, tells us that it is not a technical treatise, nor is it addressed in any wise to the professional electrician: it is, in fact, a popular account of the rise and progress of electrical science, into which only such technical terms as are in daily use have been introduced. In dealing with historical data, Dr. Benjamin has, when possible, gone to contemporary publications, and in many cases to the original writings of the discoverers themselves, while in his search after facts he has ranged through all the available literature, from Boyle's little pamphlet published in 1675 to the latest numbers of the electrical serials. Electrical like many other great inventions are, as a rule, the outcome of the labours of many men, and it is not easy to define the exact status of each. Dr. Benjamin says, "It is a singular fact that probably not an electrical invention of major importance has ever been made, but that the honour of its origin has been claimed by more than one person." The title of "father of the telegraph" is, he says, given to Wheatstone in England (not generally, it should be observed), and to Morse in the United States, "although to neither of these inventors, but to Joseph Henry, the lasting gratitude of the world belongs." Even Dr. Benjamin does not seem to be aware of the part played by Dr. Edward Davy, an Englishman who emigrated to Australia and died there not long ago; but it is unprofitable to inquire into the matter, for as we know in connection with the telephone, it is the man who succeeds in making an invention a practical success that is regarded as the discoverer. As its title implies, Dr. Benjamin's work deals with the electrical appliances which have been adapted to the service of man, and it gives all readers a good idea of the wonders that have already been accomplished, while in not a few it will inspire at least an inclination to pursue some branches of the subject further into detail. In future editions certain slips of the pen will no doubt be corrected; for instance, in the description of the Bunsen cell on p. 52, where it is stated that the carbon is immersed in bichromate solution; but errors in detail are of small moment in a work of this kind, the object of which is to present to the general reader a broad view of the "age of electricity." The book will be found to be an appreciated gift by the youths of both sexes.

Lives of the Electricians: Professors Tyndall, Wheatstone and Morse. By WILLIAM T. JEANS. London: Whittaker and Co.

THIS is the first volume of a series of the "Lives of the Electricians," and its object is to tell incidentally the story of the progress of the electric telegraph from its origin in 1837 to the present time. The present is the jubilee year of the telegraph, and the choice of "electricians" for the first series is thus accounted for—though it is customary to regard Prof. Tyndall as a physicist rather than as an electrician, albeit he has extended, and let us hope will still extend, our knowledge of magnetism. The lives of Wheatstone and Morse are written in a readable style by Mr. Jeans, who embodies in his narratives many facts of historical interest, and a good deal of controversial matter which must almost of necessity form part of a work which is intended to be also a sort of history of the electric telegraph. In speaking of Morse, Mr. Jeans says that his "ingenuity and perseverance gave to the world one of the most original and useful methods of conveying intelligence by electricity," a sentence which does not claim too much for Morse; while for Wheatstone may fairly be claimed the title of "father of the telegraph." The fame of Wheatstone, however, does not rest on one or two achievements, and the story of his life, as it concerns his inventions, is well told in this work, wherein some erroneous traditions are relegated to their proper positions.

Hours with a Three-inch Telescope. By CAPT. W. NOBLE, F.R.A.S. London: Longmans.

THIS little work is, as its author says, a "primer of the Three-inch Telescope," an instrument which in the shape of the popular "five-pounders" has found a large number of purchasers of late years, for whom such a work was much needed. It is, in fact, designed to instruct the beginner with a telescope which is devoid of elaborate accessories, and is mounted on a common table-stand. To a large extent it is a reprint of papers which originally appeared in *Knowledge*, and an observer with moderate eyesight and a telescope of 3in. aperture of fairly good quality, should be able to see and do everything described by the author, who will be pleased if his endeavours to teach should lead the amateur to pursue his studies with superior instrumental means, and Webb's "Celestial Objects," to which work the present is in several senses a stepping-stone. If the young astronomer will carefully read the directions given by Capt. Noble, and carefully work through the observations as occasions and the seasons offer and the weather permits, he will acquire a very respectable knowledge of the solar system and the starry heavens, and will be anxious to obtain a more powerful instrument as soon as possible. Not that a 3in. telescope is so very small, for this work will show the reader that a great deal can be seen with it. The book is freely illustrated, and a neat map of the moon forms an appropriate frontispiece. It is just the book to give the beginner with the telescope.

Gas-Fitting. By JOHN BLACK. London: Crosby Lockwood and Co.

THIS work is an addition to Weale's Rudimentary Series, and gives practical details of a handicraft which is rarely described in manuals of technology. The author tells us that the gas-fitter is in as great request to-day as at any time, and he evidently thinks that he will be wanted for some time longer. Mr. Black treats his subject in a workman-like manner—that is, he puts before his readers something to be done, and then tells them not only how it should be done, but also how to do it, illustrating his remarks with useful diagrams where they will help to elucidate the matter. The directions are full, and separate chapters are devoted to special branches, such as fitting up workshops, theatres, churches, shops, and cooking-stoves. A "Word to Consumers," as the last chapter is entitled, will be useful to many, especially if those who take a light to look for an escape of gas will remember what they can here read.

Safe Railway Working. By CLEMENT E. STRETTON, C. E. London: Crosby Lockwood and Co.

MUCH of the matter which this work contains has already appeared in substance in our pages; but Mr. Stretton has rendered his book complete by supplying diagrams of continuous brake arrangements and of systems of signalling. There is also a good deal of historical information put in a concise form, and much that concerns railway servants in relation to the law. The book should be studied by all members of Parliament, and if those whose business it is to comment on railway accidents in the daily press would read it their articles might be read with more attention than they now are by those conversant with railway working.

We have also received *A History of the University of Oxford*, by the Hon. G. C. BRODRICK, D.C.L. (London: Longmans), an attempt to present in a succinct form the history of a University which is among the oldest institutions in Europe. The work is of interest to all Englishmen, and will be valued by all Oxonians.——*Trusses of Wood and Iron*, by WILLIAM GRIFFITHS (London: Crosby Lockwood and Co.), will be found useful by students in Building Construction, and by architects and builders, the drawings being practical and clear.——*Expansion of Structures by Heat*, by JOHN KEILY, C.E. (London: Crosby Lockwood and Co.), is a volume which deals in a practical way with a matter that is too often neglected, and which is not often referred to in detail in works on construction. The book will be useful to architects, engineers, and builders. ——*Outlines of Quantitative Analysis*, by A. HUMBOLDT SEXTON (London: Charles Griffin and Co.), is intended for students who have but a limited time to devote to the study of practical chemistry.——*Historic Towns, London*, by W. J. LOFTIE, B.A., F.S.A. (London: Longmans), is one of a series of volumes edited by E. A. Freeman, D.C.L., and Rev. W. Hunt, M.A., and will be read with interest by all who regard London as the centre of the world. The work refers to many matters which are comparatively unknown or have been forgotten, and is illustrated by maps of parts of ancient London.

We have also to acknowledge *The Mechanics of Machinery*, by ALEX. B. W. KENNEDY (Macmillan); *The Portable Engine*, by WILLIAM DYSON WANSBROUGH (Crosby Lockwood and Co.); *The Conversion of Heat into Work*, by WILLIAM ANDERSON, M.Inst.C.E. (Whittaker and Co.); and *Practical Handbook of Pump Construction*, by PHILIP J. BJORLING (E. and F.N.Spon—) all works deserving of lengthy notice.

BUDENBURG'S RECORDING GAUGES.

A NOVEL improvement for use with pressure and vacuum gauges has been recently patented by Mr. A. Budenburg, of Southgate, Manchester. It has for its object the securing of a permanent record of the maximum pressure or vacuum indicated by the gauge to which it is attached. Hitherto it has been sought to secure such a record or indication by the use of an independent index finger or "maximum pointer," but in the case of a sudden increase in the amount of pressure or vacuum the maximum pointer is liable to be jerked or thrown beyond the actual point on the graduated scale reached by the true index finger, and an excessive indication is thus given. The improvements consist in attaching to the index finger of the gauge a light pen, pencil, or scribing point, and in securing to the dial, or in a plane parallel with the dial and concentric therewith, a disc of paper, card, or other suitable material upon which the pen may trace a legible curve. The disc of paper or other material may be, and by preference is, graduated to correspond with the scale on the dial of the gauge. If the disc is placed below the index finger, a part of the disc may be cut away so as to allow it to pass the index spindle, and it may be secured in position by a spring cap, by needle points, by catches, or other suitable means. By this arrangement the curve

FIG. 1.

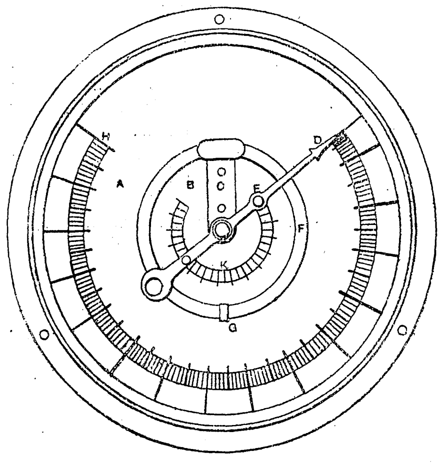
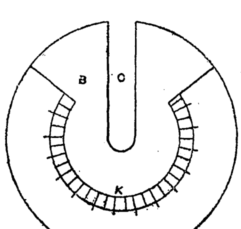


FIG. 2.



traced by the pen, pencil, or scribing point will correspond exactly with the amount of angular motion of the index finger and the maximum pressure or vacuum will be correctly indicated by the end of the curve.

Fig. 1 represents in front view a pressure gauge having these improvements applied thereto, and Fig. 2 gives in plan a representation of the disc of paper or card upon which the record of maximum pressure is taken. A is the dial of the gauge; B is the disc of card or paper upon which the record or trace is taken; C is a strap connecting the spindle with the ring F, and keeping it concentric therewith; D is the index finger, carrying at E a pencil or tracing point which bears upon B and traces thereon a curve the length of which is determined by the motion of D; F is a ring which serves to hold B in position; G is a lock or catch; H the graduation of the gauge, and K the corresponding graduation of B. The disc B is firmly held in position by the slot C, Fig. 2, and the strap C, Fig. 1, in combination with the ring F, which may be in halves, connected or disconnected at G, for the insertion or removal of the disc, or which may be hinged or pivoted at the outer end of C and be held or released by G. Alternatively the ring F and strap C may be fixed to the dial, and the disc be held in position by contact therewith. The pencil carried on the index finger traces a curve the extremity of which indicates the extreme pressure reached. The disc may be changed daily or at other convenient intervals, and to prevent tampering therewith the cover or front of the dial should be locked.

THE AMATEUR WORKSHOP.—XXXII.

Brass Foundry.—(*Continued.*)

THE particular sands used in brass moulding differ according to locality, and the best method for an amateur to adopt is to purchase such small quantities as he may require of a neighbouring founder. For the body of a mould the old floor sand which has been cast in over and over again is used; but the mould faces—that is, those portions next the pattern—are made with new sand, the latter extending to a depth of $\frac{5}{8}$in. or $\frac{1}{2}$in. only. The mould itself is faced with plumbago, or with oak charcoal, called blacking, or blackening, dusted on and sleeked over with trowel or sleekers. Flour, or pea-flour, are also used. The purpose of this is to prevent the burning of the sand into the casting; but if the blacking is of an excessive thickness—that is, beyond a mere film—scabbing will occur. Coal dust, ground up fine in a mill, is mixed with new sand previous to use, to render it porous. Sand once cast in becomes mixed with that on the floor, which is prepared for using over again by moistening with water from a watering-pot, and mixing with a shovel until it is uniformly damp—not wet, nor anything approaching to it, but just sufficiently damp to cohere; so that when a portion of sand is picked up and squeezed between the hand it does not fall apart on releasing the pressure, but retains the shape received. This watering and remixing is necessary after every casting, because the sand becomes dried and pulverised in contact with the hot metal.

The partings or joints between moulds are prevented from adhering by a sprinkling of parting sand, which is either the burnt sand scraped from the surfaces of castings, being of a red colour, and very loose and free, and, of course, perfectly dry; or brickdust simply.

The floor of the foundry is constituted wholly of the old or black moulding sand, while the facing sands are kept in suitable smaller bins or boxes. In a small workshop the black sand may be kept in the moulding trough, and the others in boxes at hand. Blackening is kept in a muslin bag in readiness for dusting over the moulds. Plumbago is kept in an open box, and taken up with the trowel or with lifters, and brushed over with a broad camel-hair brush before finally sleeking. Whiting or lime is kept in a bag, and dusted over the tops of cores when in place, or on the joints of moulds which have been uncovered, so that when the top part is replaced the transference or non-transference of the lime or whiting indicates whether or not there is contact between the joint faces of the bottom and top parts, or the drag and cope, as they are respectively termed. An iron pot, called a swab-pot, and a soft brush are kept at hand for watering the edges of moulds previous to the withdrawal of a pattern, and for mending up broken edges. A common pair of kitchen bellows are used for blowing out particles of sand which have fallen into the moulds, and for clearing the faces of patterns from parting sand. There should be a couple or three sieves, say 8, 16, and 24 mesh, a shovel, a couple of wooden rapping mallets, and a stove lined with brick, and closed with a sheet-iron door, for the drying of small cores. For an amateur's use, it may measure 2ft. by 1ft. by 1ft. inside, and be placed in any convenient situation over a common firegrate, constructed specially to supply the requisite warmth.

I cannot pretend to enter into a description of the art of moulding itself in these articles; but in the compass of a few paragraphs I will jot down some essential facts, of the nature of first principles, which, if understood and regarded, will go a long way towards helping an amateur in the requirements of this kind of work.

Perhaps the best plan will be to give two or three practical examples, and make these the medium for conveying the general instructions, and I shall select, therefore, only such articles as are likely to come within the range of the tasks undertaken by home workers. First, then, as a case of simple moulding, take a common brass bearing. This requires a two-parted box, and the journal face will be cast downwards. Hence, get a flask A (Fig. 370), of nearest size suitable, fill it with sand just roughly rammed in; bed in the pattern, sloping and smoothing the sand upwards from the hollow of the brass to the joint face of the box, as shown in the figure, first using the fingers, afterwards the trowel. Strew some parting sand all over the joint face, place on the drag B, Fig. 371 (empty, of course, and not as it appears in the figure), or that which is to be the bottom part of the flask in the mould; cover over with facing sand to a thickness of $\frac{1}{4}$in. or $\frac{3}{8}$in., the sand being worked by the hand through a fine sieve held over the mould. Throw in a shovelful of floor sand, and ram the pattern up, first with the pegging and then with the flat rammer. The knowledge of the precise amount of force required for ramming must be gained by practice. It should be only moderately hard; but as "hard" as a relative term, first watch a moulder at work, imitate him, and profit by failures. Hard ramming produces scabbing; soft ramming, lumpy castings. The sense of touch is relied on mainly for proper ramming, and the sand is levelled roughly by the left hand, or by the rammer as the process proceeds, and fresh sand filled in as required. Lastly, scrape off the superfluous sand level with the top edge of the box. Pierce it with some scores of vent holes with an $\frac{1}{8}$in. wire, allowing the wire to touch, or all but touch, the pattern each time.

Now turn over the two boxes, bringing box A, in which the pattern was embedded, uppermost; lift it off, leaving the pattern as shown at B, Fig. 371; knock out the sand from A, sprinkle the joint of the half mould in B with parting sand; replace box A, stick up a runner pin as shown dotted, Fig. 371, *a*, and ram up box A over the pattern similarly to B, that is with facing and with black sand; vent and level off. Scrape out a hollow cone with the trowel around the head of the runner pin, tap and loosen the pin, and draw it out. Lift off the cope A, stick a spike in the pattern and withdraw by gentle rapping and lifting combined. If the edges are slightly broken away in the process, moisten and make up the sand good. If they are broken badly, put in the pattern and make good to the pattern outline. If very bad, knock out the mould and run over again. Dust blacking over from the bag, or use plumbago, smooth with the sleeker of the nearest shape, and close ready for casting. Weight down, or clamp, as most convenient. If weighted, a patch of sand is levelled on the floor, the box laid down upon it, a slight slewing motion imparted to insure true bedding, and if of any considerable size, the vent wire is thrust several times between the bed and the bottom of the box to establish a communication between the vents in the lower portion of the mould and the outer air.

As one illustration of a pattern made in halves, and of a three-parted mould, I take the body of a common plunger pump (shown in Vol. XLI., page 205). In this the pattern joint of the half A is laid either on a truly strickled sand bed in the box part, as shown in Fig. 372, or on a bottom board, that is, a flat piece of board which fulfils the same purpose to the moulding box and pattern laid upon it that the sand bed in Fig. 372 does. The box B, Fig. 373, is then rammed over it, and vented precisely as described already. This box is then turned over into the position shown in the end view Fig. 373, and parting sand sprinkled; the half pattern C is laid upon half-pattern A, the middle part D put over and partly rammed up. But before completely filling the box the dowelled flanges *b*, are put on in place, and the sand tucked around and under them, and the whole rammed level with their top faces, if those faces happen to coincide with the top joint of the box part. If not level, the body of sand is rammed level with the box joint, and a sloping sand joint sleeked down to the faces of the feet. This frequently happens, and I have shown such an illustration (Fig. 375). After venting, the joint is sprinkled with parting sand, and the top E put on and rammed level and

FIG. 370.

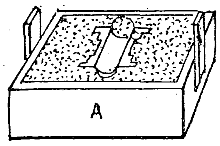


FIG. 373.

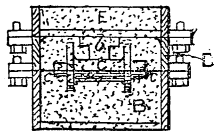


FIG. 378.

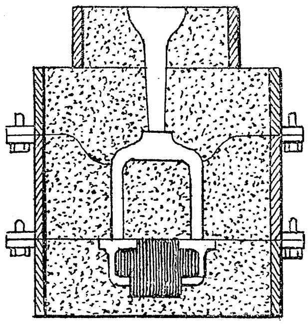


FIG. 377.

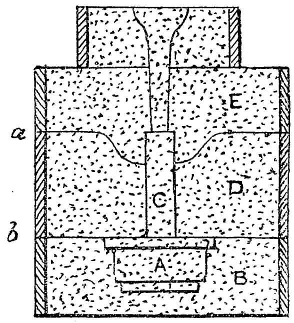


FIG. 371.

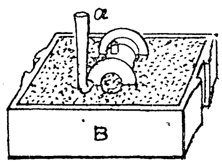


FIG. 372.

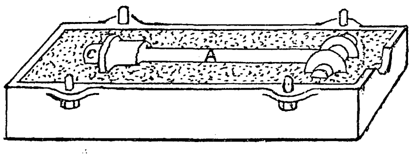
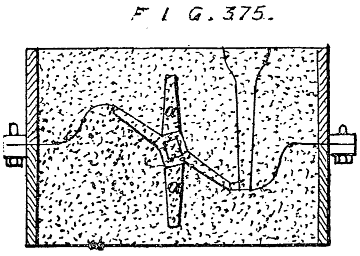


FIG. 375.



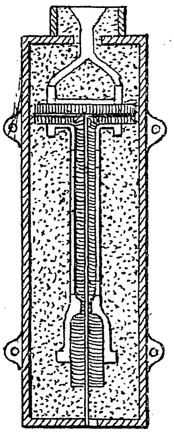


FIG. 374.

FIG. 380.

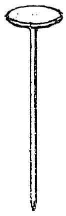


FIG. 376.

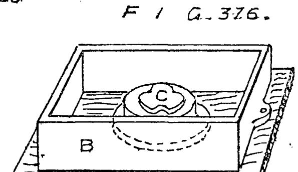


FIG. 381.

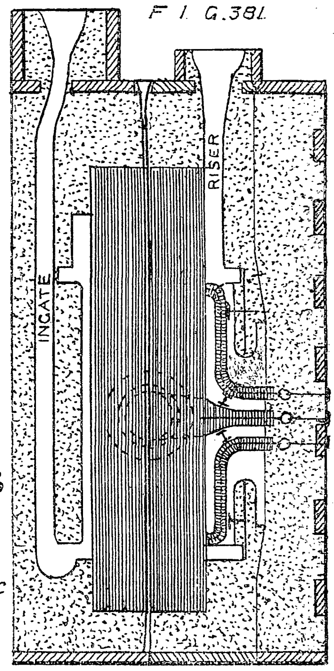


FIG. 379.

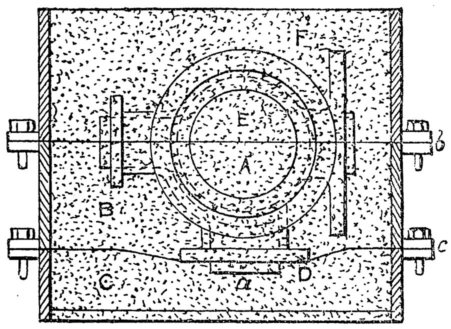
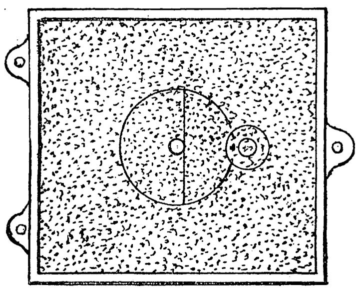


FIG. 375.



vented. The boxes are then separated: the top E lifted first, then the two feet b withdrawn upwards; the middle D taken off, lifting with it the top half C of the pattern. This box being turned over and laid on supports, the top half of the pattern C is lifted from the joint, then the bottom half A is taken from the mould B. If the edges become broken—as, for instance, between the feet and the body, where the sand is thin and weak—ordinary cut brads or sprigs must be thrust in to bind it together and assist the mending up. Lastly comes the coring up. Cores are made with a free and "strong" sand, having mixed with it coaldust and horse-dung. Being dried in the oven, the burning out of the coal and dung leaves a remarkably hard yet porous mass. Cores are further vented by ramming up a wire or two within the sand of which they are composed, and withdrawing it before drying. The shapes of core boxes are familiar to those who have seen these articles; for this one in particular see the p. 205 just now referred to. Our mould being finished, therefore, the core is dropped into the impression made by the points c, c, c. The pump being properly cast on end, a hole is shown in the end of the box through which the runner is taken, the sand being cut away with the trowel for that purpose. Being cast on end, the box would be held together with clamps of wood or iron, and either stood leaning against a support or more properly sunk a little distance into a hole dug in the sand floor. Fig. 374 shows the mould arranged for casting. Remark also that though the runners are in the figure brought into the top of the mould as being suitable for shallow castings, if this pump were long I should put the runner in as shown in Fig. 381, and in connection with that figure I shall state the reason for doing so.

I have shown the box (Fig. 373) with flat bars in the drag, vertical bars in the cope, and no bars in the middle, which is the usual type. This is to be taken merely as illustrative of that type, since most small boxes for brass founding are without bars at all (see Fig. 356, p. 362). In cases where it is desirable to give support to the sand beyond that due to its own coherence, square rods of iron, or bars of wood are driven in between the box sides, bridging them across.

Fig. 375 shows the method of moulding an ordinary throttle-valve. The sand joint is cut down to correspond with the bevel of the edges of the valve, so that it and the chucking pieces a a shall lift vertically from the mould. This forms an example of jointing other than that in a horizontal plane. Though the joint of the box remains horizontal, the sand joints vary with circumstances, being in this and many such cases made to assume a slope approximating to the vertical. Such joints, with parting sand or brown paper intervening lift without becoming broken or damaged to any serious extent.

Fig. 376 shows the jointing of a pump bucket. The body piece A is laid bottom upwards, and box B laid over it, and the sand rammed while in that position, Fig. 376; then turned over, and the arch C, Fig. 377, is put on with dowels, rammed up in box D, and the sand joint made as shown in the two views; lastly, the top box E is rammed from this joint upwards. These joints indicate also the way in which the taper should be given: all from a upwards being slightly tapered upwards; from a to b being slightly tapered downwards; and all below b being also tapered in the same direction. In Fig. 376, C represents the core print, while Fig. 378 shows the mould cored up and closed, ready for running through the ingate.

So many make small model cylinders in brass and iron, that perhaps I cannot do better than conclude the subject of brass founding with an illustration of this kind, the description being suitable for any small cylinder of not more than a few inches in bore, and having the parts and feet arranged not very differently from Fig. 379. First, the half A is laid by its face joint on the face of a sand bed, or on a bottom board, as noted previously, and rammed up in box B. Over it is laid box C, in which the face of the flange D, with its port prints a are rammed, having regard to the partings and venting. The whole is then turned over, the half E laid on A by means of dowels; a round runner laid in the joint in the position shown in Fig. 381, and the top box F put on and rammed. If a two-parted box alone is available, the face of D and a can be made in a dry sand core, or piece of loam cake embedded in the sand of the box, the jointing edges being sloped, and replaced in the same position after the withdrawal of the pattern. The moulds being taken apart, F is drawn from joint face b, D from joint face c, A from joint face b, and the moulds mended up and cleaned. They are either dried, if made in core or dry sand, or only skin-dried for a few minutes; the latter being sometimes done in small work, though always risky in cylinder work, where the cores are numerous, and several faces have to be machined.

Cores are vented as before mentioned, by ramming wires in their body and withdrawing them previous to drying, the wires being proportional to the air-space required. They need not be large, since the core sand itself is, as already stated, in itself very porous, and the wire or vent-hole or holes simply carry off the gas which is driven from the exterior of the core to the central portions, and so convey it as by a main channel to the outside of the mould. With an inch core, for example, a $\frac{1}{4}$in. or $\frac{5}{16}$in. central hole is large enough. If the cylinder in our example were of 3in. or 4in. bore, a $\frac{1}{2}$in. or $\frac{3}{4}$in. rod would be big enough, and the core would be made from an ordinary box. With core bars and hay bands, of course, we have nothing to do in small work. When we come to the port and exhaust cores, these are weak and fragile, and hence, wires must be rammed up and left in them until after casting, to afford them the necessary support. They are withdrawn from the passages after casting by means of pincers, the flexibility of the wires (soft iron) allowing them to straighten themselves in the act of pulling out. Thus, for example, if the port cores were only $\frac{1}{4}$in. thick, the wires could not be more than a

full ½in. diameter, if the ports were ⅜in. or ½in. the wires could be ⅛in. They are first bent to the shape of the interior curves of the box and bedded in the sand during the ramming up, being kept as nearly central as possible. The central wire of all should be formed into a loop at the front end. These are different from the venting wires, since the latter have to be withdrawn, and in the case of slight curved cores, string is used for venting instead of wire, which would break the cores on withdrawal. The string is laid in the cores similarly to the wires, and withdrawn while the core is green. The cores are blacked with blackwash—that is, plumbago and water, or coal-dust and water, and dried.

Now the moulding-box being open at b (Fig. 379), and the valve face downwards, put in the two port and the exhaust cores into the prints on the valve face. These will each rest in one, or on a couple of studs or chaplets of the shape of Fig. 380, being simple moulding nails made of malleable iron, tinned if for cast iron, or brass nails if for brass. Before, however, these are put in, the thickness of metal between the core and the mould is checked by means of a clay thickness piece—that is, a piece of clay made pyramidal in form, rather higher than the required thickness of metal, and laid in the mould. When the main core is laid into its prints it presses the passage cores gently downwards, and with them the yielding clay beneath, until the main core finds its bearing in the prints. Then the clay is taken out, and its thickness checked, and if necessary to bring the thickness right, the cores are fudged by filing or rubbing. The thickness of metal in the body of the cylinder is also checked in the same way, to see if it be equal in top and bottom. When the cores are such as to give correct thicknesses the stops are driven into the sand, resting against the bars of the box, if possible, or, if not, in cubical wooden blocks embedded in the sand beneath, and the cores put in finally. Sometimes stops are put in to support the sides of the passage cores as well as at the back. If the curve of the core matches that of the cylinder core, and the two are kept close together by the hinder chaplet, there is little risk of their being washed aside. Chaplets may also be put between the passage and exhaust cores, but should never come against machined faces, as the cylinder bore and the valve face.

Cores being vented, there should be no chance of the vent-holes becoming choked up by the liquid metal. This is liable to happen if the cores do not abut closely; hence it is the practice, after the cores are put finally in place, to cement the ends closely with sand and black wash, moistening the bad or broken edges with water previously, and drying the mended part in place with a charcoal fire, or a mass of hot metal suspended over it for a few minutes. An important point also is that the coring up should be done not long previous to casting, so that if a mould is made a few days previous to casting, the cores will not be put in until, at most, a few hours before casting; the reason being that the cores absorb moisture rapidly from the atmosphere, and damp cores cause blow-holes.

Fig. 381 shows the cylinder ready for casting, with the cores anchored and chapleted securely. The ingate goes to the bottom of the mould, so that the metal shall not dash violently down, but rise slowly, carrying the sullage upwards into the head metal. The same method is pursued in Fig. 375. In Fig. 378 the runner answers the purpose of head metal to the boss of the bucket, which has to be bored. In Fig. 374 the position of the runner is not the best for casting on end, but as an alternative mode for castings not very deep. In Fig. 371 the runner could be indifferently placed in any position.

PROGRESS OF ELECTRIC MOTORS.

THE following paper by Mr. T. C. Robbins, of Baltimore, who has been intimately connected with the most successful electrically-worked tramway in America, was read recently before the American Street Railway Association. There is little reference to what has been done in this country: but as an historical *résumé* of the subject with some valuable notes of the present position of electric haulage it is an interesting document. Although termed a "paper," it is really a report of a committee.

In searching for the first experimenter in the field of electric locomotion, it very soon becomes apparent that extreme difficulty will be experienced, due to the great number of visionary experimenters which seem to be attracted to this branch of physics. Though the experiment of Jacobi on the river Neva in 1834 certainly demonstrated the possibility of producing a not inconsiderable force by electrical means, a casual inquiry as to the cost of the experiment conclusively proves that very little hope remained of its application assuming a commercial form so long as chemical decomposition was the only recognised means of exciting electricity.

It remained, however, for later scientific investigators to point out that this was not due so much to the inefficiency of the producer as the exceeding crudity of the receiving apparatus and the necessary high cost of the electric fuel, so to speak, which in this case, as in many subsequent cases, was zinc. In view of the really discouraging character of this experiment regarded as even a possible commercial achievement, it is surprising that many inventors could have been found sufficiently bold to make any other attempts until radical changes had been made in the producing force; but history records that a number of other daring experimenters attempted to supplant the steam locomotive within the next decade. It is not, however, recorded that a sufficiently hopeful result was obtained at this period to be regarded as anything more than an interesting scientific display.

The intervening experiments were hardly worthy of record until the year 1860, when Prof. Page made the first recorded experiment of any note, with batteries having carbon plates in place of the inferior copper ones formerly employed. It is recorded that by means of his improved apparatus, Prof. Page was enabled to drive a car-load of passengers through the streets of Washington with an electric locomotive, travelling at the rate of 20 miles an hour. Though it is quite possible the speed is here exaggerated, and that the car-load of passengers was propelled only on the level, which would not necessarily call for a powerful effort, it is still noticeable that such an achievement was possible simply by the use of batteries and the imperfect apparatus of that time, in a manner sufficiently satisfactory to have attracted a number of business men, who for some time anticipated great results. It is now evident that nothing of a commercial nature could possibly have followed with the means at command; and though a number of more or less successful experiments of a similar kind were made, nothing of sufficient importance to even promise a commercial result occurred until the year 1879, when Messrs. Siemens and Halske, of Berlin, operated a small electric railroad of about one-third of a mile in length at the Berlin Exhibition, employing an auxiliary conductor between the rails, from which the current was taken up by means of a metal brush and transferred to the motor in the now well-known manner. Several more of these small locomotives, being rated at one or two horse-power, were made during the years 1879 and 1880, and it is recorded that with this apparatus the current was sufficiently powerful to throw horses when accidentally placed in contact with the third rail. These latter experiments partook of a much closer approximation to the commercial character, for the simple reason that during the interval between Prof. Page's test and that of Messrs. Siemens and Halske the greatest advance yet recorded in electric locomotives had taken place—namely, the introduction of the mechanical producer or dynamo machine, which, apart from the details involved, rendered possible the substitution of coal for zinc as a fuel. That the energy of the former had now to be passed through a steam-engine was a comparatively important detail, considering the enormous disproportion between the energy produced from coal and zinc, from a financial standpoint; and though the inefficiency of the engine as a thermo-dynamic motor militated strongly against the complete triumph of this new order of things, the extraordinary efficiency of the infant dynamo operated in great measure to place the new power on a commercial basis. Indeed, so wonderfully efficient were even the earlier dynamos manufactured by Messrs. Siemens, that the first recorded results proved indisputably that under such favourable conditions as those which Messrs. Siemens were able to avail themselves of, competition with horseflesh seemed possible even from the first, though it was a daring man who in these times would even hint at competition with steam and other well-known converters.

The little machines above noted were so satisfactory in their operation that they were quickly followed by an electric railway for actual business traffic, which was constructed by Messrs. Siemens and Halske, between Lichterfelde and Military College, Berlin. The electric motor or car on this road was built so as to closely resemble the ordinary European tramcar, and the motor was attached under the floor. It is recorded that the performance of this car was eminently satisfactory in dry weather, but considerable difficulty was experienced in operating in wet weather, until several changes had been made in the manner of conducting the current, it being subsequently found necessary to use an overhead conductor, which is the first recorded example of this kind, and appeared to be so successful that the road has continued running without any radical changes up to this time. It must, however, be remembered that the power required was very small, since the road is entirely level from end to end, and the car was limited in size, being only able to carry about 25 persons when fully loaded.

Passing over a number of minor experiments which followed this achievement of Siemens on the other side, the first notable example after that of Prof. Page's in this country appears to be the electric locomotive of Thomas A. Edison in the summer of 1882, which is said to have attained a speed of nearly 40 miles per hour on a level track at Menlo Park, New Jersey. The experiments were conducted for a considerable time, but do not appear to have been of a character sufficiently encouraging to warrant any attempt in a commercial way, and no machines of this type were ever placed on a commercial road. The manner of taking up the current was similar to what had before been tested by Siemens in Berlin, and afterwards abandoned as not affording sufficient insulation in wet weather.

Later in the year 1882, Leo Daft constructed a number of small electric locomotives, which were tested and run for a considerable time on a track provided at the works of the Daft Electric Light Company at Greenville, New Jersey, which were the first recorded example of a number of locomotives (there were four employed at one time) running on the same track at the same time, from the same generating apparatus; and a number of experiments were conducted from time to time for the satisfaction of a large number of visitors, among whom were many electrical and engineering experts, to prove what was then a matter of considerable doubt, that locomotives could be run in parallel from a producer of sufficient capacity. This was so completely demonstrated at that time that in this direction no further doubts existed, though it seemed to be for a long time the standing objection to the progress of this new enterprise from those who were less familiar with the true inwardness of this problem. On these occasions the four cars were purposely manipulated in the most difficult manner, being all started at the same time as nearly as possible, and all the evolutions which a most exacting audience demanded were made without at any time showing the least reason to doubt that the system was capable of indefinite extension on the same lines. Not the least extraordinary of the effects which constant experiments developed was the remarkable tractive capacity of the motors when operated with insulated wheels and using both rails as the conducting system. It was clearly shown that a small locomotive weighing but 450lb. was capable of developing the extraordinary tractive force of 300lb. on a dry rail. This was repeatedly demonstrated, and the subsequent experiments with the same apparatus developed the astonishing fact that it was capable of ascending a gradient of 2,900ft. per mile without any extra tractive appliances whatever, with a driver weighing upwards of 150lb. to add on the car. It will thus be seen that an effect was arrived at contrary to anything which may be evolved from the coefficients of Molesworth. There have been many opinions as to the cause of this; but the fact remains that the above achievement was repeated day after day before a large number of technical persons, and can, of course, be repeated at any time, though it is not possible to reproduce this effect on the large scale required by commercial practice, for reasons which cannot form a part of this paper. The increased traction under favourable conditions is not by any means an unimportant feature in considering the relative weight and energy of a given motor. In the fall of 1882, an experiment was made at Chicago national exhibition of railway appliances with a motor consisting of a Weston machine placed upon a platform car and driven by a second Weston machine, by means of two copper conductors placed near the track. This car travelled on a circular track under cover without any gradients, and, as might have been expected, created a favourable impression among the spectators, though it would not be classed with commercial performances, since the energy required was comparatively insignificant; it served, however, to keep up the public interest in matters of that kind, and was so far successful.

In February of the following year, it is recorded that a motor weighing 300lb., constructed by Chas. J. Van Depoele, was put in operation at the works of their company, and operated a car which is stated to have been capable of carrying 25 people, and the trials were conducted for several days, and

are said to have met with perfect success. In the following year a number of experiments were carried out at the Daft Company's factory at Greenville, New Jersey, with a view to demonstrate the possibility of electric locomotion on a much larger scale; and in May, 1883, an electric locomotive, afterwards called "Ampère," was begun for an experiment on the Saratoga and Mt. McGregor Railroad, a narrow-gauge road running from Saratoga about ten miles to Mt. McGregor. Some time was occupied in experiment prior to the construction of this machine; but in the fall of the same year (1883), the locomotive was finally finished and forwarded to Saratoga, where a number of experiments were made on a part of the track which had been furnished with a third rail to the distance of about a mile and a quarter from the depot, the dynamo machines being situated about midway, and a few hundred feet from the track. In this case a third rail was used, supported on blocks of wood saturated with resin, and experiments revealed the fact that with the low potential employed, the insulation was sufficient for a practical experiment, even when a considerable portion of the tracks was covered with snow. The main achievement of this was that it towed a car weighing over 10 tons, loaded with 68 passengers, over the road, including a gradient of 93ft. per mile. Though several difficulties were experienced, due to the comparative crudeness and temporary character of the local arrangements, sufficient was accomplished to prove the possibility of commercial electric traction; and since it was the first example of electric locomotion on an ordinary steam railroad, it attracted attention, and encouraged others to proceed in the same direction. It is noticeable that about this time a number of experiments were recorded with what are now known as accumulators on the other side of the water, and a number of more or less successful experiments were made, which only served to develop the fact that accumulators were then, as they are probably now, susceptible of great improvement.

The extraordinary impetus which had been given by the introduction of the dynamo machine was re-enforced by the comparative success of the experiment just noticed, so that within the next few months a large number of electricians and others found themselves sufficiently encouraged to construct a great variety of electric apparatus for the complete extinction of horses and steam. As you are doubtless aware, the greater part of these have been entirely unproductive; but the most notable cases have not only survived, but are now being prosecuted with a vigour and success which naturally results from their having assumed a thoroughly commercial character; and in the year 1884 a combination of important capitalists was effected under the title of the American Electric Railway Company, with a view to placing everything of this kind on a sufficiently strong commercial basis to insure its adoption; but as some difficulty was experienced in securing concerted action, nothing of importance has yet resulted from this combination, the inventors, as before, pursuing their different ways alone. Here, perhaps, it may be as well to state that electric locomotion alone had not by any means absorbed the attention of inventors, the question of transmission of power for stationary purposes having appeared to present an even more attractive field. Much had been accomplished in this direction, and practical results attained by such distinguished inventors as M. Marcel Deprez, Messrs. Siemens and Halske, of Germany, and Sir William Siemens, of England, together with Messrs. Ayrton and Perry, and others of lesser note. Notable among the achievements of the French inventor was the transfer of nearly 40 horse-power for a distance of several miles by an ordinary telegraph wire.

In this country, though workers in this direction have apparently been less numerous, the results have generally assumed a more important character regarded as a commercial achievement. The first recorded example of the establishment of a central station exclusively for the distribution of power was that of the Massachusetts Electric Power Company, which was placed in May, 1884, and has since grown to considerable proportions. This company uses the Daft system. Several others similarly equipped have since been put in operation with entirely satisfactory results, which my paper will not allow me to describe. There are, however, a large number of satisfactory motors in operation in different parts of the country, though not, so far as I know, worked from stations exclusively for power; among the motors so employed may be mentioned the Sprague, Van Depoele, Edgerton, Baxter, D'hul, and a host of others, which may fairly be said to be too numerous to be mentioned, though with one or two exceptions these inventors have devoted themselves to matters of very small power, especially for use in operating sewing machines, dental instruments, &c.

In August, 1885, Messrs. Knight and Bentley operated a small road in the city of Cleveland, O., with a subterranean conductor, which may be said to be the first serious attempt with that form of conduit yet made in this country. The experiment extended over a considerable period, and is described as being quite successful, though for some reason of which I am not informed the plan was not adopted, and the experiments have been discontinued, though these gentlemen are still doing good work in Providence, R. I., and are, I trust, preparing themselves for a brilliant future. It will be unnecessary for me to remind you that a plan of this kind must ultimately be adopted in many of our large cities, particularly since the beginning of the overhead-wire crusade.

In the year 1885, C. J. Van Depoele constructed and operated a locomotive which is said to have done excellent work at the Toronto exhibition, in the fall of last year, and this has been followed up from time to time by notable works and experiments in different parts of the country, chiefly among which may be mentioned Montgomery, Ala., South Bend, Ind. This inventor, after the manner of the early German road, has adopted an overhead conductor, which sems specially suited for use in cities where the necessary permits can be obtained, and appears to have met with such success as to promise greater things in the future.

Passing over some minor achievements, I am led to speak of the installation of the Baltimore and Hampden Electric Railroad as the one commercial plant which has been operated for a sufficient time to allow of a proper statistical comparison, not only with horses, but with other mechanical tractors, and in so doing I append figures showing results of operating this road for twelve months by the Daft system, including a winter of extraordinary severity for that region, and under such conditions as I am sure you will conceive are sufficiently commercial in their character. A profile of the gradients and curves on this road will be a sufficient assurance that the experimental element has not been allowed to predominate in selecting the ground for such purpose, except in a manner sufficiently prejudicial to afford unusually severe means for satisfying ourselves as to its enduring character. The statistics here appended will afford so clear an insight to the results of this experience that I will not further dwell upon it, except to remark that, though I must confess myself strongly in favour of so convenient and sufficient a substitute for horses, or other mechanical tractor so far tested, I have not allowed myself to be led astray by the scientific allurements of the case, and feel satisfied that a careful analysis of the case will lead others to conclude, as I do, that electricity employed as the means of transferring the energy of mechanical tractors is not only coming, but is here, and in all essential particulars has been here for some time past. It is not too much to add that the Baltimore and Hampden-road stands alone in this particular, that it was started on a purely commercial basis as a purely commercial transaction, and has continued, and is now being extended, simply because it has proved its right to stay by the performance, which leaves little to be desired in that direction.

About the time that the Baltimore road was started, the Daft Company was engaged upon the manufacture of a large electric motor, Ben Franklin, intended for use for experiment on the Ninth Avenue Elevated Railroad in New York. This was subsequently put in operation and experimentally used for a considerable time on a short track at Fourteenth-street, and towed four cars over two miles of that road. It was ascertained during these experiments that a more powerful motor would be required to fully meet the requirements of the case, and the experiments will shortly be resumed on a larger basis.

Lieut. F. J. Sprague has since built and put in operation a motive car on a short branch of the Third Avenue Elevated Railroad at Thirty-fourth-street. The experiments with this motor have not yet been concluded, but I understand that they have been quite successful, and will probably result in an extended application of this motor.

In concluding this brief review of this comprehensive subject, I feel that I should not be doing it full justice if I were not to attempt a refutation of many charges which have been brought against electricity by persons unfamiliar with its peculiarity.

It is said to be unsafe; and though with high potential this is undoubtedly the case, I am prepared to say that with the potential now in use on the Baltimore and Hampden Railway, the experience by a year's constant running 18 hours per diem leads me to state that so far as human life is concerned it is absolutely harmless.

Secondly: It has been said to be uncertain. Again, quoting the experiences of a year, I am able to state that after the little difficulties incident to a primary installation had been removed during the first month or two, it is as certain as any other form of mechanical tractor in all weather.

Third: It has been stated that specially skilled help would be required to operate a line so equipped. I am again able to say that the experience before referred to has enabled me to place upon the road men who were entirely unfamiliar with electricity in any of its applications, and that these men are now our sole reliance for all the operations required, and interruptions are as much the exception with us now as with any ordinary road.

For the year ending September 1, 1885, the road carried with three cars, with horses, 227,155 passengers at 5 cents each, making 11,357.75 dol.

For the year ending September 1, 1886, the road carried with two cars, propelled by the Daft electric motor, 311,141 passengers at 5 cents each, making 15,557·05dol.

This shows an increase of 83,986 passengers with two cars propelled by electricity as against three cars propelled by horse-power for the same corresponding time, and an increase of 4,199·30dol.

The average number of passengers carried per car per annum propelled by electric power was 155,570.

The average carried per car per annum for corresponding time by horse-power was 75,718 passengers, an excess of passengers per annum in favour of electric power of 79,852.

The average gross earnings per car per annum, with cars propelled by electric power, was 7,778·52dol.; the average gross earnings per car per annum by horse-power was 3,785·91dol.; showing an excess of gross earnings per car per annum in favour of electric power of 3,892·61dol.

The average cost of horse-power per car per day is estimated at 6·50dol.; the average cost of electric power per day on this road is $1\frac{1}{2}$ tons of coal at 1·50dol., equals 2·25dol.; engineer, 2·00dol.; fireman 1·50dol.; oil and waste, 50 cents; interest on plant and repairs, 2·75dol.; making 9dol. per day. The power furnished at this cost is ample to run three motors and cars on this road, making electric power per day 4·00dol. Under more favourable conditions, such as cheaper fuel or water, power to drive the dynamos, and more favourable gradients and curves, the cost of electric power per car per day would be proportionately reduced.

BEE-FLOWERS.*

It is interesting to me to have confirmation of my experience of the value of Erica carnea as a bee-flower. Growing this beautiful vernal heath extensively for decorative purposes, I have observed for many years past that bees frequent it as soon as its blossoms open; but this does not take place in the North Midlands until March or April, unless, indeed, the season be abnormally early. It is somewhat presumptuous to dispute the accuracy of an observer of such eminence as Müller, whose observations in Switzerland led him to the conclusion that bees would not reach the malodorous secretions of Erica carnea, knowing the quick perception of the honey-bee in regard to honey-yielding flowers. I have concluded that either Müller must be mistaken, or that there exist varieties of E. carnea functionally different to the kind we cultivate, or bees that labour under a like disadvantage. I have gathered Erica carnea, or herbacea, in the mountains near the Lake of Thun, and comparing specimens of our cultivated kinds, I cannot distinguish any difference. Your correspondent, "Contingensis," writing from the South of Ireland, enjoys climatic advantages that do not reach England, and his teaching has rather a local than a general significance and application. Except in nursery gardens, Erica carnea is not to be found anywhere about Matlock. It is not native there. Bees are not invariably attracted by sweet-scented flowers. Daphne mezereum has both colour and fragrance, but it is not the most tempting flower to bees, and it is shy of removal and of difficult culture, and would be too expensive to an amateur bee-keeper whose indulgence in an apiary happened to be directed by considerations of ultimate profit. Too great a variety of bee flowers is not desirable, but a regular succession is eminently so, from spring until autumn.

Winter aconite (Eranthis hyemalis) is mainly visited by bees in early spring, as are crocuses, Scilla sibirica, Arabis albida, Aubrietia græca, and wallflowers, all easily grown and hardy plants. Then a great breadth of Limnanthes douglasii should be provided. The blossom of gooseberries, currants, and raspberries, though unattractive as regards colour, divert the attention of bees from all the brighter flowers about. Oddly enough, two apparently tempting flowers—sweet alyssum and seakale—are passed over unvisited by bees.

Nearly all the Borageworts are useful bee-flowers. Marjoram, thyme, and horehound are invaluable in their season, and I can indorse the recommendation of your correspondent in regard to Melilotus officinalis and alba—it is the blossom and not the seed that has the fragrance he describes. It is a late summer blooming plant, and a biennial,

* By W. INGRAM, Belvoir, in *Gardeners' Chronicle*.

and growing very tall, requires ample space. It is a great honey plant.

While on the subject of bee-flowers let me remark, in reference to the recommendation of R. Veitch and Son of Impatiens glandulifera, that my experience as to the value of this plant as a bee-flower is totally at variance with theirs. It is a handsome, free-growing, and blooming plant; but honey-bees, when they have any other flower to pasture on, never approach it. It abounds in pollen, but even that does not tempt them. The larger humble-bees find something in it congenial to their tastes, and casual observers may have been led astray by the frequency of their visits to it. I have for several years past advocated that the cultivation of bee-flowers should be pursued coincidently with the extension of the bee-keeping industry. I practically and successfully proved it last season, both as to the quantity and quality of the honey.

ELECTRICAL WELDING.

AT a meeting of the Boston Society of Arts last month, Professor Elihu Thomson gave a practical demonstration of his method of electrical welding. We extract the following account of the experiments from the New York *Electrical Review*:—By the processes in common use it is difficult, if not impossible, in many cases to weld together different metals. Two pieces of the same kind of cast iron, zinc, tin, brass, and especially copper have not been easily welded. By means of electricity they may be easily united. Iron, steel, and platinum, which have been the metals hitherto most easily welded, are by the new process still more readily united. To attempt by the new process to weld unlike metals may fail on account of a great difference of their temperatures of softening, or of their specific electrical and heat-conducting capacities. The method is to forcibly press together the two pieces to be united while passing a large current. Uses: The joining into one continuous length of short pieces of copper and iron wire. In the factory of the Thomson-Houston Company wires are joined by this method for making joints in all copper and iron wire used. The largest copper rod yet welded is a little less than ½in. diameter, requiring about 20,000 ampères. The same current will weld iron 1in. diameter, the difference in the size of the two metals being due to the greater resistance and lesser conductivity of iron. Specimens of various sizes, shapes, and materials were here shown; cast iron, steel and cast iron in one piece; steel, brass, copper also in one piece; copper rod bent at joint after welding. Brazing can be done successfully by putting brass on a hot joint while current is passing. The smallest wires yet united by welding by this process have been $\frac{1}{30}$in. diameter. Less fuel is required by the electric method of welding on account of the small time required for the operation and the application of the heat locally, and the small losses from radiation and conduction. The time required being so short, more joints may be made in the same time by comparatively unskilled labour. In arc-light circuits a current of 10 ampères, with an electrical pressure of 2,500 volts, is not infrequently employed. In incandescent lighting a current of 250 ampères, at an electrical pressure or electromotive force of 100 volts, would represent the same amount of electrical energy. In welding wire enormous currents are employed. Fifty thousand ampères, at an electrical pressure of ½ volt, would represent exactly the same amount of electrical energy. This amount of current would probably weld steel 1½in. in diameter in less than two minutes. Electric lights demand a continuous application of power, while the welding, for instance, of a 1½in. piece of steel would require 35 H.P. for only one minute, the same power being required continuously to operate 40 to 45 arc lights. The means for obtaining sufficiently large currents are two—storage batteries and alternate current machines connected with transformers.

A secondary or storage battery of very large surface, and consequently of low resistance, is put in an arc-light circuit and charged from the terminals of the cells; large-sized conductors connected with such binding posts as are shown in Figs. 1 and 2. The battery gives out its heat so fast that most of the energy is developed in the external circuit or at the point to be welded. The battery, however, is not portable; the liquids are easily spilled, a long time is required for charging, and it is not so manageable as the induction coil or transformer. The coil, Fig. 1, is composed of a bundle of fine iron wires L L, around which are wound a number of layers of comparatively fine wire connected by the terminals A A to a source of alternating currents, a dynamo in this case giving 50 to 100 alternations per second. The length of the iron core is 12in., the diameter about 1½in. The secondary coil S S represented in the diagrams as composed of 5 turns of large copper was in the smaller instrument shown composed of 64 No. 10 Brown and Sharpe's gauge copper wires wound in parallel eight times around the primary. The ends were bolted to copper plates upon which the clamps are placed, one of which slides by an adjustable spring shown at the bottom of the diagram. By means of a cam the clamps may be separated to any extent. It takes only a few seconds to place the pieces of metal to be welded in the clamps. The iron core on which the primary circuit is wound direct may be pulled in and out. The power of the currents induced in the secondary coil is thus varied and adapted to any sized piece of forging. The resistance of the secondary coil is ·00015 ohms.

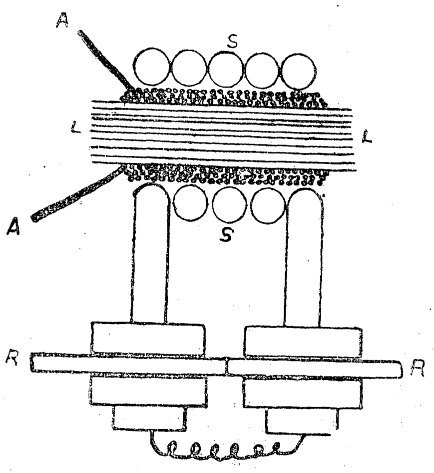


Fig I

In the transformer or induction coil, illustrated in Fig. 2, the primary coil P P is a ring 12in. in diameter, 2½in. wide, and ¾in. thick of many turns of insulated copper wire. The ends A A of this coil are connected with the alternating dynamo, and alternating currents thus pass through the wire of the primary coil. The secondary coil is a single heavy bar of copper bent to make one turn outside of the primary coil. The secondary is represented by the heavy black ring, the terminals of which S S are bent out to a parallel position and connected to massive screw clamps, M M. The secondary coil is shaped like a Jew's-harp. The parallel portions of this midway between S and M are made so that the clamp terminal M at the right may be moved. The screw C is used to force the terminals apart, the bars to be welded R R are clamped in position, the clamp C is unscrewed, and

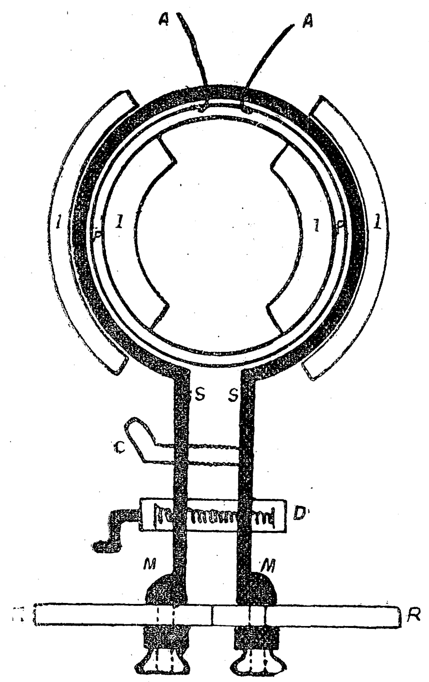


Fig II

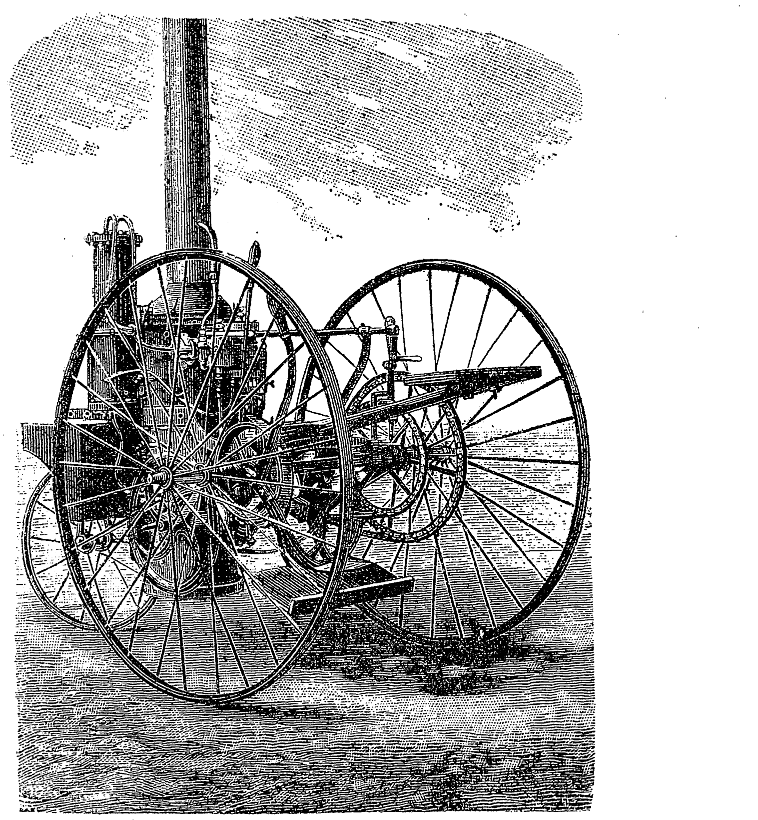
the tension of the spring D is adjusted by the screw attached to it. The pressure of the spring gives good contact of the bars R R. The primary and secondary coils are now wound around with an endless coil of iron wire I I I I. The iron wire does not touch the primary or secondary coils, but is wound on a sheet-iron casing, the secondary coil thereby being free. The resistance of the secondary coil is ·00003, and under the influence of a good primary current gives an electromotive force of two volts; less, however, is used in most cases. There is a small percentage of loss in the transformation, a current of 20 ampères and 600 volts in the primary circuit gives in the secondary circuit nearly 1 volt and 12,000 ampères. To generate the alternating current an inexpensive dynamo is used weighing 500lb., absorbing 25 H.P. at 1,800 revolutions per minute. There are 10lb. of copper wire on the armature, and 40lb. on the field magnets. The large output from so small a machine without destruction comes from the fact that the machine gives current only for short intervals. There are suitable switches to stop the flow of current when the weld is complete. The primary circuit may be cut or the resistance in the circuit of the field magnets of the dynamo may be varied, a method employed in the present case. To prevent overheating the primary coil of the machine illustrated in Fig. 1 may be pulled out to any extent, or resistance may be added to the primary circuit or the strength of the field magnets of the dynamo varied as described above.

The ends of the pieces to be welded are brightened, and are allowed to project a little beyond the clamps, when in position. A flux of some kind is then put on the joint—powdered borax for metals that have a high melting point; chloride of zinc, resin, or tallow for lead, zinc, and metals which have a low melting point. The current is now turned on, the ends of the rod become red, then white hot, and at the point of fusion soften; the tension of the spring causes the joint to become upset or thickened. The current is shut off, the clamps unloosened, and the bar, with the weld still red hot, may be removed. Of course, many metals do not require even a red heat for fusion. In uniting a large to a small piece, the end of the large piece is first turned down to the size of the smaller. Sometimes the joints are hammered while in the clamps. It is probable that the result is caused by heat alone, though some electrical action may play a part. One circumstance tends to produce uniform heating of the abutting bars. Suppose one part of the surfaces is in much better contact than the rest. The larger part of the current will therefore flow in the path of least resistance. This part becomes hot, its resistance increases in consequence, and the current is to a large degree diverted to the colder portions of the joint, until the whole of the abutting surfaces are equally heated. Two pieces of iron wire about $\frac{1}{16}$in. diameter were welded with the smaller induction coil. The pieces in position, Professor Thomson stood watching the machine one hand on the rheostat. The audience sat breathless. A movement of the switch, and in less than three seconds the junction of the pieces of wire was white hot, and the weld complete. There is more difficulty with the manipulation of brass on account of the oxidation of the zinc contained in it. Twice from a too sudden increase of the current there was a snap, and liquid metal was thrown out from the joint. Connections were then made with the larger apparatus, of which Fig. 2 is a horizontal section. Mild steel rods ½in. diameter were united, borax being used as flux and placed on the rods after they were placed in position. The joint during the passage of the current was very bright. In operating on some brass, the belt transmitting the power slipped. While the metals were cold, the resistance of the junction of the two pieces was low; when, however, the temperature rose the resistance increased, less current flowed, and the dynamo speeded, as the belt did not then slip, and an excess of current was caused. Notwithstanding this difficulty, the union of the brass was successfully accomplished. Copper ⅜in. diameter was next united. A copper rod $\frac{5}{16}$in. diameter and about 10in. long was bent into a circular form and clamped. To show the power of the apparatus, the current was turned on, and the copper maintained at a red heat. It could have been easily melted, as the limit of power of the apparatus was not approached.

STEAM TRICYCLE WITH PETROLEUM FURNACE.

A BRIEF description of a steam tricycle is given in *La Nature*, and may be of interest to some of our readers, though the use of motive power other than that obtained from human muscles seems to rob the tricycle of its raison-d'être.

M. Louis Lallemand, a skilful mechanic of Vassy, has just constructed a steam tricycle, to be heated by petroleum, and as the question of terrestrial mechanical locomotion is one that interests a large number of readers, we shall describe the apparatus. The length of the tricycle, as well as its extreme width, is 3½ft. The boiler is of welded iron plate. Its height is 2ft., its external diameter is 12in., and its total capacity is about four gallons. It is provided with 30 brass tubes, and serves as a frame for the engine, the cylinder of which is 2⅜in. in diameter, with a stroke of 4¼in. In the centre of the boiler there is a copper cylinder, forming a



steam-dome. The pressure gauge is placed to the left of the cylinder, under the eye of the driver, and the feed pump is to the right. The escape pipe enters the smoke stack and quickens the draught. The throttle valve is within reach of the left hand, as is also the lever of a Prony brake fixed upon the axle. Another hand lever, fixed to the foot-rest, is designed to serve as a bearing-point. The driver's right hand rests upon the steering winch, and has within its reach a lever for changing the velocity, that permits of throwing either of the two driving pulleys into gear. These latter are are driven by the shaft of the engine through the intermedium of pitch chains. The two large wheels are 3½ft. in diameter, and the small one 1¾ft. They are provided with a rubber tire, in order to prevent noise. The water-tank, which has a capacity of about 7½gals., is situated in front of the generator, and partially covers the front wheel. The petroleum reservoir, which holds 2¼gals., is situated over the tank. The firebox, which is of peculiar and very simple structure, is suspended from the generator, and always keeps a horizal position, whatever be the slope of the road. The petroleum enters the firebox through a flexible tube, and the fire is regulated at will through the intermedium of a distributing cock within reach of the driver. The total weight of the apparatus, empty, is 500 pounds. The consumption is about three and a quarter gallons of water and three and a half pints of petroleum per hour. It takes about ten or twelve minntes to get up a pressure. Upon a good road a speed of from seven to nine miles per hour may be obtained. M. Lallemand has already made four trials of this tricycle, each of which lasted twelve minutes. The distance run over in each of these was about two miles, and the gradients ascended never exceeded 3in. to the foot. On a level road, a pressure of two atmospheres suffices to run the apparatus at a speed of from 3½ to 4½ miles per hour. The constructor has not as yet been able to perform more prolonged experiments, as up to the present he has not obtained permission to run his apparatus in the streets. According to him, the use of petroleum is very advantageous as regards the regulation of the production of steam and as regards the quickness with which a pressure may be obtained; but in France this product is still too dear to prove economical.

NEW USE FOR THE RADIOMETER.

AT a recent meeting of the Société Technique de l'Industrie du Gaz en France, M. Frère, Manager of the St. Quentin Gasworks, brought forward a proposition for employing the radiometer in gasworks to indicate the time for putting on the night pressure. He said he had himself used the instrument in this way for some months, and had found it act satisfactorily. It was constructed in the usual way—viz., a glass globe in which four vanes, black on one side and white on the other, revolved almost *in vacuo;* the motive power being furnished by the increased pressure imparted to the air on coming in contact with the hottest part of the apparatus—that is to say, the blackened sides of the vanes. It is well known that as long as there is sufficient light the vanes will turn; but when the luminous rays become feeble, the rotary movement ceases. If the radiometer is exposed to the setting sun, the vanes stop, in very clear weather, about 20 minutes after sunset; and in very dull weather sometimes 30 minutes before sunset. In applying the peculiar property of this instrument to the practical purposes of a gasworks, M. Frère recommended that the workman in charge of the governors should begin to put on the pressure five minutes after the stoppage of the vanes; and if this were done, the consumers would, he said, have a proper supply of gas at the moment they require it. By taking note each day of the exact time at which the radiometer ceased turning, the average time for lighting up could be determined at the close of the month. M. Frère thought that, without putting forward the indications of the radiometer as absolutely reliable, it would be possible to make good use of the monthly averages. These, compared one year with another, and with corresponding months, would enable gas managers, in certain cases, to give the consumers a reasonable explanation of any excess of consumption which might be the subject of complaint.

AN official compilation shows that the average age of the members of the Society of Friends who have died during the denominational year just completed was 58½ years, an average age much in excess of that amongst the general population.

FRENCH official statistics relative to sugar show that during the eleven months of 1886 which ended on November 30 last there was a diminution of 46,146 tons in the importation into France of foreign Colonial sugar. As to foreign beetroot sugar only 288 tons were imported, as against 48,450 tons in 1885. On the other hand, the exportation from France of home-made sugar increased from 2,672 tons in 1885 to 18,687 tons in the eleven months of 1886. The exportation of refined sugar also rose from 65,487 tons in 1885, to 100,087 tons.

THE *American Inventor*, of Cincinnati, a monthly journal, says:—"We print this month's issue for the first time by means of electricity. We are running four presses with a single motor, and it is quite a novelty in action. The motor is built in a very substantial manner, and there are no parts that wear rapidly even with ordinary care. The expense for repairs cannot amount to 10 per cent. of that required for either steam, gas, or hot-air engines, and we now see no reason why it will not give, for many years to come, as good results as at present."

SCIENTIFIC NEWS.

DURING the present year there will be an annular and a total eclipse of the sun, and a partial eclipse of the moon. The total eclipse will take place on August 19, the line of centrality passing over the southern part of Russia, part of Chinese Tartary, and the principal island of Japan. The sun will rise partly eclipsed at Greenwich at 4.53. The annular eclipse on Feb. 22 will be visible only in the Southern Pacific. A partial eclipse of the moon on Feb. 8 will be invisible at Greenwich; but the similar phenomenon of Aug. 3 will take place from 7.36 to 10 o'clock p.m., and the eclipse will amount to 0·42 of the moon's diameter at 8.49.

It appears from the calculations of Dr. H Oppenheim of Berlin, and Dr. J. Holetschek, of Vienna, that Finlay's Comet (*e* 1886) is identical with De Vico's periodical comet, probably with the elements altered by perturbation. It is still twice as bright as at time of discovery, and will probably be visible with a telescope until the end of February. It is in the constellation Pisces, and its position for Jan. 8, Berlin midnight, is, according to Dr. Holetschek, R.A. 0h. 28m. 10s., N. Dec. 3° 45′.

Barnard's comet is still visible to the naked eye; but is becoming rapidly fainter, and on Jan. 10 will probably require a telescope for most observers. Its position on that date is at Berlin midnight R.A. 20h. 11m. 46s., S. Dec. 1° 20·1′.

Another minor planet (No. 264) was discovered on the 22nd ult. by Prof. Peters, of Clinton, New York State. It is the eleventh discovered in 1886. No. 261, discovered by Prof. Peters on Oct. 31, has been named Prymno.

By a strange error of the telegraph, the death of Prof. Theodor von Oppolzer, of Vienna, in his 46th year, was announced as that of Prof. T. von Bamberger.

The death is announced of Mr. H. M. Jenkins, secretary of the Royal Agricultural Society, and formerly editor of the *Journal* of the Geological Society. Mr. Jenkins was a member of the Technical Instruction Commission, and prepared an elaborate report on agricultural education in the United Kingdom and the Continent.

Mr. Thomas Moore, F.L.S., who for 38 years had been curator of the botanic garden belonging to the Society of Apothecaries, which adjoins Chelsea Hospital, died suddenly on New Year's Day at the age of 65. Mr. Moore was co-editor with Lindley of the "Treasury of Botany," and author of "Index Filicum."

The death is also announced of Mr. John B. Root, inventor of the water-tube boiler which bears his name, and of spiral riveted piping and machinery for making it. Mr. Root, who was fifty-seven years of age, had taken out more than seventy patents.

The Association for the Improvement of Geometrical Teaching have arranged, by permission of the authorities of University College, Gower-street, to hold their annual meeting in the College on Friday, Jan. 14th, at 11.30 a m. The afternoon sitting, the President, Mr. R. B. Hayward, in the chair, will commence at 2 p.m., when the following papers are to be read:—"The Teaching of Modern Geometry," by the Rev. G. Richardson; "The Modern Treatment of Maxima and Minima," by the Rev. J. J. Milne; and "Geometry from an Artist's Point of View," by Mr. G. A. Storey, A.R.A. All persons interested in the objects of the association are invited to be present at both meetings. The association have issued during the year "The Elements of Plane Geometry," Part II. (corresponding to Euclid, Books III.-VI.), and a "Syllabus of Elemetary Geometrical Conics" (both published by Messrs. Swan Sonnenschein), and have sent out to members an abstract draft of a syllabus of elementary solid geometry. Syllabuses of arithmetic and of elementary mechanics are in a forward state of preparation.

The snowstorms have produced the usual number of suggestions for the rapid removal of the snow from the streets, the most feasible of which is the use of salt, followed by prompt

washing down the sewers, as is done in Paris. The mixture of salt with snow produces a freezing mixture which has a temperature of about zero, or below, according to the proportions, and if allowed to remain on the surface it does injury to the public health, and also to the roads and the pipes beneath, when allowed to soak in. One writer, a "surveyor," proposes to melt the snow by means of batteries and coils placed in gully holes. When the batteries are not required to make the snow melt "rapidly" they may be kept in subways beneath pavements, and there provide a "substitute for gas" for adjacent dwellings!

The number of applications for patents during 1886 was 17,162, slightly more than in any preceding year. In 1884 the number was 17,110, and in 1885, 16,101. The departmental committee appointed to inquire into the working of the Act, and to suggest reforms, should hurry on their report.

The town council of Bombay has unanimously resolved that the municipality must bear its share, with the Government and other public bodies, in the expenses of the establishment of a technical school, and a sum of 5,000 rupees was voted for the purpose at a late meeting. The scheme is one drawn up by Dr. Cooke, Principal of the Poona College of Science, and explained by him to the Council. The skilled artisans, he said, turned out by the school would be a benefit to the country and to the municipality alike.

The wires of an electric arc lamp outside a shop in Holborn fired the other day, and being covered with some inflammable material, flames of about a foot long were produced and maintained for some minutes. Probably the use of inflammable material was considered permissible as the wires were in the open air.

The Consett Iron Company are extending their steel works, and three of the new and large boilers are to be heated by gas.

At a recent meeting of the French Académie des Inscriptions, M. Berthelot read a paper on "Certain Metals and Minerals used in Ancient Assyria and Chaldea." By the help of chemical analysis he had investigated the substance of several objects from Assyria and Chaldæa with interesting results. A sacred tablet from Khorsabad was found to be entirely composed of pure carbonate of soda—a rare substance even at the present day. Among the objects brought back by Mr. Sarzec from his excavations at Tello are two remarkable examples of the employment of metals without alloy. One is a vase of pure antimony; the other is a statuette of copper without any trace of tin.

A correspondent writes from Venice to the *Frankfurter Zeitung*, that one or two days before Christmas a singular phenomenon was seen at Savile, near Udine, which recalls accounts of the mirage sometimes presented near Messina. The sky was partially covered by clouds, in which the surface of a calm sea was discerned, with boats passing over it, and even a steamer cutting its way. Presently houses came in view, then large beautiful buildings, palaces, and churches, and, as the features became more defined, the cathedral of St. Mark, with the Piazza and tower were plainly presented, and the neighbouring canals. The spectacle faded gradually away, having made a great impression on all who saw it.

The New German Rifle.—The new rifle, which bears the title "M." (*i.e.*, Mauser), "71, 84," in token that the old model 71 has been adhered to in principle, with some modifications of it made in 1884, is described as being 1·3 mètre long without, or 1·8 mètre with, the bayonet, and weighs 4·6 kilogrammes with empty magazine or 5 kilogrammes when the magazine contains its full store of eight cartridges. These are cased with brass, each being 78 millimètres long, and weighing 43 grammes. The powder charge consists of 5 grammes of new rifle powder—"M. 71." The weapon, of which the barrel is of rifled steel, coloured brown outside, to protect it against rust, can be sighted for a distance of from 200 to 1,000 mètres. It has a calibre of 11 millimètres. The rifle can be used either as a single shooter or repeater, and is fired in the usual way. It is also announced that velocipedes—both bicycles and tricycles—will soon be introduced into the German Army, chiefly for the use of orderlies in fortresses, and in the region of detached forts.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

**** In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects; For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

6 SERPENTIS AND OTHER PAIRS.

[26654.]—IN the ENGLISH MECHANIC for May 29th, 1885 (letter 24270, Vol. XLI.), I called attention to some twenty double stars, chiefly discoveries of Mr. Burnham's, and remarked that a careful examination of them at the present time would at once show whether they were physically related or only optically double. In the *Journal* of the Liverpool Astronomical Society for December last Mr. K. J. Tarrant gives the results of three nights' measures in 1885 of one of the pairs alluded to in my letter—viz., 6 Serpentis (β 32). The following are the principal measures of this beautiful object:—

De.	13·2°	2·28″	1875·41	(4 nights)
β.	13·6	2·37	1879·40	(2 nights)
Tarrant	14·0	2·27	1885·49	(3 nights)

The annual proper motion according to Auwers's Bradley (this I take from the recently published Pulkowa Catalogue of 3,542 stars, for a copy of which I am indebted to the great kindness of Director O. Von Struve) is − 0·0053sec. − 0·098″. If the small star was unconnected with 6 Serpentis, the angle at the date of Mr. Tarrant's measures should have been about 21·5°, and the distance 3·51″. Hence these two stars are animated by a common proper motion, and probably form a physical pair.

I trust that American observers will not neglect the fine pair Ceti 82 (β 395) mentioned in letter 24270. The place for 1885 is in 0h. 31m. 26s. − 25° 24·0′, and therefore it is almost too low for observers in this country. The star is visible to the naked eye, and has an annual proper motion of 1·355″ in the direction of 91·3°. In addition to the stars already mentioned in letter 24270, an examination of the pairs B.A.C. 920 (β 525), B.A.C. 1101 (β 533, cf. *Memoirs* R.A.S. XLVII. p. 231), 15 Hydræ (β 587), 52 Herculis (β 627), B.A.C. 6762 (β 658), and B.A.C. 708 (β 668), at the present time would tend to throw light on the physical relationship of their component stars. The beautiful, but rather unequalled and difficult, pair β 163 is evidently another physical object. The principal star is Lalande 41386, which according to Argelander, has a motion of + 0·0006sec. − 0·105″. The only measures of this pair I can lay my hands on at this moment are Dembowski's; but they are sufficient, though only extending over three years, to prove that this pair also is animated by a common proper motion. He gives—

252·2° : 1·18″ : 1874·549 (one night)
Mags. 7·5, 9·0 : aria velata.
250·6° : 1·18″ : 1875·548 (one night)
Mags. 7·0, 9·0 : meglio in distanza.
252·6° : 1·16″ : 1876·463 (one night)
Mags. 7·0, 9·0 : sufficiente.
253·7° : 1·10″ : 1877·819 (one night)
Mags. 7·0, 9·0 : la definizione varia.

If this pair was an optical one the angle would have increased to 267° at De's last epoch. The place of this pair for 1887·0 is 20h. 13m. 7·3s. + 11° 7′ 24″. It is about 15sec. preceding, and 22′ north of a small 6 mag. star.

Jan. 4. **H. Sadler.**

ASTRONOMY BY PHOTOGRAPHY.

[26655.]—BECAUSE the Brothers Henry and some other observers have succeeded in taking wonderful photographs of the starry vault, we are threatened with a revolution in our methods of studying astronomy, and the following, which appears in a Liverpool paper under the rather strange heading of "Science Notes," may be taken as a sample of the stuff that is to come:—"At the recent soirée of the learned societies of Liverpool, held in St. George's Hall, there were exhibited a number of stellar photographs which attracted the attention of nearly all present. This was due very largely, no doubt, to the remarks of the mayor and of Sir Robert Ball on their vast importance to the astronomical world. The photographs were not particularly interesting in themselves except to those who understood their deep significance, yet they were surrounded by a great crowd all the evening. They consisted of photographs about ten inches by ten, of stellar spaces, of little white dots, varied by misty dashes, on a brownish ground. These uninteresting-looking pictures relate to one of the most fascinating phases of scientific research. Over 2,000 years ago Ptolemy made a catalogue of the stars, marking them by numbers from one to six, according to their brilliancy. Number six was the smallest star visible to the naked eye, and that quaint old star chart is full of interest to the modern astronomer. From the days of Ptolemy to the times of Tycho Brahe, in the 16th century, astronomy was lost in the mists of the dark ages; but the patient labours of the poor Dane, and the invention of the telescope by Galileo, brought it once more to the front. Every year some new discovery has been made, or some larger or more perfect instrument added to the countless ones already turned skyward; but the application of photography to astronomy has revolutionised the science (!) The work of the Brothers Henry, of Paris, in photographing the stars, has been told all over the world, and the French savants are moving energetically to have photographic apparatus sent to Algiers and every favourable spot on earth. The idea of photographing the stars has a very definite purpose. We know that our world circles round the sun, and that the sun and its family of planets are moving round somewhere else; but what the solar motion really is is not so well known. If the star map of Ptolemy had been photographed, we could now have measured the solar movement which has taken place since that time; but, unfortunately, it was taken by hand in a crude way, and for exact measurement is of no value. The maps made by Herschel a century ago, and by Argelander, in Bonn, fifty years later, are of great use to modern workers, but are not of such an exact nature as science demands. The Brothers Henry took photographs of the sky with a view to determine, in a scientific and reliable way, where we are all going to. They have exhibited enlarged copies of their work, which have gone round the world. But they never show their negatives—that is, we only see their improved and corrected work; we never see the real picture."

Now we all know what "astronomy" means. It consists in taking photographs of the stars, and using them as evidence against the observations made at the eye-end of a telescope. **T. B. W.**

TEMPERATURE AND RAINFALL IN 1886.

[26656.]—

—	Mean temperature.	Deviations from averages (20 years ending 1880).	Rainfall in inches.	Deviations from averages (10 years, 1867—1876).	Number of rainy days.
January ...	34·1°	− 2·5°	3·28	+ ·36	24
February ...	33·4	− 5·7	·85	− 1·41	6
March	38·4	− 2·2	3·10	+ ·63	14
April.........	45·4	− 1·8	1·99	− ·02	17
May	51·1	− ·8	6·00	+ 3·73	19
June	56·1	− 2·3	1·15	− 1·13	11
July	61·2	− ·4	2·86	− ·02	18
August......	61·6	+ 1·1	1·36	− 1·18	10
September..	56·6	+ 1·2	2·19	− 1·48	12
October ...	51·0	+ 2·8	3·90	+ ·57	20
November..	43·8	+ 3·5	1·80	− ·29	16
December...	35·3	− 2·6	4·35	+ 1·14	18
Year	47·3	− ·9	32·83	+ ·90	185

It will be observed that the temperature was in general below the average, noticeably so in February—the coldest February, indeed, during the last 20 years. March, too, was colder than the average, the first fortnight with a mean temperature of 30·5°, or more than 6° below the average of January, being probably the coldest on record. The spring and summer months were not distinguished by anything particularly worthy of notice, with the exception, perhaps, of June, which was unusually cold. The first week in October was marked by a spell of almost sultry weather, the thermometer on the 5th rising to 75° with a mean temperature for the 24 hours of 65°, or considerably above the average of July.

The only remarkable feature in connection with the rainfall was the extraordinary record of 6in. for the month of May, which I believe is unprecedented in this neighbourhood. Of the total of 6in. no less than 3·49in. fell during the 48 hours ending 9 a.m., May 13th, 1·65in. being due to the 12th, and 1·84in. to the 13th. This also established a

"record" both for 24 and 48 hours, at least as far as this district is concerned. In conclusion, I may state that my thermometers are placed in a Stephenson screen 4ft. from the ground, and my rain gauge is at an elevation of 529ft. above sea-level. **B. A.**

Handsworth.

THE SNOWSTORM AND THE WIRES.

[26657.]—THE almost complete destruction of the telegraph system in the home counties on the 26th ultimo raises the question whether its risk might not be partially avoided by a different method of hanging the wires. Travelling in Western France last autumn, I noticed that the wires, instead of being hung on cross-pieces from the poles, had their insulators fixed directly to the poles by short metal brackets. I have never seen this method in use here. It seems to me that while a certain amount of carrying capacity per pole is lost by it, it is more than made up by the much less liability of the line being blown down by a solid mass of snow being formed in the wires: for the wires being formed almost perpendicular, must give hardly any lodgment to snow, which would be blown clean through them by the wind instead of settling on them as it does in the English horizontal system. It also appeared to me that the poles were considerably slenderer than English ones of equal capacity, owing to the less heavy nature of their superstructure. Perhaps a telegraph engineer will let us have his opinion on the subject.

January 3rd. **H. C. Sothern.**

SUGAR ANALYSIS.

[26658.]—ERRATA in letter 26633.—Paragraph 3, line 4: Instead of "To the clean filtrate add sodic sulphide so as to remove the whole of the lead in excess," read, To the clear filtrate add sodic sulphite, &c. **M. O. H.**

RAILWAY SPEEDS AND MYTHS—TIMING OF TRAINS—DEFECTIVE METHODS AND "PERSONAL EQUATION"—ECCENTRIC RESULTS.

[26659.]—AS there seems to be a revival of the public interest—seldom long dormant—in the splendid work now being done by our English express trains, I venture to offer a few hints on the subject with a view to securing the most useful results from the systematic timing of them which appears to be carried on regularly by many fellow correspondents and others. I need hardly say that I am in a position to speak somewhat as an expert, and I feel sure that some friendly hints will be acceptable.

In the first place, it is advisable to have a clear understanding as to the actual possibilities. Do not run away with the notion that speeds of 90, or even 80, miles an hour can be attained by any engines now in use. The former has never been done. The latter (80 miles an hour) was reached on a trial trip by one of the Bristol and Exeter double-bogie engines with 9ft. single driving-wheels, down 1 in 90 *with no load*. But with *one* carriage attached 78 miles an hour was the maximum that could be managed. The G. W. 8ft. engines, specially tried down 1 in 100, could not get beyond 78 miles an hour because of back pressure. No modern engines are adapted for beating these records, as weight-dragging has had to be considered as much as speed. Thus the G. N. 8ft. engines, which have the same cylinder-diameter (18in.) as the G. W., have 4in. longer piston stroke in order to draw heavier loads. This increases their pulling power, but also largely increases the piston velocity required to attain a given speed, consequently lessens the likelihood of their rivaling the G. W. engines in absolute maximum. The Caledonian 8ft. singles would be more likely to reach a higher maximum with light load, as they have only 24in. stroke; but then they have smaller cylinder diameter ($17\frac{1}{4}$in.) and boiler power. This applies also to the L. and N. W. "Cornwall," No. 173. No other engines running at the present time can be expected to achieve higher results, as it has been necessary to aim at weight-pulling power and the maintenance of a fast average up and down hill rather than at extreme rates with light loads or any loads. Hence it may be assumed at starting that speeds of 75 miles an hour, or a fraction over, are the quickest that will be found by *accurate* timing, and that even these will only be met with under very favourable conditions—i.e., moderate loads and falling gradients.

Secondly, it may safely be taken for granted that speeds much exceeding 60 miles an hour even with light trains are *never* attained on rising gradients, and rarely maintained even on the level. This could easily be demonstrated *à priori* on sound theoretical principles, but it is convincingly shown by practice. During my recent tests of every leading type of English express engine, extending over about twelve months, I found this to be an invariable rule. Even the slight ascent of 1 in 1,320 which prevails on the first 50 miles of the G. W. makes a wonderful difference to the engines as compared with the similarly slight descent going the other way. With the average number of carriages composing the two fast expresses (absurdly named the "Flying Dutchman" and "Zulu") the G. W. 8ft. "singles" have usually quite as much as they can do to pass Didcot (53 miles) in the 60 minutes allowed. I have known "Prometheus" in fine weather with six coaches (including five bogies)—equivalent to about 120 tons weight—run through Didcot in 57 minutes; but that was quite exceptional. On the other hand, "Tartar," with seven on (five bogies) and a head wind, lost six minutes to Didcot and eight to Swindon; and "Courier," in fine weather, but with eight on (seven bogies)—weighing about 165 tons—lost five minutes to Didcot and $7\frac{1}{2}$ to Swindon. It is very seldom that 60 miles an hour is steadily maintained, or at any point exceeded in the down run to Swindon, notwithstanding the fast timing. The quick time is made by the maintenance of a high average which is practicable owing to the easy character of the road. When time is exactly kept the distance of 66 miles from Ealing to Shrivenham is run in just 72 minutes, giving a travelling rate of exactly 55 miles an hour. There is a slight loss through the slack at Didcot, and this is made up by temporary acceleration on the short lengths of 1 in 1,320 down between Hayes and Slough, and between Twyford and Reading, also on the level near Moulsford. On those parts 60 miles an hour is sometimes reached, and occasionally 65.

In Vol. XXXIX., at p. 7, you quote an article from the *Engineer* in which this sentence occurs: "The Great Western broad gauge 'Flying Dutchman' and 'Zulu' express trains between London and Swindon run daily on portions of the journey —*where the line is perfectly level—at more than 80 miles an hour* for such short distances." Unless the "80" be a misprint for "60," this statement is wildly inaccurate. Such a performance with any engine now running or ever yet built is simply impossible, as repeated experiments have conclusively proved. As a matter of fact, the G. W. expresses attain a lower *maximum* speed between London and Swindon than any other expresses running out of London, excepting, perhaps, those on the L. and S. W., between Waterloo and Basingstoke. On all other lines higher speeds have to be run down hill to keep time after the loss in climbing to the summits. The G. N. after Potter's Bar, Knebworth, and Stoke Box; the L. and N. W. after Tring, and on the Northampton Loop; the Midland after Elstree, Leagrave, Sharnbrook Summit, and Desborough; the G. E. after Elsenham and Brentwood; the L. B. and S. C. after Merstham and Balcombe, all have to run at 65 or 70 miles an hour down hill to keep time, and even the S. E. and L. C. and D. driving have to exceed 60 at certain points. The G. W. run, where high speeds are really done, is not on the $53\frac{1}{4}$ mile an hour length from Paddington to Swindon, but on the following piece to Bath, which is only timed at 47 miles an hour. (It may be mentioned here that the 11.45 a.m. is not due at Bath till 2.0, and leaves at 2.3 instead of 1.58, as stated in "Bradshaw," the time of the up "Dutchman" at Bath being also given five minutes too early—viz., 12.23 instead of 12.28, the correct time.) Down the Wootton Basset Bank of 1 in 100 passing Dauntsey, and again down the similar incline through Box Tunnel, the trains almost daily run at 70 miles an hour, and often more. On the occasion above mentioned, when $7\frac{1}{2}$ or 8 minutes were lost to Swindon, 4 minutes were gained in each case between Swindon and Bath by running at over 70 miles an hour down the 1 in 100 banks. The up trains, on the other hand, from Swindon to London have a falling gradient nearly all that way, and so the up journey is very much faster. There is nothing to prevent its being run in 77 minutes with moderate loads, and it is usually done under time; but when the weight exceeds 140 tons, if the weather be at all adverse, time is apt to be lost. There is also an invariable reduction of speed up even the short bits of 1 in 1,320 after Reading and Slough. My experience, indeed, has been that the most powerful modern engines feel the slightest rising gradient as a severe check. Let them be running 70 miles an hour just before, directly they get on a rise, down goes the speed by degrees, first below 60 and then to 50, 40, or even lower if the ascent be at all sharp or the trains at all heavy. A speed of 61 miles an hour up 1 in 176 was recently quoted in these columns, but that arose from a pure misconception as to the gradient. The part where that speed was run was in reality 1 in 200 *down*. This, therefore, suggests also that those who time trains should make themselves acquainted with the sections of the line; else they are apt to mislead themselves and others.

But it may be asked, "How is it, then, that we see speeds of 80 miles an hour, or more, recorded in the public prints"? Simply through error or through exaggeration, possibly unintentional. A common mistake on the G. W. is made through the way the mileposts are marked, the number of the mile being repeated with each quarter (from London to Didcot) thus: "$\frac{30}{III}$" for $30\frac{3}{4}$. This has led many persons unaccustomed to the extreme quickness of sight needed for correct railway-timing to mistake three-quarters for a mile. Thus three-quarters (supposed to be a mile) done in 45 seconds would appear to be 80 miles an hour, instead of 60. It is within my personal knowledge that such a mistake has often arisen in this way. Another source of error is in the inaccurate statement of station-distances in time-tables. Of this there are abundant instances in these columns which I could quote if space permitted. A still more fertile source of error is mere looseness of recollection. We can all remember the fierce dispute in these pages about the alleged feat of a G. N. engine which was asserted to have run 12 miles (down the Stoke bank) in 8 minutes. I have no doubt whatever as to the origin of this error. It arose through the common disposition to underrate time and overrate distance in such cases. A friend of high scientific attainments and accuracy who was at a trial of the G. W. 8ft. engines in 1847, told me truly some years afterwards, when I was a boy intensely interested in railways, that the speed reached (down hill) was a mile in 48 seconds (i.e., 75 miles an hour). I noted this down at the time and kept the record. But some years afterward, as his memory of the fact became less distinct, he used to say it was "a mile in forty-odd seconds." Ultimately the fraction disappeared from his mind, and he asserted positively that the mile was run in "40 seconds," and did so in perfect honesty and good faith. I am convinced that in the G. N. case the distance was a small fraction over 11 miles, and the time a small fraction under 9 minutes; say, 11 miles 5 chains, in 8 minutes 55 seconds, a perfectly practicable feat. That would soon become "*over* 11 miles in 8 minutes and some seconds," and then "nearly 12 miles," and finally the fractions would be dropped, and we should get "12 miles in 8 minutes."

Other sensational records are pure exaggerations, though possibly unintentional. On p. 303, Vol. XXXIX., it was stated that an American engine on the Philadelphia and Reading line ran 2·8 miles in 2 minutes, equal 84 miles an hour. An expression of doubt as to this statement brought out Mr. Barnet Le Van (Vol. XXXIX., p. 516) in defence. But his own figures actually showed (apparently unnoticed by him) that the time was $2\frac{1}{2}$ minutes, which at once brought down the speed to 67·2 miles an hour! Another correspondent in these columns some years ago asserted that the L. and N. W. "Precedent" engine ran 80 miles an hour. But he, fortunately, gave us a test of his accuracy. He added that they weighed 53 tons, had 7ft. driving-wheels, and took the 8.15 a.m. down train. As they did not weigh 53 tons, but only 32 tons, 19 cwt., had not 7ft. wheels, but only 6ft. 6in., and as there was no 8.15 a.m. down train, we had little difficulty in appraising the value of that correspondent's "80 miles an hour." A writer in another scientific paper declared he had *driven* a L. and N. W. "Bloomer" ("Una") at 84 miles an hour, and even gave the timing to seconds. But he, too, gave his gauge. He went on to say that the load was 14 coaches of 14 tons each, and that the engine had 17in. cylinders with 24in. stroke. As those coaches weighed barely 12 tons each, while the cylinders are only 16in., and the stroke is but 22in., we could judge of *his* accuracy very easily. The same writer gave an equally mythical account of a run with the 7ft. 6in. Bloomer "Caithness." Yet one more illustration of the eccentricities of "personal equation." A writer asserted that in a "special" from Didcot to Swindon he had run the 24 miles in 17 minutes, or at 84 miles an hour, including starting and stopping, the distance being uphill all the way, at the rate of about 1 in 700. Evidently he must have miscalculated by at least 5 minutes, and possibly much more. But he gave his measure by also alleging that the G. W. engines have "8ft. 6in. drivers," and that they are timed to run the "Dutchman" to Swindon, 78 miles, in 80 minutes, the correct figures being respectively 8ft., $77\frac{1}{4}$ miles, and 87 minutes. It is by this slip-shod way of writing that we get all those fabulous speeds of 80, 90, or 100 miles an hour.

I fear I am trespassing grievously upon valuable space, and therefore will compress the remainder of my remarks. Let me caution all "timers" against trusting to memory. Nothing is more unreliable in such cases. I say unhesitatingly that timing is worthless unless written down when taken. It is also of comparatively little value unless taken with a chronograph or stop-watch. Few people are aware how difficult it is to catch the precise moment of passing a quarter-mile post at high speeds. The tendency is to be late in taking the first and too early with the second. People omit to take the time till the first is well past, and they take the second post directly it comes in sight. Also, they are apt, in the veritable hurry of the moment, to put down minutes wrongly. If a post is passed at, say, 24 minutes

58 seconds, the minute hand is in appearance over 25 minutes, not 24, and so it often happens that the record shows 25 minutes 58 seconds, thus losing a minute in the next length. When an interval of some miles occurs without a post being caught (as must frequently happen through stations, tunnels, or trains intercepting the view) this may be a fertile source of error. Timing through stations is, of course, not a trustworthy test of speed, unless the distances be exactly known; but still, the times should always be recorded, for it will often be possible to know the distance subsequently, and so a good run, whose record would otherwise be lost, might be recorded. It is well, for the same reason, to note times of passing particular tunnels, bridges, and other recognisable landmarks.

I hope these hints and remarks, which are based on large and special experience, may be found most useful and interesting to my fellow correspondents.

Wellington, N.Z. **Charles Rous-Marten.**

RAILWAY SPEED.

[26660.]—It is pleasing to see that Mr. C. R. Marten, p. 393, throws cold water on 90 miles an hour. It is all moonshine. A 9ft. wheel on Bristol and Exeter may have run just 80 miles an hour, but no other broad-gauge engine ever has, and certainly no narrow gauge one ever has.

Time what trains you like, and where you like, and you will not find a higher speed than 75, and seldom more than 72 miles an hour, and plenty fast enough, too, is the opinion of

Practical Man.

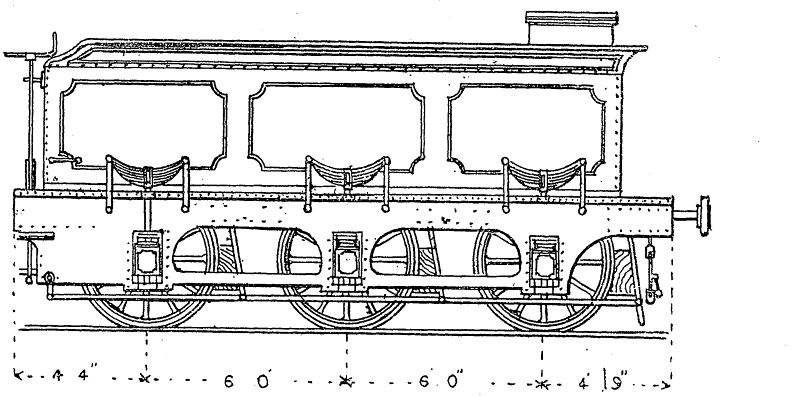
LONG RUNS ON RAILWAYS.

[26661.]—In *Whitaker's Almanack*, 1887, it is stated that a train runs 165 miles, from Dublin to Cork, without a stop; and Edinburgh to Newcastle —124 miles. Would some of our readers say if they have ever travelled in those trains, and if they *do* perform these runs?

Practical Man.

PASSENGER TRAINS AND PARTING COUPLINGS.

[26662.]—The use of some means of apprising drivers of the fact that they have lost part of their load is so important that it does not matter how it is accomplished provided it is accomplished effectually. I can think of no more effective means than an arrangement which would cause the engine whistle to sound, for that would effectually call the driver's attention. Any arrangement must depend upon human intelligence to a certain extent, and Mr. Rogers's objections 2, 3, and 4 would probably hold good; but they refer to details which are quite minor compared to the object of calling the driver's attention promptly to the fact that he has lost part of his load. Mr. Stretton says that an electrical contrivance to warn a driver when his train has parted is of no practical use, and he considers that an efficient automatic continuous brake is wanted to bring each portion of the train to rest. If that contrivance would give prompt warning to the driver, it would undoubtedly be best in the majority of cases; but at what period in the 20th century does Mr. Stretton think it likely that railway companies will fit goods trains with automatic brakes? The letter of "W. F." (p. 392) is a curiosity. Addressed to one of the daily newspapers it might pass; but in the "E. M."! Surely, "W. F." need not tell us that waggons which have broken loose on an up-gradient will run back; and as surely he might have remembered that the driver has a whistle on his engine, by means of which he can "alarm" any signalman within hearing distance, and cause him to promptly block his section. A smart driver would use his whistle directly he found his train had parted. Let us examine the subject. F. and K. are two stations nearly a mile apart; the line dips so as to form a sort of V, with a signal-box at the dip. A train of goods waggons leaves F. to proceed to K, and with the usual snap or jolt at starting a coupling nearly breaks; but a sufficient tug has been imparted to the train to cause the whole of it to follow the engine down the incline, and sufficient momentum is gathered to carry the whole train past the signal-box in the dip. The signalman accordingly gives "line clear," and the signals at F. are set for another train to follow. In climbing the other bank, however, the racked coupling parts, and the hinder portion of the goods train runs back, and if a train with insufficient brake power has been permitted to follow, it will in all probability run into the detached portion of the goods, and no one is to blame—except the companies which allow goods trains to be run without providing some means of acquainting drivers with the fact that they have lost a part of their trains. If the driver of our imaginary goods train had been made acquainted with the true state of matters, he could have sounded his whistle, and attracted the attention of the signalman, who would have promptly blocked the line. Your correspondent "W. F.," does not seem to be aware of the *fact* that in the smash referred to an up train was prevented from running into the débris simply because the driver of the down train which ran into the goods sounded the alarm on his whistle. If the driver of the goods had had prompt intimation of the break in his train, his "alarm" whistle would in all probability have prevented the disaster. **Nun. Dor.**



EXPRESS TRAINS.

[26663.]—I have lately been travelling on the principal English railways, and I now send a copy of my journeys on the Midland Railway. I send the best and the worst run I have had on that line, and I will do the same for my runs on the G. W.R., G.N.R., L. and N.W.R., L. and S.W.R., and G.E.R.

Trusting that you can find space for them, I will send the runs on one railway each week until they are finished, with the Editor's kind permission.

MIDLAND RAILWAY.

Kentish Town to Kettering, 3 p.m. ex St. Pancras. The best run. Oct. 25, 1886.

Miles.	Stations.	Booked Time.	Actual Time.	Speed.
		h. m. s.	h. m. s.	
	Kentish Town...	3 4 0	3 5 30	
5¼	Hendon.........		3 15 0	33·15
13	St. Albans.........		3 30 0	52
10¼	Luton..............		3 41 30	53·47
19¾	Bedford (A)......		4 0 30	62·36
	Sharnbrook (B)..		4 13 0	
22½	Kettering (C) ...	4 30 0	4 28 0	50

REMARKS.—(A) Usual slack through Bedford (B) Slacked at Sharnbrook summit. (C) Slacked at Wellingbro'. (B) and (C) by signal.

Load equal to 10½. Engine 1327. Principal dimensions of loco:—Cylinders, 18 by 26; coupled wheels, 7ft.; bogie ditto, 3½ft.; wheel base, 18½ft. Heating surface, 1,313 sq. ft. Burns 28¾lb. of coal per mile. Tender holds 2,950 gals. of water and 3½ tons of coal.

MIDLAND RAILWAY.

Kettering to Kentish Town, 1.30 p m. ex Kettering. The worst run. Oct. 18, 1886.

Miles.	Stations.	Booked Time.	Actual Time.	Speed.
		p.m.	h. m. s.	
	Kettering (dep.).	1.30	1 30 30	
	Sharnbrook Summit		1 48 30	
22½	Bedford (A)......		2 1 0	44·36
19¾	Luton (B).........		2 26 30	46·47
10¼	St. Albans........		2 38 0	53·47
13	Hendon...........		2 53 0	55·71
5¼	Kentish Town...	2.52	3 0 0	45

REMARKS.—(A) Usual slack through Bedford. (B) Stopped by signals outside Luton for 4 minutes.

Load, 11. Loco 896. Chief dimensions of loco:—Cylinders, 17 by 24; coupled wheels, 6ft. 8in. Heating surface, 1,112 sq. ft. Consumption of coal per mile, 28lb. **French Loco.**

MIDLAND ENGINES, 800 CLASS.

[26664.]—I now send diagram of Midland tender (No. 804), which was drawn at the same time as the engine illustrated on p. 370. The tender ran on six wheels 4ft. 1½in. diameter, and carried 2,000 gallons of water and 3½ tons of coal. Length of tender-frame, 21ft. 1in.; distance between engine and tender at sides, 6¼in.; from centre of trailing wheel of engine to first wheel of tender, 9ft.; total length of engine and tender over frames, 47ft. 2in.; total wheel base of engine and tender, 37ft. 6in. The total weight given, p. 370, 60 tons 14 cwt., is in average working order.

Clement E. Stretton.

Consulting Engineer Amalgamated Society of Railway Servants.

Leicester, 24th December, 1886.

NEW MIDLAND ENGINES

[26665.]—Yes, the new 1667 engines have just been in shops; 1669 has a new boiler, and is doing fine work with the Scotch trains from London now. This shows that all the fault has been in the small boilers. **Loco.**

DOUBLE-ENGINE RUNNING ON THE MIDLAND.

[26666.]—In your journal of Nov. 26th, p. 286, there was a letter by Mr. C. E. Stretton about the long empty trains on the Midland. That, I hear, has made no small stir at Derby; anyway, stir or no stir, it has soon had a good effect. The trains have just been reduced in weight; the empty stock taken off; with the result that one engine can now work its train and save coal, and do it without a pilot engine. Why was this not done months ago? They say attention was not called to it. Then, sir, I say some officials must go about with their eyes shut. Everybody might have seen two engines and a lot of empty carriages day after day, week after week, and month after month. The letter in question in your columns seems to have got before the directors' meeting, and resulted in a resolution to cut down the useless weight. On Monday, 20th ult., the directors' order came into play on the Scotch expresses; the empty Pullman car to and from Edinburgh was taken right out of the train, and two short eight-wheeled bogie coaches took the place of two 60ft. twelve-wheelers —total reduction of train, 30 tons dead weight. Well done, directors, say I. Better late than never; but better if it had been done last September. I hear the Great Northern is to be the first to consider the idea of third-class dining and sleeping carriages. I wish our Midland had been the first, because there is a grand future for this sort of traffic—at least, that is my opinion.

Leeds. **M.R. Shareholder.**

RANGE OF BAROMETER.

[26667.]—I am obliged to I. W. Ward, letter 26653, for his communication. It will be cut out of the "E.M." and put in my notebook. But then, alas, the inmates of a hospital will suffer, because my "read" copies go to a hospital. I know also that a reading-room in a Yorkshire village to which I send the "E.M," (Ours) wouldn't like a mutilated copy.

May I make two suggestions suitable for this period of the year? Let some subscribers club together copies of "Ours" to, say, St. Bartholomew's, Guy's, St. Thomas's, Royal Free, King's College, University of London, Charing Cross, and, say, three or five other hospitals, and let the poor inmates whilst suffering have something worth reading.

I know that I often get rid of weariness or of a headache by reading "Ours," though *sometimes* reading "Ours" gives a headache if subject is too abstruse; or another ache if questions or answers are too absurd. If any of my questions or answers have caused this ill effect, pray let me apologise.

But to return, 2d. a week for 52 weeks is 8s. 8d., and 12 times 8s. 8d. is £5 4s. If approved, put me down 17s. 4d., and ask for cash down. If 15 copies, put me down £1.

(2) Having cared for others and for you (!), Mr. Editor, now one word for myself and the other subscribers to "Ours." I think it would be acceptable if we had a weekly barometer record, to be placed in the same position each week in each issue—say, just before "Letters to the Editor."

and the weekly lecture as to our good manners (!), followed by memoranda of any special rise or fall outside London. This would be a lasting record. I long to see this enduring record, which a newspaper record may be but is not, for the multitude who cannot keep files of newspapers.

A. P. Bower
(A now very old subscriber and well-wisher, constant reader, and constant spoiler of the columns by Queries and Replies).

HORIZONTAL WIND-POWER.

[26668.]—IF I have mistaken Mr. Philip Vallance's definitions, 26632, p. 389, I am afraid I must put some of the blame on him. When we are told that "the sails are made of half a 14ft. deal cut diagonally," &c., we naturally understand that the sails are 7ft. high, or long. But it appears that they were to be really made of a whole 14ft. deal cut diagonally, &c., though the first idea was not disturbed by the context. And when we learnt further on, from Mr. Collingridge, that sails of 7ft. height on arms of only 8ft. length would yield, on Mr. Vallance's principle, a power of four horses, it seemed quite consistent with the greater power claimed by Mr. Vallance for his 14ft. arm, and proportionately greater spread of sail, without going any higher. Such a height as 14ft. never entered my head; and if it be necessary to have so much lumber on a series of arms near the top of a lofty pole in order to obtain a working power horizontally, I do not see what advantage over the old vertical mill is to be obtained by it.

Mr. Vallance, I presume, is aware that it takes a broad sail to exercise any appreciable power ahead at sea when lying within six points of the wind; and that a plank 9in. wide should do so with a weather edge 2½in. thick, may pass with the marines; but the sailors would never believe it. This would render the sails worse than useless for six points on each side of that which brings them dead against the wind, or more than ⅓ of the circle. Also, though it is only at one point that the thick edges of the sails are driven against the wind, yet as they all on the same arm are in the same position, the five, instead of 2½ft., must together present a resistance of 12½ square feet, and this incessantly. For if the machine were making only six revolutions a minute, the interval would be less than a second of time between each of the arms taking the place of its precursor. The thickness of the arms also would offer some square feet of resistance in addition, which makes it all the more wonderful that Mr. Vallance achieved so much success with it: Against all these difficulties he assures us that the story of the seven ploughs is true. But I cannot help regretting that he has to go 40 years back for his witnesses. I was in hopes we, of this age, might ourselves bear testimony to its extraordinary powers, whatever they be; but the question, "Where is it to be seen at work?" remains unanswered.

Mr. Vallance says "the weight is no objection." To my mind it is the greatest barrier of all. Who, for instance, would sleep easy in his bed with such a machine swaying away over his house-top, or even near his dwelling, in gales far short of those that tear down telegraph poles and uproot oaks?

The chief recommendation of a horizontal wind engine is that it can be erected anywhere, provided it is carried above immediately surrounding trees, or builings, and where it is open to a free current of wind from all quarters. It is therefore difficult to understand Mr. Collingridge's excuse for not increasing the power of his windmill. The works below would occupy much less room than a steam-engine with boiler and cylinders, and above, space for enlargement is unlimited, if there were no objection from neighbours on account of its weight and unwieldiness, and the danger of its being shivered to pieces and doing mischief in rough weather.

With regard to the opinion of Mr. B. Boothroyd (26631), backed by his American authorities, wind-power still is applied to many useful purposes besides those he mentions. Is he aware that, apart from those in private hands, there are stated to be no fewer than 12,000 windmills constantly at work in Holland draining and dredging the canals and polders, at an expense to the country of about 4,000,000 dollars per annum? Also his estimate of the average velocity of wind cannot be accepted as decisive. Sailing-vessels have gone to Australia and back to England at an average speed of more than 200 miles a day, calms, light airs, and head winds included both ways; and seven miles an hour, at which he fixes the average of wind, is but 168 miles a day. Besides, there are regions in the latitudes of the Trade winds where an alternate land and sea breeze of good power are almost as regularly looked for as night and morning by those who inhabit there.

A good handy horizontal windmill would be likely to obtain public favour just now; but I very much doubt if it is to be gained by a wooden turret of 30ft. diameter, 14ft. in height, constructed chiefly of loose deals, altogether over two tons in weight, and placed on the upper part of a lofty shaft. Mr. Vallance himself suggests that it would be only suitable for wildernesses and waste places (Dec. 17, p. 346). Something light and handy is wanted that might be set up in our business premises, or over our own workshops. Its medium of propulsion might be canvas, like a British ship, not topheavy *louvre boards* like a Chinese junk.

London, Jan. 3 **Raymond Browne.**

[26669.]—AS the horizontal windmill power has been already illustrated in Vol. X. page 631, I should not think of asking for it again; but if Mr. Boothroyd has any thought of erecting anything of the sort, and will communicate with me at Cootham, Pulborough, I will lend him a working model of one I have.

Wind at seven miles per hour has a pressure of about ¾lb. on the square foot, and I think about 4H.P. may be got from such a mill as I have described. It is true that wind is too uncertain for dependence to be placed on it for any constant supply of electricity, so that it would require to be accompanied by a steam-engine to do the work when the wind failed; but if the position were good, the engine would be seldom required.

Philip Vallance.

[26670.]—I HAVE been much interested in the letters on "Horizontal Windmills." While the field was occupied by the three first writers I did not feel inclined to interfere; but now we have another in the person of Mr. B. Boothroyd, who gives us some facts collated by him during seventeen weeks, which facts have made him an unbeliever in the practicability of horizontal windmills for electric lighting. Seventeen weeks is a very short term to decide a matter of this importance. If Mr. Boothroyd could give us the figures showing the variations in the speed of the wind during that period, it would greatly assist your readers to judge of the correctness of the conclusions he has arrived at. Taking the bare statements, they do not appear to me to justify his conclusions. If there was an average of seven miles an hour during the term, there must have been a speed exceeding, say, fourteen miles during a great portion of that time, and the wheel which would give 2H.P. at eighteen miles would give 1H.P. at fourteen miles an hour, and 1H.P. free of expense for electric lighting is not to be despised. Accumulators that would receive this charge for eight hours would light six lamps of 15c.p. for fourteen hours, or more than four and a half hours for three days. We must not forget that there are twenty-four hours during which the windmill may work, while the light is only required for a few hours daily.

Gwalia.

THE AMERICAN ORGAN.

[26671.]—"COUNTRY SOLICITOR'S" friend has unwittingly bestowed a good bit of praise on the American organ. "You can only pray on it," and let *me* add *always*, and it does the praying so well that there is no need to swear *at it*. I mean Mason and Hamlin's. Some of the family might well draw imprecatory groans from you; not that I have a word to say for such excess of temper. Perhaps the best way to deal with it is to ask those who have long used it, Does it accomplish a fair amount of the promises its sponsors are responsible for? Or, is it like *Punch's* hopeful youth, when asked what his godfathers and godmothers had done for him, replied, "Nothing whatever—neither before or since"?—a perversion of the original intention, I must add. **H. Ussher, B.A., M.D.,** Surgeon.

CHURCH ORGANS.

[26672.]—AMIDST the trade competition as to who shall make the most noise for the least money, it is refreshing to find Mr. Audsley advocating the good old plan of adequate scales and low pressure. It is the only plan to get tone as distinct from mere noise, though the high-pressure scream may be absorbed to some extent in large resonant vaulted buildings. The art *par excellence* of organ building consists in the welding together of unison, mutation, and chorus work into one satisfactory whole, but the high-pressure organs will not stand a proper "chorus."

Mr. W. T. Best holds that no organ requires more than 50 stops. Adding five to this for my particular hobby of a pedal swell organ, I find that everything can be worked in that is necessary, and for this number three manuals are ample with a reasonable system of control.

I quite agree with Mr. Audsley that in a three-manual organ the great should be the lowest.

Thomas Casson.

CHAMBER ORGANS.

[26673.]—I FEEL sure that there are many who, like myself, are glad to welcome the return to articles and correspondence on organs and organ-building in your pages, and it is no breach of confidence to tell you that my attention (as an amateur) was called to it by an organ builder of great celebrity in London, with the result of my taking current numbers, and buying Vol. XLIII. in its entirety.

I think Mr. Audsley would confer a very great favour on many besides myself if he would describe more fully the scale, design, and constructive particulars of two of the stops he has spoken of—one the euphone (known so well in Continental organs), and the wooden violoncello stop of the Schultze model. We have not all the opportunities of seeing pattern pipes; but a drawing would be of great assistance.

I am greatly interested in the articles on Church Organs, and I am extremely glad to see stated the fact, so often omitted, that the great West organs of foreign churches are seldom used for accompaniment purposes. There is invariably, where funds are sufficient, the second organ in the chancel, designed solely and entirely to accompany the choral parts of the service. Would that such a course had been adopted in our Anglican churches! How many fine West organs would have been saved from being boxed up and spoiled in inadequate organ chambers!

I add, for the benefit of those interested, the specification of one of C. Coll's model chancel organs. It is well to notice it is constructed with the object of giving a solid accompaniment to the unison singing of plain song tones and masses.

GREAT.	
Bourdon (metal and wood)	16ft.
Montre	8ft.
Flûte harmonique	8ft.
Prestant	4ft.
SWELL.	
Viole de Gambe	8ft.
Voix céleste	8ft.
Flûte octaviante	4ft.
Plein jeu (5rgs.)	
Basson—Hautbois	8ft.
Trompette	8ft.

No pedal stops; usual couplers.

The pressure of wind is, I believe, rather heavy, and the effect of this organ in the church is most solemn and dignified. **J. B. Croft.**

Barnham Vicarage, Thetford.

CONCERNING THE LUMINIFEROUS ETHER.

[26674.]—IN the letter of your valuable correspondent, Wm. John Grey, F.C.S., last week, it appears to me he makes a very common mistake in asserting that "Sir Isaac Newton imagined that light was actual transference of matter, and upheld this view till the last." This notion appears to me to have been offered by Newton as an hypothesis only, and I can recall to memory many instances where he equally favours the theory of vibration of etherial matter, of which, as far as I know, he may have been the author. Thomas Young, who may be quoted as a good authority, says in his Bakerian Lecture on this subject, "A more extensive examination of Newton's various writings has shown me that he was in reality the first who suggested such a theory." At any rate, Newton says: "Were I to assume an hypothesis it should be this, if propounded more generally, so as to determine what light is, further than that it is *something or other capable of exciting vibrations in the ether*; for then it will become so general and comprehensive of other hypotheses as to leave little room for new ones to be invented" (Birch, Vol. III. p. 249). With Laplace the matter is quite different: he demonstrated mathematically Newton's emission hypothesis to give the only possible mode of propagation of light; but we have had every possible and impossible hypothesis come through this mathematical ordeal, so that we may now take this hypothesis at its worth, it being no longer popular philosophy.

With regard to the ether, this is believed in by many, and it appears to me a very necessary kind of matter for the expostulation of the professor, who would have his reputation seriously injured if, with unbelief, he should have the intellectual and moral courage to assert that he did not know the mode of propagation of light, heat, and electricity through bodies and space by its agency, whereas the amateur may hold any opinion on the subject, or none.

For the above-mentioned sciences you may make the ether just what you require to satisfy the particular case in hand; but for astronomy you must give the ether no property of matter whatever, even the very first indications by which we know matter as such. Thus it must possess no gravitation and no momentum, or no resistance to other matter moving through it; in fact, in relation to the lightest astronomical bodies, it must be *immaterial* or *non-existent*. Some of the demonstrations of the presence of ether are amusing if we refer back a few years: thus Young says it is demonstrated by the *electric fluid*, which it resembles in a certain degree. Sir John Leslie, the

able and original experimenter on heat, demonstrates it by its similarity to *caloric*, which he showed was a kind of liquid heat; but, of course, these ideas are now only ridiculous when the popular theories are past by which they were supported. It appears to me that ether is now made to fill the gap in physical science where we should otherwise be obliged to admit ignorance, and it takes at present a somewhat equivalent place in certain sciences to the once assumed universal forms of matter in relation to ordinary matter, which preceded positive chemistry.

Wm. F. Stanley.

THE LUMINIFEROUS ETHER.

[26675.]—I SEE that Mr. Grey (26642, p. 391) accuses me of writing "in an exceedingly disrespectful manner" about the luminiferous ether; but I must submit that he has confused things a little. What elements of disrespect may be found in my remarks are not applicable to the luminiferous ether at all; I was writing about the newly-generated *electrical* ether, and my disrespect was directed entirely, not even to that imaginary entity, but to the people who take upon themselves to call it from the vasty deep, and, like other conjurors, build up a ghost out of the rags and figments of their own imagination, and try to pass it off as something real.

As a matter of absolute fact, all that we *really know* on the subject is that there is a *something* in space which transmits light; we call that something ether, and there is an end of our *knowledge*. Anything else is either mere guessing, or more or less justifiable hypothesis (the scientific name for guessing), based upon induction from observed facts. Now, such hypotheses are not only legitimate, but useful in science, as long as they are recognised as merely preliminary attempts to form a theory, or as mere experimental illustrations; but it is neither useful nor legitimate to try to give them a fictitious validity, and to convert a guess into a dogma, merely because the guess is that of a great thinker, or appears to offer a convenient explanation of obscure facts. I have nothing to say against the data referred to by Mr. Grey; but I do say that the deduction is absolutely worthless (worthless that is, as to this jelly-like ether), for what is the reasoning? Certain facts are taken as to the relation of elasticity and density to transmission of energy by wave motion in ordinary matter, subject to gravitation and internal friction. Granted; but there is a great gulf fixed between those facts and their application to the unknown something, as to which all we know is that it is *not* subject to gravitation and has *no* internal friction. I refuse to jump that gulf. I say it is sounder wisdom, truer science, to admit humbly that I know nothing whatever about the mode in which this something which we call *ether* transmits energy. *A pretended explanation not only disguises ignorance, but tends to perpetuate that ignorance.* I deny that we are bound to provide some explanation for everything we do not understand. Let us wait.

When Mr. Grey, adopting the dogmata taught by professors who pretend to explain what they know nothing about, says, "This medium, whose properties are rather those of a solid or jelly than a gas, is the luminiferous ether," I have no great objection to offer; but when he goes on, still adopting these dogmata, "it pervades all ordinary matter, no doubt packing itself away among the molecules," I fancy he has got outside his knowledge and within the region of guesses. For my own part, I have considerable doubts. I am by no means sure that this hypothetical ether pervades ordinary matter; or that, in space, it is anything but matter in the ultra-gaseous condition of Crookes's vacua.

But to come back to my remarks, p. 310. Not content with *the fact* that this ether, be it what it may, does transmit light, and making more or less probable guesses at the process, these guessing philosophers are taking to asserting that this ether is electricity—a matter as to which they have not one particle of real knowledge. They seem to think that as they do not know what ether is, or what electricity is, they may properly assert that the two unknowns are one known jelly, and that they may mould and season this "precious jelly" at their pleasure.

I had listened, a few days before I wrote, to a lecture by one of our best professors, who was pleased to tell us all about this jelly, which he said is an elastic, incompressible fluid, filling all space, but contained in a sort of network of material not permitting the fluid to pass, but freely traversed by all ordinary matter. He even showed us a model of the processes by which this fluid is transferred, so as to produce electrical phenomena. The fluid disagreed with me, and my remarks were the result of that mental indigestion.

I had previously made notes of certain remarks by the same professor for future purposes. "The transparency of an electrolyte may be explained by supposing that the percentage of dissociated atoms is too small to perceptibly affect the properties of the liquid in bulk."

Now, the existence of such dissociated atoms is itself a mere wild guess, opposed to known facts. Another time he says, "What if we get 'through the looking-glass' . . . in search of new principles. . . . Helmholtz says that electricity is probably as atomic as matter . . . a substance of negative weight is not inconceivable." Now, I protest against applying the principles of "Alice in Wonderland" to scientific hypothesis. Nor do I admit that the mere circumstance of a guess being made by Helmholtz makes it what the Jesuit casuists call a "probable" dogma—that is, one to be safely adopted, true or not. I once objected to being asked to walk up to the top of a ladder, and then turn its lower end up into space for the next ascent, and I say that all this kind of stuff is worse than nonsense. Another time my friend, the professor, remarks, "There are two obvious ways of *explaining* the transparency of an electrolyte on the electro-magnetic theory. One is to *assume* that the minute and rapidly reversed electro-motive forces *which constitute* light, &c. . . ; the other is to *assume* that electrolytic conduction only occurs among dissociated atoms, &c." I protest that all this is not science; it is pure and simple rubbish, and mischievous rubbish. How can we *explain* anything by *assuming* that something exists of which we have no sort of evidence?

Of course, we may pretend to explain anything, if we can invent whatever conditions we like; but this is dreaming, not teaching. Its result upon its students can only be to produce a set of conceited pedants, who fancy they know all the secrets of the universe, while they are really lost in the fogs of a contented ignorance.

I, at all events, will always be found among those who refuse to bow the knee to this modern Baal. I seek to follow the light of Truth alone. When I do not see that light I am willing to wait. I will conclude with a very pertinent quotation from an American review of my "Electricity," where it is said: "He rattles up the dry bones of scientific dogma in a most uncomfortable manner, but persistently adheres to proved laws in preference to mere hypotheses. He bears particularly hard on the practice of giving a phenomenon a name, and then using the name to explain the phenomenon. This practice has been so much followed in elucidating electrical matters that the author of this book seems to be undermining scientific structures when he tells us that 'we know absolutely nothing about forces which every schoolboy is ready to explain'; yet a little reflection convinces us that popular knowledge did not grasp the principle, but merely the name." The writer of those words has truly perceived the principle which I hold to be the true path of scientific progress.

Sigma.

MR. HIGGS'S COIL.

[26676.]—IN compliance with the desire of Mr Benjamin Boothroyd in his flattering mention of my coil in last week's issue of the "E. M.," I beg to state that I shall have much pleasure in furnishing as many details in the construction thereof as may be required by the readers of your valued weekly.

The instrument was constructed solely for the purpose of working the electrodes in spectrum analysis, a short description appearing in the "E. M." of Oct. 22, 1886, and although it has been in working order (but in an unfinished state) for several months, giving 7½ to 8in. sparks, it did not equal my expectations, which previous experiment had justified—viz., that of obtaining sparks the length of body of secondary or terminal to terminal, a distance of 10in.

It was finally completed only on the day previous to the meeting of the Associated Science Soirée, on which occasion the points were kept at 9in. apart for the greater part of the evening; since then it has been doing the whole distance of the terminals, which is a trifle over 10in., with the same battery power.

Seeing that the subject has been somewhat exhaustively treated in previous volumes, I propose in an early number merely to give sufficient particulars, which, if closely followed, will enable those of your readers so disposed to construct for themselves a coil equal, at least, in performance to the above-mentioned.

Tue Brook, Liverpool. **George Higgs.**

ROAD REFORM.

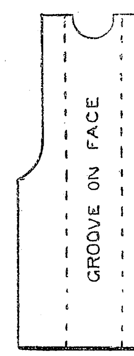
[26677.]—I HAVE long desired to see a reformation of our common roads or highways. I fail to see why such reformation has not taken place ages ago. It is supposed that many of our roads were originally laid out by sheep making their paths between gorse, &c., when the country was in a wild state; and the crookedness of many of our roads seems to confirm this. Other roads were probably made to go out of their direct course over hills in order to keep the pack-horses out of bogs and swamps that existed in times remote; but why such roads should continue to impede traffic in these modern vehicular days, now that Old England has the world to compete with in matters of trade and industries, I cannot reasonably imagine. It cannot be that such roads are expenseless, for on many of them a one-horse load requires from two to four horses, and there is lost time, distance, and fatigue to be added. In many places the distance is nearly double what it needs to be, roads zigzagging and leading over hills for no purpose.

There is no sense in retaining such roads now, for they cannot ease road rates, and they cause the country to pay for an immense amount of work for which there is no return. Suppose an unnecessary road-hill to be twenty yards in altitude, and that the weight of daily traffic up it (including all that there moves) is thirty tons: then the daily work caused by such hill is 4,032,000 foot-pounds, which in a year amounts to 1,471,680,000 foot-pounds, which means 10,950 tons to be lifted at public expense. This for one small hill for one year only! Would it not be better to lift such hill out of our way "once," than that that hill should stand and cause us to lift (in the future) a thousand times its own weight in traffic over it? Perhaps some of our readers and cyclists can give a rough estimate as to how many such hills as the above could (taking high and low together) be averaged in the country, for if this was generally known, I cannot think that road reformation would be far in the future. **Norfolk.**

CUTTERS.

[26678.]—WILL some of our skilled mechanics kindly give an opinion on a suggested alteration in the construction of vertical and other cutters that have grooves on their ground bevels?

What I would propose is to cut a groove on the face of the tool of such a section that would, by its junction with the bevel, produce the desired form of the hollow at the end; the process of sharpening would then act on all the cutting parts simultaneously, and their form and depth would be unaffected by wear. I have tried the plan on the accompanying form only (this is magnified to



make plain my meaning); but I see no reason why it could not be made applicable to all such tools.

In practice I find that a few circular rubs on the iron slab charged with crocus, the bevel lying quite flat, keeps the tool in working order.

The section of the groove on the face of the tool is something of this form, and it ought to extend a little beyond the internal diameter of the hollow at the end.

Ant's Hill, Langharne. **A. Bedford.**

NOTES UPON THE WIMSHURST ELECTRIC MACHINE: ERRATA.

[26679.]—SOME errors have crept into letter 26634 which call for correction. Thus, in the 33rd line, for "unavoidable" read "unavailable"; and I would here add that anyone trying this method would be very liable to be placed in an awkward predicament, by reason of some of the cement getting upon the pin fitting the boss and thus becoming a fixture. On page 390, for "boxwood" read "baywood"; where 4ft. is printed in connection with the grooved standards for glass case, it means the feet or ends of same. The diagram showing the construction of the sectionally made up disc has been left out. **A., Liverpool.**

DOES VACCINATION PREVENT SMALL-POX?

[26680.]—IN reply to your correspondent "Lavant," I assert, with Dr. Allinson, that the national vital statistics of this country, published by the Registrar-General, lend no support to the theory that vaccination is a preventive of small-pox; on the contrary, they prove irrefutably that, concurrently with the extension and most rigid enforcement of vaccination by a despotic law, small-pox has increased.

If we take the annual reports of the Registrar-

General for the years 1854-83, which cover the whole period during which the compulsory law has been in force, we find that whilst in the first 15 years—1854-68—the deaths from small-pox in England and Wales were 54,700; they increased during the following 15 years—1869-83—under the strictest enforcement of a law which secured the vaccination of 95 per cent. of all children born, who survived the age of three months, to 66,447, giving a total of 121,147 under a régime of 30 years of compulsory vaccination.

"Lavant" says that vaccination would be still more preventive if repeated at the ages of 16 to 18; but if the vaccinated die in large numbers under 10 years of age, how are they to be saved by re-vaccination at 16?

Now, the reports of the Registrar-General before quoted show that of the 121,147 small-pox deaths recorded in 30 years no less than 67,472 were of children under 10 years of age.

The fact is, there is not the remotest connection between the small-pox death-rate and vaccination unless the latter *increases* the former, which it would not be difficult to prove; indeed, other conditions being equal, an unvaccinated person is far more likely to recover from an attack of small-pox than one whose vitality has been lowered by vaccination.

Atlantic-road, S.W., Dec. 28. **Wm. Young.**

A QUESTION IN COAL ECONOMY.

[26681.]—REFERRING to the remarks of "Nun. Dor." (letter 26620, p. 369), it should be borne in mind that coals and slack in a chemical works are not exclusively used for generating steam power, but also for mixing purposes and concentrating solutions. The extent of the operations in some of these works may be understood when I state that in the works of the Widnes Alkali Co., Ld., where I am engaged, the annual consumption of fuel is about 170,000 tons, of which not more than 32,000 tons are for engine purposes.

There are also used 40,000 tons of lime and limestone, 17,000 tons of sulphur ore, and 65,000 salt and salt cake, &c., from which result caustic soda, bleaching powder, and other products.

Chemical.

LIFEBOATS.

[26682.]—THE method of anchoring is not the only thing which prevents lifeboats from righting when capsized, for I see that "the self-righting capabilities of the Looe lifeboat have just been tested. The boat was turned over successfully, but failed to right herself, and the two men who were in her narrowly escaped with their lives. A second attempt was made, but no better results were attained. The boat in each case remained on her side." As a matter of fact, lifeboats seem to remain in much the same state as they were when the exhibition of life-saving apparatus was held at the London Tavern somewhere about 1870. There are few of the modern devices stationed around the coast, and it might possibly be advisable when a donor presents a new boat to stipulate for an improved pattern, if such a thing is to be had. Meantime, some dreadful nonsense has appeared in the papers about lifeboats and the means of propelling them. In the course of a leading article upon the recent disastrous loss of lifeboat crews, the *Times* suggests that electricity might be made available as a motive power for lifeboat service. "Accumulators," thinks the *Times*, "might possibly be fixed so as to form a portion of the ballast." To which the *Electrician*:—"Certainly they might, though as ballast they would be somewhat expensive, and for any other purpose storage batteries would be utterly out of place in a lifeboat. It is decidedly unfortunate that the leading English journal should entertain such hazy ideas upon a matter of this character. Apart from such fundamental objections as to the impossibility of keeping the cells always in a condition for active service at a moment's notice, we doubt whether any makers of accumulators would be prepared to supply cells guaranteed to stand the amount of knocking about which must be undergone in such service. The *Times* is possibly aware that accumulator cells cannot be hermetically sealed up. In this connection we may, however, mention that, notwithstanding this difficulty, the E.P.S. Company, after very numerous experiments, have recently succeeded in designing a form of cell which will bear repeated and rapid inversion without serious loss of liquid. In this case, however, the application is only upon a small scale, and any failure of action would tend to the preservation rather than the destruction of human life—that is to say, the cells were designed for use upon a self-propelling torpedo, which will shortly be brought out by Mr. Nordenfelt. One of the boats which capsized off Southport made a voyage of 12 miles out to the vessel. We should be glad to get some idea of the power required to propel a boat with a crew of twelve men at the rate, say, of 10 or 12 knots an hour through a storm such as that of the 6th inst."

It is unfortunate, as your contemporary says, that the "leading English journal" should set out such hazy ideas; but what can be expected from the daily press which talked of a million foot-pounds of force in a small box, and bonneted for the electric light, spring sewing-machine motors, and all sorts of new batteries. This lifeboat business is, however, a serious matter, and a committee of experts, which should include of necessity a number of old beachmen, ought to be formed to report upon lifeboats generally. **Nun. Dor.**

THE HYDRAULIC RAM.

[26683.]—REMEMBERING a dispute in your pages about the hydraulic ram and its principle, I think the following, which I found in the *American Machinist*, may interest some of your readers. The writer says:—

"I received a forcible illustration last summer of the principle upon which the hydraulic ram operates. By a blast in the quarry about 75ft. of 5in. suction pipe was shaken down, the break taking place at an elbow. The pipe lay at the bottom full of water, with the open end about 4ft. above the foot-valve. Wishing to empty it as quickly as possible, I thrust my hand into the valve and pushed the 'clack' open. It opened easily, and the water started out with a rush, but the rush shut the valve with a force that nearly left me fingerless. By substituting a stick for my hand I soon had the pipe ready to put in place again. But the elbow was a wreck, and another one was not to be had very soon, so I extemporised one from a 4in. oak plank. Two pieces 12in. square were cut off, and from two sides at right angles with each other large semicircular grooves were cut to the centre, just fitting the outside of the pipe. Then, with a ⅝in. bolt in each corner, the two halves of my wooden coupling were squeezed upon the pipe. A crack or seam about ¼in. between the two blocks was caulked with hemp, and the pump started. A new iron elbow is patiently waiting now for the wood one to give up its grip; but I think it will take more than the frosts of one winter to end its usefulness."

T. K. C.

APPARATUS FOR PRACTISING CHANGE-RINGING.

[26684.]—I HAVE recently invented an apparatus which can be fixed in a private house for practising "change-ringing." A large room being available, two strong beams, about 18ft. apart, may be fixed across from wall to wall, the ends being built into the walls; smaller cross beams, mortised into these, form with them the lower frame. Upon this a frame, in which the dumb bells are hung, is erected in the usual manner; but the beams, which are above the strong beams, are also built into the walls. There are eight small pits measuring 4ft. 7in. by 10in. In each of these pits is hung a cast-iron dumb bell, with proper wheel attached. The dumb bell is so designed that the centre may be far from the centre of revolution; this result is partly produced by the casting being thicker at the lower part of the bell. The effect of this is that, while the dumb bell only weighs 170lb., it gives the same resistance as a church bell of a much greater weight. In the upper part of the casting is a slit 3in. by 1in., through which passes the wrought-iron stock, on the ends of which gudgeons are turned in one piece with it. To support the wheel a piece of wrought iron passing diametrically across it is bolted to the lower part of the dumb bell, and is firmly fixed to the stock and bolted again to the upper part of the wheel. Its end projects beyond the wheel, and may be used as a stay; but in practice it is found better to ring these bells without sliders. Across the two lowest spokes of the wheel, and concentric with it, is fixed a curved piece of wood, a segment of a circle, the horizontal section of which is also curved on one side, but straight on the other, with flat ends, which are attached to the said spokes. As the projecting part passes its lowest position it presses a button, which forms part of a pneumatic bell apparatus, and thus a gong, placed at some distance below the frame and just above the ringer's head, is made to sound. Instead of the pneumatic, an electric apparatus may be used with the frame. If the gongs are not required to sound, small taps may be opened to let the air out of the tubes. The above should always be used in connection with the well-known "Clapper Stay," which is giving great satisfaction in various parts of the country.

Glanvilles Wootton, Dorset. **E. R. Dale.**

THE new list of members of the Institution of Civil Engineers, corrected for the New Year, shows that there are now on the books 1,556 members, 2,231 associates with corporate privileges, 488 non-corporate associates, 20 honorary members, and 929 students attached, or a total of 5,224. The gross increase in the past twelve months has been 252, or nearly 5¼ per cent.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60092.]—**Navigation.**—I am sorry I have been so long in acknowledging "R. E. F.'s" kindness in offering me a solution to this query; it is owing to my being unable to get the "E. M." sometimes for months after publication. I send an address this week that will find me. Since sending above query I find that there are tables published by Captain Lecky for finding the distance from a headland or mountain by the altitude; but I have not seen them as yet. Perhaps some of the readers of the "E. M." can inform me what formula they are deduced from. The problem is not in common use amongst merchant seamen, as far as I am aware of. I believe it is taught in the R.N.; but it is not in the requirements of the Board of Trade for merchant seamen. The solution given by "A Fellow of the Royal Astronomical Society" is quite near enough for my purpose, as it is only an approximate distance I require (not a rigorously exact one), and one which can be readily found by such tables as are always at hand. I may state the purpose I most frequently use it for is to get an approximate latitude for finding the longitude by chronometer, and also for checking the position so found. My address will be found in the "Sale Column."—D. SHEARER.

[60936.]—**Oxygen.**—I simply mean that by adding salt to the mixture of $KClO_3 + MnO_2$, the production of oxygen can be regulated by applying different amounts of heat.—HOLLAND.

[60982.]—**Chronic Inflammation of Nostrils.**—"Misery" has found many counsellors. May I add my experience (described in my letter to "Necessitous"), which, in my own person, was such as to enable me to assure him of hope. Dr. Allinson, beyond doubt, does good in advocating less animal food; but were he a large employer of labour, as, say, a railway contractor, he would find that if he made his system of dietary compulsory with all his men, their comparison would convince him that his theory is very imperfect. When at the age of 25, I had some six months' treatment at Malvern, confining myself to a purely cereal and vegetable diet; drinking water, and water only; spending the whole day, from sunrise to sunset, excepting meal times and a snooze after dinner, in the open air; a 3lb. loaf of bread being my breakfast, and yet, leaving me still hungry. I ask your scientific contributors to enlighten "our" readers by accounting for this enormous appetite and digestion; after which I propose to offer a few items showing some of the evils of the system which, in hopes of obtaining that which I had never yet possessed, i.e., in health, I had been persuaded to so ascetically follow at Malvern.—THE DISPENSER AT THE FREE DISPENSARY, LYDNEY.

[60990.]—**Steel-McInnes Brake.**—This brake is, to all intents and purposes, extinct, having been taken off the Caledonian engines. For further proof of this, and details, I refer "Inquirer" to Mr. Stretton's "Safe Railway Working," page 169.—C. R.

[60994.]—**Waggon Couplings.**—A plan for tightening up the coupling was shown at the Inventions; but whether all the new couplings work with loose couplings or not depends upon what is meant by "new." If those in actual use, it may be said they are all loose.—J. S.

[60995.]—**Engines.**—Engines which have a small leading wheel run better than those coupled in front.—LOCO.

[60998.]—**Cottage Range.**—This querist can procure a suitable range from any of the foundries which cast things of the kind. There are several patterns, and a good fire at the side of the oven is all that is necessary to cook any joint that can be got into the oven.—P. P.

[61000.]—**Pipe Moulding.**—As the subject of pipe moulding is attracting some attention in your columns, the following notes, contributed by Mr. T. Wathey to the *American Machinist*, may interest your readers. The writer says: Some time since I had to make some special pipes. They were straight on the inside; but the outside looked more like a big jar. They were 2in. thick from the socket to within 8in. of the top; from there they were 1in. thick, so as to be of the same diameter as common pipe. There were 20 pipes 36in. diameter, and 40 which were 30in. The order was like most foundry orders—to be filled yesterday. There were some casings in the shop, used to ram up pipe in; but these pipes could not be rammed up in them because the casings were oblong, and on two sides there would not be more than ¼in. space for the rammer. The casings were made, or supposed to be, in half-segment circles 6ft. long; the pipe wanted was 12ft. long, so four of these segments

would make the length. I made a furnace on the bottom where the pipe was to be loamed up; it was a cheap affair, but answered the purpose very well indeed. I made two plates 3 by 4ft., with two square holes in each to hold the bearing bars. The bars were square, with a shoulder about 2in. from each end to hold the plates against falling in; the bank held them against falling out. A plate for the bottom and a few grate bars made everything complete. The casing being in 6ft. sections, a man standing inside could loam up one very comfortably. Get the two casings on the floor, one over the furnace and the other alongside it. Get inside and put on loam, about ⅜in. thick. If, after you have the loam on, and are congratulating yourself on the nice job you have, it should all slide off, don't get disgusted; that is exactly what happened to me, and I can sympathise with anyone in the same fix. While you are in the casing, let one of the boys get a lot of sticks and shavings ready; then, as soon as you are ready, hoist one section on the other, keeping the joints clean, so as not to throw them out of line. Get a fire started as quickly as possible, or you may have a land-slide. Have a brisk fire for ten or fifteen minutes; then slack it down a little by putting on a plate, with a brick or two under it. The steam will soon begin to come out of the holes; when it ceases you will know the loam is dry. Now for the centres. There are plates for the bottom of the casings that the pipes are cast on. These are turned up in the lathe so you can get a cross with three arms for the bottom and the same for the top, with a hole in the centre for the spindle. As soon as the loam is dry rake the fire out and let down the bottom centre. The most common way of setting sweeps is to put in the spindle and then put the board on; but this will not work well in this case. The best way is to fit the sweep to the spindle, and lower all together, then put the top cross on and centre it. It is a long way to reach from the bottom of the mould to the top, so I made a scaffold, using two pieces of 2in. by 4in. wood, and bored a hole in it 2in. diameter for the spindle, and two holes to bolt the pieces together. To each of these pieces I nailed a half-round board fitted to the spindle. These bolted together will never slip. Get into the casing as soon as possible after getting the fire out, for if it gets cold the loam will be liable to slip off again. One man and two boys made one 36in. pipe in one and a half day, and one 30in. pipe in one day. I had the top end of the spindle squared, so that a wrench 5ft. long would fit it. This was very handy in turning the spindle; one of the boys could turn it. Some moulders may wonder why I had three instead of four arms to the cross. When a man gets into a casing directly after the fire is withdrawn he may want to get out very quickly. Three arms offer less obstruction to his exit than four. The casings are made with a rammer on the side from the top to the bottom. The rammer is rammed up with a draw gate at the bottom. Use this rammer to fill up the socket, or to a foot above the bottom. The other rammer is made by a core that fits around the top of the pipe and outside the centre core, with 12 or 14 grooves cut in stem for rammers, so when you have about 12in. of iron in the bottom rammer you can get it over into the other as quickly as possible. The mould can be dried either where it stands or put in the oven.—P. M.

[61005.]—**Combination.** — It is not easy to answer such a question as this without knowing something of the construction of the rather peculiar organette with 31 reeds. It is possible that the tubes might be closed with pallets, and so "A. B. C." might achieve what he desires with the ordinary harmonium action—that is, keys depressing levers carrying pallets, which, opening the mouths of tubes, would allow the wind to enter. That arrangement could be made removable, so that either paper or keys could be used.—ORGANON.

[61006.]—**Length of Belting.**—As one of the correspondents who replied to this, I have, for satisfaction sake, referred to Rankine, and he gives the length of the straight portions of the belt, when crossed as $\sqrt{C^2 - \left(\frac{D+d}{2}\right)^2}$, which is the same as cosine of angle. Using "Miller's" own figures, this gives $\sqrt{145^2 - 60^2} = 130{\cdot}5$in. nearly, or 261in. for the two straight portions, which is the only point "Miller" seems in doubt about. This agrees pretty well with the 22ft. I gave in my correction, and which was calculated from the nearest table of cosine I had by me. I believe other correspondents were a little more accurate; but an inch or two on such a long belt would not matter much.—T. C., Bristol.

[61007.]—**Polishing Whalebone.**—Whalebone can be polished with pumice dust and water, and a felt rubber, the finish being put on with dry-slaked lime—that is, quicklime allowed to slake in the air, and sifted. Of course, the polishing can be done on a wheel, and the speed may be anything the querist likes.—SAML. RAY.

[61010.]—**Donkey Pump.**—A direct answer to this query would read much like an advertisment, if one is compelled to choose between two good pumps. "Tug-Boat" should endeavour to see other pumps at work, and then, knowing exactly what he wants to do, he will be able to form a better idea of which pump will suit him than can be gathered from his query, and he will be able to answer it himself.—MARINE ENGINEER.

[61022.]—**Leather.**—In complete ignorance of what this querist wants to do—whether he wants to use the colouring matter or to bleach the leather, I can only suggest that after soaking his leather in water he should hang it in a warm bath of sumac, or dip alternately into baths of sugar of lead and sulphuric acid—the latter, of course, very dilute.—NUN. DOR.

[61033.]—**Panorama.**—You want a frame, preferably of iron, and gas-piping will answer and be convenient for different-sized stages. The rollers must be supported in standards, which are held together and apart by the gaspipes, and both should be fitted with a bevel gear at the top, so as to be driven by crank and flywheel, and preferably gear acting on a small horizontal shaft carried on the top of the standards. Gear is better than belt, as there is no slipping, and both standards should be arranged for affixing the gear so as to roll the canvas backwards and forwards.—J. T. M.

[61035.]—**Re cutting Fret Saw.**—There must be some mistake about this fret saw, for blades of the kind generally used for sawing frets are sold at from 4d. to 1s. a dozen. Whatever saw it is, it will scarcely pay a "Young Turner" to grind off the old teeth and recut.—C. K. P.

[61041.]—**Joints in Hot-water Pipes.**—Rust joints would be best, made with sal-ammoniac and iron filings; but perhaps a mixture of white and red-lead well rammed in will answer all purposes. Spongy cast tubes are not fit for boiler work.—T. L.

[61042.]—**Seeds.**—Coat the seeds with gelatine.—J. T. M.

[61043.]—**Power of Gas Engine.**—The power of such an engine will be about one horse.—C. T.

[61045.]—**Spring Motor.**—This is a matter for experiment. There is no formula to answer such a question.—D. G.

[60948.]—**Electrical Replacement Indicator.** —TO "JULIUS."— Thanks for your kind notice. You are quite right in surmising that the diagram in question was drawn under pressure. In any, even the quietest, home circle there is always considerable pressure on anyone attempting to write on scientific or mechanical subjects, unless he can manage to lock himself up in a separate room—a boon that, I fear, few of "ours" possess. I cannot, however, detect any error in the drawing, though possibly I should recognise it instantly on its being pointed out to me. I have, therefore, published my address in the proper column, and should esteem it a favour if you would write to me direct, pointing out what you refer to, as we shall get at it quicker this way than through the "E.M.," and, if it is as you infer, I can publish a correction in the usual way.—EDWARD CONRY.

[61070.]—**Reversing Gear.**—The form of reversing gear for screw-cutting lathes most in use by English makers was designed by James Nasmyth, and a sketch of it is given in the Appendix to his Autobiography published last year. The sketch will enable a mechanic to construct one. Nothing can work better.—R. R. N.

[61070.]—**Lathe.**—The rocking plate rocks on the stud which carries wheel D, which same stud carries the first of the change-wheel train. It is in, or out of, gear, according as the driving is done through the wheels B or C or not. In the

FIG. 1 FIG. 2

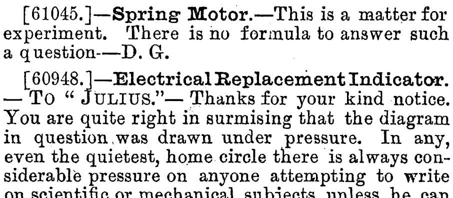


figure the lettering corresponds with my answer given on p. 331. At the two extreme positions of the wheels the plate is clamped with a bolt passing from the back of the headstock through the slot-hole, or in some cases there are two round holes in the plate corresponding with the extreme positions of the gears, through which a pin is thrust to lock the plate. Fig. 1 shows the plate in one position, Fig. 2 in the second position, and the arrows show the direction of motion. The wheels B and C run loose on studs set in the rocking-plate.—J. H.

[61071.]—**Planing Machine Tools.**—I do not see why the dragging of which you complain should occur. A slight amount of angle from the perpendicular is sufficient to throw the tool off. Is there stiffness in the plate? Does it pivot freely?—J. H.

[61099.]—**A Rule of Grammar.** — Having failed to get an answer from Mr. Hall as to who made the rules of syntax, I should like now to ask Mr. Van Eys (p. 395) what is a "grammatical error" —an expression he uses several times?—G. W. M.

[61101.]—**Stars Visible from Bottom of Well.**—"E. D." will remember that I made the statement at which he takes exception simply as a deduction from the opinion of Herschel quoted by him. That it is correct so far as the stars which he mentions are concerned is self-evident, for of these γ Ursæ Majoris (Phecda) has a declination of 54° 22′, and thus in the latitude of London is 2° 52′ from the zenith at its meridian transit; ζ Ursæ Majoris (Mizar) has a declination of 55° 33′, and so similarly never approaches the zenith nearer than 4° 3′; whilst β Cassiopeiæ (Chaph) is even worse situated than either of the two former, having a declination of 58° 29′, and so in its most favourable position a zenith distance of 6° 59′. Surely this will content "E. D." In conclusion, I have to express my thanks to "F.R.A.S." for his kindly reply to my query of last week.—B. A.

[61145.]—**Does it Boil?**—What is boiling? It is merely the steam or vapour generated by heat rising to the surface of the water. It is no index to the heat—i.e., it is no test of the water being at 212° F. Take the late storm, when the barometer was at 27·87 or 28, or 28·2, or 28·5. No water in an open vessel during that storm attained 212° F. If water is heated in a partial vacuum, ebullition will take place many degrees below 212° F. If under pressure, then the ebullition point is raised. The term "boiling" misleads.—R. S. T.

[61145.]—**Does it Boil?**—It appears from the remarks of "Weald," p. 374, that his particular point is simply the distinction between boiling and evaporation. The distinction is very simple: evaporation takes place at all temperatures and pressures—at a rate which is, however, related to temperature and pressure; even solid ice evaporates. But there is a point of temperature, variable with pressure, at which the liquor can no longer be heated beyond that temperature; all excess of heat applied is used up, not in heating the liquid, but in converting it into vapour—that is to say, the distinction of the boiling point relates to the liquid, not to the vapour; but the rate of evaporation increases as the temperature rises, and appears to increase suddenly at the particular boiling point, because when that point is reached there is a sudden increase in the available heat.—SIGMA.

[61145.]—**Does it Boil?**—TO MR. S. BOTTONE. —Thanks for yours, p. 374; so explicit and clear. Neglecting more palpable manifestations, would you not say that displacement of atmo. by vapour is characteristic of boiling, and that in all non-boiling evaporation the requisite expansive stress is wanting? And in non-boiling condition, however hot the water, is vapour "given off" otherwise than passively (i.e., surrendered to absorbent atmo. above)? Does increasing steam as boiling approaches, with cauldron upon fire, result from growing expansive stress, or is increase solely due to increasing temp. of solvent (viz., air above surface, with analogy to solution of sugar, &c.)? If the latter, then any idea as of semi-ebullition, so seductive, is absolutely wrong. This is the point. Advice from a mind necessary; no good applying to any scientific book or Book (on legs). To "W. A. S. B."—I must object to your statement that I "concealed" a presumed belief in my query; and also to the insinuation, on whatever ground, that the query was other than bonâ fide and sincere, as I have explained it to be. The protest against "polysyllabic ebullition" at which you rejoice is your own and not mine; my own remark had a different bearing, which you missed.—WEALD.

[61171.]—**Electric Railway Signals.**—The new system now worked through the Severn Tunnel is Spagnoletti's improved plan. When one signalman accepts a "be ready" for a train, he unlocks the lever in the box in the rear, that man takes off the signal, then he puts it back to "on" after the train has gone, and the first man locks it again till that train is clear; it is very good and simple. —ELECTRIC.

[61167.]—**Water Tanks.**—If you take an ordinary carpenter's slide rule and look on the C line for the number of gallons you are dealing with, under that on the D line you will find a number which expresses the depth and width. If your dimensions are all in inches refer to the A line for the gauge point 174, below that on the B line will be the length of your tank. If your dimensions are in feet, or feet and inches, the gauge points will be different. By varying the position of the slide you can alter the dimensions to any extent, whilst the capacity remains the same. Although

I have taken some time to describe it, the actual operation is a matter of a few seconds. I give an example what are dimensions of a parallelopiped to hold, say, 56 gallons; I say nothing of frustrums of cones:—

174 gauge point		A
39 length		B
	56 gallons	C
	20in. square	D

—J. F., Auld Reekie.

[61218.]—**Lighting Optical Lantern.**—I use a 24-cell battery by Schanschieff, which gives 36 volts and supplies current to an incandescent Swan lamp of about 20 volts resistance, the result being that the lamp gives a very white and steady light of some 75 to 80 candle-power. One charge of the battery suffices for four hours' work, which can either be taken continuously or by instalments. The energy of the liquid is not then exhausted, and the solution can be transferred to the cells of a dark room or other lamp, and afterwards worked out. The solution costs 5s. per gallon, which at first sight appears rather high; but as each gallon produces from 27 to 30 ounces of quicksilver, which the maker repurchases at one penny per ounce, the cost of work is really brought to a very moderate figure, and when the very simple management of the battery and its thorough efficiency are taken into consideration, the results, in my opinion, are thoroughly satisfactory. No porous pots are used, and no fumes or smell produced. The battery is charged by simply pouring into each cell so much of the solution as will about two-thirds fill it, and the whole of the elements are let into the cells simultaneously, and as easily taken out. The battery is, in fact, as easily used as an oil-lamp; whilst it is free from the great heat, smell, smoke, and other objectionable features of oil, and also gives a far better light. Schanschieff's advertisement appeared in the "E. M." early in the year, and Mr. Christopher Davies spoke very favourably of the battery early in the summer, I think. The portable box containing my battery measures 21in. long by 8½in. wide by 14in. high, and forms a convenient stand for the lantern.—LANTERNIST.

[61223.]—**Balancing Millstones.**—I presume "Chatteris" has not the patent balance to his stone, so it is of no use to try to instruct him in that; but may be he has a great lump of lead in the back of the stone to obtain the standing balance. If so, this is undoubtedly the reason of its "dipping" when running, as its raises the "centre of gravity" upon that side. He may obtain a remedy by getting a piece of iron D-shaped in section, about 1in. thick and 1½in. broad at centre, tapering both in breadth and thickness to ends, length about 1½ft. to 2ft., and putting this upon opposite side to where dip is well up the top hoop. "C." might find it advisable to try it at one or two places temporarily before fixing, with a small bolt in each end, either tapped into the hoop or the hoop cut through and nuts leaded into the side of the stone. If "C." does this, I think I may promise him a sure cure for the stone dipping. P.S.—To find the exactly opposite place to the dip, get a piece of wood, shape it to thin wide point, rest it on the bed-stone, then gently cant it up when the stone is in motion, and it will just touch where it dips. If "C." now takes his colour brush which he uses for his staff in one hand, holding his piece of wood in the other, he can touch the back of the stone at the same time as it touches his stick, and so show the heavy side.—WILL.

[61233.]—**Permanent Way.**—The only kind of rails used on the Continent are those with flat bottoms. They are nailed on wooden sleepers, or fastened with a little iron wedge to steel sleepers. —HOLLAND.

[61233.]—**Permanent Way.**—A full description of the construction and working of Continental railways is given in Mons. Ch. Couche's work on "Permanent Way," translated from the French, sold by Messrs. Dulau and Cie, 37, Soho-square, London, dated 1877. A description of Mr. Webb's metallic permanent way was given in the *Engineer*, May 1, 1885, p. 497.—T. ATKINS.

[61239.]—**Circular Saw.**—There is not, that I am aware of, any exact relation in size; but for a saw ranging from 12in. to 18in. diameter, the shoulder would be about 3in. in diameter; for one from 6in. to 8in. diameter, from 1½in. to 2in. If the saw heats, it is in consequence of being forced or from want of packing and oiling. The guide need not be so long as the diameter of the saw; but a considerable portion of its length, one-half or more, must stand ahead of the saw, so that the wood may have a certain amount of initial guidance as the saw commences its cut.—J. H.

[61241.]—**Chronic Catarrh.**—This will probably be called ozœna, resulting from, not climate nor diet, but scrofulous constitution, and inherited. I have had the treatment of several somewhat similar conditions, and although marked improvement generally soon followed, yet permanent cure was tedious. "Necessitous" can at once commence one of the most useful remedies thus:—At any chemist's shop get a long glass-stoppered 1oz. phial, half-fill it with a mixture of equal parts glycerine and sulphurous acid. Close the mouth and one nostril, inhale or sniff the vapour into the open nostril, the quantity of vapour being regulated by covering more or less the mouth of the phial with the tip of finger. Act in same way with the other nostril. Do not attempt at being heroic, but cease for the time being, when the vapour causes pain. Repeat the operation several times daily for, say, a week. A week's treatment with sulphurous vapour will no doubt induce "Necessitous" to study the medicinal action of other drugs in attenuated doses, the medicinal action of which is now admitted by the great authority, the *Lancet, vide* the paragraph p. 366, on Borated Fish, in "Ours." "Necessitous" will also find kali bichromate, 3 ×; mercurius 10 datus, 3 ×; mercurius cum creta, 3 ×; silica, 3 ×; graphites; phytolacca; and many others, one and all, afford convincing proof of benefit.—THE DISPENSER AT THE FREE DISPENSARY, LYDNEY.

[61243.]—**Failure of Amalgamation.**—If this querist will turn up No. 1,122, Sept. 24, 1886, page 82, second column, he will find particulars of what I have found to be a "splendid dodge." Nothing can be easier, cleaner, or quicker. Price about £8.—S. BRETTON.

[61243.] — **Failure of Amalgamation.** — Thanks to "Sigma"; but I had noticed his reference to the addition of oil. I really am afraid to try it, lest it should introduce further complications by getting on the carbons and in the pores of the porous cells that are none too open already. Perhaps he will tell me where I can see an account of the original experiments and the exact method of mixing, and much oblige.—M.M.I.SC.S.

[61249.]—**Boiler for Boat.**—I have used successfully, for the purpose of heating a boiler to drive a pair of marine engines, 1in. stroke, ⅝in. cylinder, three of those French spirit lamps where a centre tube contains a wick, outside of which is another circular wick. These three burners I have transferred from their lamps and fitted them into one cistern 8in. long by 5in. wide, 1½in. deep. They keep up easily 30lb. of steam. The arrangement of open wicks supplied by a cistern outside of boiler, as usually sent out by the London firms for this purpose is a delusion and snare—the spirit is wasted, the wicks are charred, and probably the boat catches fire.—C. H. F. C.

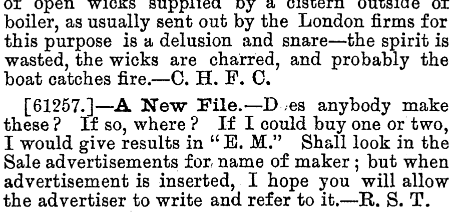
[61257.]—**A New File.**—Does anybody make these? If so, where? If I could buy one or two, I would give results in "E. M." Shall look in the Sale advertisements for name of maker; but when advertisement is inserted, I hope you will allow the advertiser to write and refer to it.—R. S. T.

[61260.]—**Dip for Brasswork.**—Warm your previously-cleaned work, give coating nitrate of silver, 60 grains to the oz.; blacklead if necessary, then lacquer.—S. BRETTON.

[61261.]—**Mirror Galvanometers.**—If brass bobbins are used, they should not be metallically connected. The insulation resistance is higher with ebonite bobbins. A galvanometer for condenser-work should have a large number of turns, and the needles should be damped as little as possible. I have fitted galvanometers with removable vanes and dampers. They can then be used for a variety of work.—G. BOWRON.

[61264.]—**Safety Valve.**—"London Brum" will find the blowing-off pressure to be 55lb. per square inch (nearly) by the following:—28lb. weight × 13½in. length of lever = 378; this divided by 2·75 area of valve, multiplied by 2·5 fulcrum (6·875) = 54·981b. per sq. in.—DROFSIDDE, Belmont.

[61266.]—**Induction.**—Mr. A. E. Conti, one of the cleverest practical electricians of the day, has devised a simple method of effecting this. Let L represent the disturbing circuit (be it telephonic



or telegraphic), and F the telephonic circuit influenced by it. Let the wire F be coiled into a parallelogram as shown, so that at X it comes close to the disturbing wire. By duly regulating the number of coils, it will be found possible to make the induction set up in X, exactly balance and neutralise the contrary induction in F.—S. BOTTONE.

[61268.]—**Soldering Lamp.**—I find Hacking's patent soldering blowpipe answers excellently for this purpose; price about 1s. 6d.—S. BRETTON.

[61274.]—**Cell.**—Many thanks. Have advertised address.—FIX.

[61278.]—**Hot-Air Motor for Organ.**—I have used a Rider's hot-air engine to blow my chamber organ during the past eight years, and have found it admirably adapted for the purpose. Hayward Tyler and Co. are the makers, and they will, if you have gas, supply a gas burner as the source of heat, which gives positively no trouble. You must, of course, have special bellows. Mine I made myself, with automatic arrangement for the feeders to feed into one another when the reservoir is full, and to return to their duty when the reservoir is about three-parts empty. Ordinary ingenuity will enable you to effect this. My bellows are about 20ft. from organ; but the supply of wind is perfectly regular and always ample.—C. H. F. C.

[61279.] — **Rhea Fibre.** — In reply to Geo. Edwinson, I hope shortly to have some band, round and flat, suitable for lathework, &c. I will then advise where it can be got. At present I have some hundredweight of line for twisting, which can be seen at 218, Gresham House, London, E.C.—URTICAN.

[61280.]—**Link Motion.**—If you can refer to "Rankine's Steam-Engine," page 498 will answer your query as to Stephenson's link motion, and possibly the others also. The method given is a close approximation, and finds the equivalent throw and lead of a single eccentric to do the work of the two eccentrics when the block is in a given position of link. The result is that the throw is reduced as the block moves to centre of link, until ultimately it is less than the lap, so that the port is not opened in mid-position. If you cannot obtain access to Rankine, the Editor will possibly reproduce the diagram if you desire.—T. C., Bristol.

[61281.]—**Worm-holes in Violin.**—Reply to 61195 applies equally to your case. See last week's "E. M."—S. BRETTON.

[61281.]— **Worm-holes in Violin.**—Remove strings, bridge, tailpiece, &c. Dissolve 1oz. of naphthaline (albo-carbon) in 4oz. of good benzoline. Pour the mixture liberally over the instrument, so that it soaks well into the wood. Cover the instrument with a blanket for an hour or so, then stand it in a current of dry air. You will be bored no more.—S. BOTTONE.

[61282.]—**Length of Belting.**—Using Rankine's formulæ, as in my reply this week to 61006, the length of each straight portion of belt (when open) is $\sqrt{C^2 - \left(\frac{D - d}{2}\right)^2} = \sqrt{186^2 - 24^2}$ = 184·4in., or 15ft. 4½in. nearly. The single angle is evidently $\frac{4}{31}$ = ·13 nearly, or 7½° as nearly as my tables give; so that arc of large pulley embraced = 180 + 15 = 225°, and of smaller pulley 180 − 15 = 165°. Total length of arcs = $\pi\ 10 \times \frac{225}{360} + \pi\ 6\frac{165}{360} = \pi\ \frac{3240}{360}$ft., or 28ft. 3⅓in. Total length is, therefore, 28ft. 3⅓in. + 30ft. 8¾in. = 59ft., say.—T. C., Bristol.

[61282.]—**Length of Belting.**—In this question the formulæ will differ from those of (61008) p. 329, being with the same notation for open belting.

$$\text{Sin. } \phi = \frac{D - d}{2\ c}$$

$$L = \left\{ D\left(\frac{\pi}{2} + \varphi\right) \times d\left(\frac{\pi}{2} - \phi\right) + 2\ c \text{ Cos. } \phi \right\}$$

In this example D = 10ft., d × 6ft., and c = 15·5ft.

$$\therefore \text{Sin. } \phi = \frac{4}{3} = \text{sin. } 7^\circ\ 24'\ 49''$$

$$\therefore \phi^\circ = 7{\cdot}4136^\circ$$

Hence arc. ϕ = 7·4136 × ·0175 = ·1297

$$\frac{\pi}{2} + \phi = 1{\cdot}5708 + {\cdot}1297 = 1{\cdot}7005$$

$$\frac{\pi}{2} - \phi = 1{\cdot}5708 - {\cdot}1297 = 1{\cdot}4411$$

$$\therefore D\left(\frac{\pi}{2} + \varphi\right) = 10 \times 1{\cdot}7005 = 17{\cdot}005\text{ft.}$$

$$d\left(\frac{\pi}{2} - \phi\right) = 6 \times 1{\cdot}4411 = 8{\cdot}6466\text{ft.}$$

$$\text{Cos. } \phi = {\cdot}99165$$

$$2\,c \text{ Cos. } \phi = 31 \times {\cdot}99165 = 30{\cdot}7411\text{ft.}$$

$$\therefore L \qquad \therefore L = 56{\cdot}3927\text{ft.}$$

Erratum.—In the result of (61008) p. 329 there is an error: L there should be 42·4171, not 22·4171, as will be obvious from the preceding line.—MILVERTON.

[61284.]—**Electro-Magnet.**— Two Leclanches give two to three volts, and an indefinite number of ampères, according to resistance. Use a bar of good soft iron, 15in. long, ⅝in. in diameter; bend it into a horseshoe, so that the legs stand about 4in. apart. Wind each limb with about 1lb. No. 22 s.c. The attractive power of an electro-magnet varies inversely as the cube of the distance.—S. BOTTONE.

[61285.]—**Screw Tool.**—Where is your difficulty? Are you striking the thread by hand-chaser, or cutting up in a screw-cutting lathe? In either case if you can strike the thread to correct pitch and not "drunk"—the thread, I mean, not yourself—I can't see why you cannot get them to fit, unless the inside and outside tools are of different angles of thread.—T. C., Bristol.

[61286.]—**Heating by Means of Paraffin.**—If I understand rightly, you cannot use this effectively without a blast of steam or air, and therefore it is not fitted for boilers for heating a greenhouse. There may be a paraffin oil which burns like ordinary oil without blast. If so, my reply will not apply to such paraffin oil.—R. S. T.

[61286.]—**Heating by Means of Paraffin.**—After wasting some pounds in experiments with hot water, I find by far the cheaper and most effective mode is to use Gillingham's hot-air stoves; the price ranges from 35s. upwards. A paraffin lamp is used as the heat generator. No attention required after lighting for nine hours.—S. BRETTON.

[61286.]—**Heating by Means of Paraffin.**—I should try a large flat lamp of tin with several wick apertures, as many as you may think necessary for the size of your boiler. You could make it yourself, soldering up the tin and soldering and riveting (with little rivets made out of thick copper wire) the wick tubes, which must be a good fit to the wicks. The little toothed wheel of the ordinary paraffin lamp will not be necessary, as you can pull the wick up to the requisite height with the fingers or a pin each day. Keep the bottom of the boiler scraped pretty clean from all coatings of soot, tar, &c. If your lamp should not burn well, and the wick should get soon charred, cut a hole in the top, say, 2in. diameter, and cover it with wire gauze soldered carefully all round the edges.—EDWARD CONRY.

[61287.]—**Tempering Gun-Lock Springs.**—Heat the spring to a red in a charcoal or clear fire, judging the colour in the dark; harden in water. Smoke it all over with a candle or gas smoke, and heat it on a hot plate until the smoke has burned off, then drop into water. N.B.—A little practice is required, and even when that has been obtained, failures occur occasionally.—SAML. RAY.

[61287.]—**Tempering Gun-Lock Springs.**—To harden and temper gun-lock-springs, go to work as follows:—(1) Make your spring of a bright red (not a white welding heat), dip in cold water; (2) take out of water, hold over fire for a few seconds, keeping it on the move till the water on the spring is dried up, and the spring is just hot enough to be held in the hand. Now dip the spring in oil, any oil (candle is often used). Turn the spring over and over, so as to distribute the grease evenly. (The object of warming the spring is to cause an even distribution of the oil). Now have a clear fire. No more smoke than possible. Lay your spring on the top of the fire, turning it in all ways, sides, top, and ends, every second. Do not let it rest more than a second without shifting or turning. Soon you will find your spring all ablaze, or rather the oil on it; when you see the oil blaze, with a tongs lift the spring off the fire, hold it over the fire, say, 6in. above; hold the spring during all stages by the small wire-like stud; but never forget, while the oil is alight, to still keep turning the spring over and over. As soon as the grease ceases to blaze give the spring one or two turns on the fire, but not for more than two or three seconds. Now take spring away from the fire and allow to cool—do not cool it. The foregoing is the method we gunmakers adopt, and if you can follow out the instructions you can't fail. Mind, if your main spring is too long or too short, no matter how well it may be tempered, it is apt to come to grief. Then, do you forge your own? But give your address in the "E. M." if you don't succeed, and I will give the whole secret from beginning to end. No, it is no secret; but I am diffident about taking up too much of the Editor's space. Springs for ordinary locks. Do you mean door and box locks, same as for gun locks? I have made hundreds of them; but where the box-lock spring, &c., is small, it is best to use a penny dip or spirit lamp and blowpipe.—ARMOURER.

[61288.]—**Carmine.**—The following recipe I have tried myself, and have obtained excellent results; it is from a work by Piesse:—Take 9oz. of carbonate of soda and dissolve it in 27 quarts of rain-water, to which are added 8oz. of citric acid; when brought to the boiling-point, 1½lb. of the best cochineal, ground fine, is added and then boiled for 1¼ hour; the liquor is then strained or filtered, and set by to cool. The clear liquor is then boiled again with 9½oz. of alum for about 10 minutes, and is again drawn off, and allowed to cool and settle for two or three days. The supernatant liquor is then drawn off, and the sediment which is fallen to the bottom is filtered and washed with clean cold soft water, and is finally dried by evaporating all the moisture. The result is fine carmine.—CATO.

[61291.]—**To Impart the Appearance of Age to Delicate Wood-Carvings.**—Prepare metal box or cupboard as nearly air-tight as possible, and in it expose your work to the fumes of ammonia. S. BRETTON.

[61291.]—**Ageing Wood Carvings.** — Ammonia gas darkens wood very sensibly; but the stains most used in France and Switzerland are: (1st) Dried walnut shucks boiled in eight times their weight of water; apply cold. (2) Red American pearlash, ½oz.; burnt umber, ½oz.; water, 1 pint. This is very intense in colour, and must be diluted with water if required for lighter tints. Both these dyes to be applied with a stiff brush to insure touching the hollows.—S. BOTTONE.

[61292.]—**The Serious Accident at Carlisle.**—The hose pipe got frozen up between the engine and tender, hence vacuum could not be created. No. of Midland engine 1580, has since been sent to Derby for repairs.—ROVER.

[61292.]—**The Accident at Carlisle.**—The serious accident at Carlisle, which very fortunately was not as disastrous as it might have been, was caused by the failure to act of the non-automatic vacuum brake upon the 8.50 p.m. London and North-Western mail from Euston. The North-Western engine, City of Liverpool, came into collision with Midland engine No. 1580 a considerable distance north of the Carlisle platform. To save the reputation of the dangerous brake, the blame is, if possible, placed upon the unfortunate driver. A rule says, "Drivers must, when approaching, leaving, or passing through the citadel station Carlisle, proceed with caution, and have their engines or trains under sufficient control to be able to stop short of any obstruction that may be upon the joint line, whether the signals indicate danger or not." In the present case the driver did his best to obtain control over his train; but when the brake failed to act he was powerless. This accident is another which results from the North-Western Company neglecting to adopt an efficient automatic continuous brake. — CLEMENT E. STRETTON, Consulting Engineer Amalgamated Society of Railway Servants, 40, Saxe Coburg-street, Leicester, 1st Jan.

[61293.]—**Compound Loco. on Cal. Ry.**—The engine proved useless. It left Perth for Carlisle with the Highland express on Saturday, Dec. 18, but failed between Carstairs and Carlisle; at the latter place, when it arrived, the gear was all out of place and only one cylinder in use. The Saturday previous, with the same train, the engine failed utterly at Carstairs. Yes, the number is 124, and it was at the Edinburgh Exhibition. The engine has since been patched up and sent to St. Rollox, where it is being attended to under the direction of Mr. Drummond.—ROVER.

[61295.]—**Turning Slate.**—Use carbonado. Slate will never (in reason) turn the nose of the tool; it will cut rock, rock-crystal, and hardened steel.—R. S. T.

[61296.] — **Gas - Burners.** — In reply to "W. S. A. B.," burners consuming a mixture of gas and air have the gas jet so adjusted that a certain definite proportion of air is drawn in with the gas. When the burner becomes heated the air expands, and as the burner is constructed to pass only a definite *bulk* of air, the expansion by heat reduces the actual quantity of air drawn into the burner, destroying the correct proportions, and causing the flame to have a deficiency of air mixed with the gas. If the burner is cooled the proportions correct themselves and the flame again becomes clear.—THOS. FLETCHER.

[61297.]—**Pepper Mill.**—I am not engaged in this; but the foreman at Messrs. Dell, of London, told me French burr stones are used for grinding pepper, but that there is a little difference in the dress of stones to that for wheat, &c., the ordinary stones, with a top runner, being used.—T. C., Bristol.

[61298.] — **Armature.** — The Cabella armature will be found fully described in the recent edition of Prof. S. P. Thompson's book on "Dynamos," at p. 124.—BOBADIL.

[61298.]—**Armature, Cabella's.**—A form of ring armature recently devised by Signor B. Cabella closely resembles the form of Gramme armature. It is built up of copper strips. These are separately cut out, and consist each of a straight piece, having two arms projecting at right angles; a sleeve of insulating material is placed over the axle, and round this these copper pieces are arranged to the number of some 240 or so, having their arms projecting symmetrically round in two radial sets, one near one end and the other near the other. The channel formed thus between the two sets is lined with insulating material, and then entirely filled up with soft iron wire wound round. Then straight strips of copper 8 millimètres broad and 2 millimètres thick, are screwed across the outside, nearly parallel to the axis, from the ends of one set of radial projections to the ends of the others, forming a parallelogram section. But in order to connect the ring all round in a continuous circuit, these external strips of copper are connected at their two ends to pieces which project, not from the same internal copper strip, but from adjacent strips. Thus an external bar will connect the anterior end of the first strip with the posterior end of the second, and so on. Every third strip is carried along the axle, and connected to a segment of the collector. According to Prof. Ferrine, one of Cabella's armatures placed between the poles of a 60-light Edison ("Z," old pattern) instead of its ordinary armature, increased its powers so that it could be used for 150 lamps. More recently Signor Cabella proposed to make the external strips of iron and very deep radially, so as to dispense with the iron wire winding. See Thomson's book on "Dynamo-electric Machinery," pages 125 and 126.—S. BOTTONE.

[61299.]—**A Capricious Dynamo.**—I should suggest that the caprice is that of someone who has meddled with the connections of the field-magnet coils.—SIGMA.

[61299.]—**A Capricious Dynamo.**—The series coils on your field-magnets are the cause of your trouble. The back current from your bath flows round them and reverses the magnetism when the shunt coils are nearly inactive. You are also probably working the machine at a lower speed than it was made for. As for the residual magnetism, seeming irregularities in a mass of iron, which is made of hard and soft metal united, are not worth puzzling over. Disconnect the series coils of your field-magnets and use the shunt only. The machine was not intended for plating purposes; but will do very well without the series coils.—L. MILLER.

[61301.] — **Amateur Workshop.** — Brass foundry; yes. I believe it is a rule absolutely without exception. It is so in the case of the most refractory metals, as gold and platinum, as well as in that of metals used for solders and fusible alloys. —J. H.

[61304.]—**Emery Wheel.**—Buy them. Don't try to make unless you have plenty of leisure, plenty of apparatus, and, above all, plenty of spare cash. If you want extra good, get them made of corundum by the makers of dental wheels. If you will try and make them, first make sure (of which I am far from sure, and even believe to the contrary) that glue will not be found to be the real and efficient binding material—certainly not if to be used wet.—R. S. T.

[61304.]—**Emery Wheel.**—The querist who wishes to make an emery wheel of emery and glue should insure his life before he attempts to use it. If he wants a solid emery wheel, let him buy one properly made, or make some emery buffs by procuring suitable discs of willow or alder, coat the edge with glue, and sprinkle on emery, renewing as required. A wheel compounded of emery and glue would be what is known in the shop as a "caution"—that is, it would not only be dangerous, but it would not do what it is required to do, which, by the bye, is not stated.—SAML. RAY.

[61305.]—**Aluminium in Dentistry.**—"Story" overlooks the fact that aluminium is extremely soluble in weak organic acids, such as vinegar, and is therefore unfit for dental purposes.—THOS. FLETCHER.

[61305.]—**Dental Composition and Aluminium Solder.**—"Story's" last question as to solder is perhaps right and proper to be answered, and is, indeed, an interesting query; but is it right to ask manufacturers how the "compositions" of their trade are made? "Story" may be an opponent. "Godiva" is a well-known article. Should the makers be expected to give the receipt?—R. S. T.

[61305.]—**Dental Composition and Aluminium Solder.**—Seeing that the "Stent," "Godiva," and "A 1" modelling compositions are private property, it would be more in keeping with the "fitness of things" for "Story" to apply to the proprietors for the formula. Up to the present date there is no aluminum plate or solder in the market suitable as a base for artificial dentures, because it is subject to oxidation in the mouth, very much the same as zinc, as also being deficient in the needful strength to resist wear and tear, like the gold or dental alloy plate.—DENS.

[61306.]—**Question in Mechanics.**—This has been answered very fully by "M.I.C.E.," in October or first half of November, I believe. Perhaps "M.I.C.E." will give you the number. —T. C., Bristol.

[61306.]—**Question in Mechanics.**—A similar query to this was replied to by me in the "E. M." of Sept. 24th, page 91, under the heading "Hydrostatic Pressure." The resulting equation being $x = l(1 - \sqrt{1 - s})$ where l is the length of the rod or beam, x the length of submerged portion, and s the specific gravity. In the present case $l = 12$, $s = \cdot 7$. If these are substituted in the above, we get $x = 5\cdot 43$ft., which agrees with the answer given

in the query. As regards the thread taking a vertical position, the submerged portion is pressed upwards by a vertical force acting at its centre of gravity, the other portion being similarly acted upon downwards, both these being vertical forces. Now, if the suspending thread is sloping, there will be a horizontal pull or thrust, and as there is nothing to counterbalance this, the rod must move sideways until the thread is vertical.—M.I.C.E., Bath.

[61308.]—**Amateur Workshop.**—You can only get such small quantities by applying at a brass foundry, where you could no doubt get a bag full for a few pence.—J. H.

[61309.] — **Photographic — Removing Varnish, &c.**—Make a strong solution of common washing-soda in hot water. When cold, immerse the plates in one by one. Allow them to stand 12 hours. The varnish films will be found to float off. If the plates are gelatine plates, they must be put in a saucepan with cold water, and a bit of soda as big as a walnut, and then boiled for five or ten minutes to melt the gelatine. Methylated spirits will dissolve varnish; but not gelatine. If, however, it be desired to remove the varnish from the negatives, without destroying the film, methylated spirits will do for collodion pictures, and benzole for gelatine. The second query would require an advertisement to reply to it. Look in the advertisement sheets of this year's *Photographic News Almanac*.—S. BOTTONE.

[61310.] — **Electricity.** — An induction coil giving 3in. spark would do this effectively. Price about £8.—S. BRETTON.

[61310.]—**Electricity.**—To kill a dog, perhaps a strong battery of Leyden jars would be most suitable. They would, of course, require to be charged by a good electric machine. A powerful induction coil might also do; but the jars would be be cheapest.—BOBADIL.

[61310.]—**Electricity.**—A good induction coil, giving about 2in. spark, and costing about £2 to make, would kill a dog if the shock were made to pass along the spinal column. But would it not be more merciful to use prussic acid, or the carbonic-acid chamber?—S. BOTTONE.

[61310.]—**Electricity.**—This is a large question. It goes from the battery for the diamond light on the hair made in a thimble to the biggest dynamo made. A man was killed at one of the exhibitions by putting both his hands on a dynamo, and so "short-circuiting." If so, a dog could be made to do so, and he would be killed on the spot as the man was. The query suggests a possibly humane death for half-starved or injured animals. Only let the current be strong enough to insure instant death—no lingering.—R. S. T.

[61310.]—**Electricity.**—It depends a good deal on the dog and the degree of vitality he possesses. There are certainly electrical machines in existence, and plenty of them, that would kill a dog, or 20 dogs, in an instant; but the cheapest are far beyond what any humane society would care to spend, as they range from the £500 arc-lamp dynamo to the £20 induction coil. I have killed a cat with a 1in. spark, and should certainly think the same means would do for a dog; but these powerful coils are dangerous playthings. Any experimenter who gets even a ½in. spark through him will have cause to remember the incident for a very considerable period; and in handling and adjusting coils, unless great caution be observed, the experimenter is very apt to get an accidental shock, and such an accident, with a coil powerful enough to kill dogs, might possibly produce entire or partial paralysis for life. Probably a specially-wound coil would have to be made, as some current (i.e., a fat spark) is required. A ¼-amp. spark at sufficient tension will kill almost any of the more highly-organised living creatures, from the human species downwards. A much more satisfactory way of disposing of animals is stifling with charcoal fumes, morphia, or ordinary coal-gas. The latter is the method employed at the Dogs' Home.—EDWARD CONRY.

[61310.]—**Electrical Slaughter.**—There are plenty of machines which would kill a dog, or an induction coil would do it. The best way would be to charge a battery of Leyden jars up to the required degree.—SIGMA.

[61311.]—**Water-Resisting Cement.**—Is there any objection to marine glue?—S. BRETTON.

[61311.]—**Water-Resisting Cement.**—Will not Portland cement—either neat, or 1 of sand to 1 of cement—do for this?—T. C., Bristol.

[61311.]—**Water-Resisting Cement.**—The cement made of rubber which can be dissolved in naphtha called water-proof cement. I forget its other name. It is made of rubber and shellac. Buy it; don't make it, or be careful of setting yourself and the house, or both, on fire.—R. S. T.

[61311.]—**Water-Resisting Cement.**—Under what conditions is this cement to be used? Hydraulic cement will answer the conditions stated in the query; but perhaps "Selim" wants something more. Aquarium cement may possibly suit him: Take three parts each of litharge, fine white sand, and plaster of Paris, and one part powdered rosin. Mix into a paste with boiled linseed oil, to which a little driers has been added, and let it stand for several hours (mix at night and it is ready in the morning); but five is long enough. Be sure to have all ingredients reduced to fine powders and mixed intimately.—SAML. RAY.

[61311.]—**Water-Resisting Cement.**—There are various kinds of cements, each adapted for a special purpose. You do not say for what purpose you want the cement. For insulators—sulphur, lead, or plaster of Paris mixed with a little glue to prevent too rapid setting. For tanks—Portland cement. For glass and metal—best and purest gum arabic put into a small quantity of water, and left till next day, when it is of the consistency of treacle. Calomel is then added to make a sticky mass, and well mixed on a glass or china plate with a spatula or knife-blade. No more should be made than is required for immediate use. The cement hardens in a few hours, but it is better to leave it for a day or two.—EDWARD CONRY.

[61313.]—**Making Cotton Fabric Fireproof.** Prepare a solution of tungstate of soda in water, about 4oz. to the pint. Soak the articles in this solution, and hang them up to dry.—S. BOTTONE.

[61313.]—**Making Cotton Fabrics Fireproof.**—What is meant by "fireproof"? A solution of alum or sal-ammoniac will render most textile fabrics uninflammable; but the best thing is a solution of tungstate of soda, to which a little phosphate of soda has been added.—NUN. DOR.

[61313.]—**Making Cotton Fireproof.**—Soak it in strong solution of alum in water. Experiment with different strengths on small pieces of material, as if you have the solution needlessly strong it crystallises on the threads and renders the fabric clammy in wet or damp weather.—EDWARD CONRY.

[61314.]—**Footpaths.**—If the footpaths have ever formed part of a "right of way," the farmer must not plough them up, even if they traverse his fields.—SAML. RAY.

[61315.]—**Joints in Water-Pipes.**—Ten years ago I laid similar pipes, only of larger size, under the bed of a navigable river, and used rings of sheet lead to make the joints. The work was and is entirely satisfactory.—SILEX SEADRIFT.

[61315.]—**Joints in Water-Pipes.**—If faced joints, use red-lead putty, and as little as you can, pulling the joint well together; or you might obtain some soft "vulcanised fibre" washers from Mosses and Mitchell.—T. C., Bristol.

[61315.]—**Joints in Water-Pipes**—1. Get some old rope, worn and soft, and rub red lead well into it (red lead, in powder, worked up to a paste with boiled oil); then lay the rope in a ring on the surface of one flange, lapping the ends neatly over one another, having previously worried them out pretty loose, and bolt other flange down on it and pull up tight. 2. Similar old rope, with powdered chalk and water in a wet paste. 3. Similar old rope, or thick cord plaited in three and well-rubbed with powdered plumbago and grease, as little of the latter as it will work with well. 4. Ordinary flat-plaited lampwick with red lead (as in 1), or white and red lead powder (two-thirds to one-third), or chalk; this makes a very neat joint. For cold water all these will do, and without no extreme pressure are about equally good, with perhaps the first for preference.—EDWARD CONRY.

[61317.]—**Gilding on Glass.**—There is a process described in "E. M.," December 18th, 1885, page 315, in which the glass is painted with nitro-muriate of gold and the gold then reduced by hydrogen. I do not know whether this is the process you mean; but I hope it may be of use.—LONDINIENSIS.

[61319.]—**Photographic.** — To "BOBADIL" AND G. EDWINSON.—The acid must be entirely driven off the chloride of gold by heat.—BOBADIL.

[61320.]—**Static and Potential.**—The former case is, as you state, potential, as the spring tends to recover itself; but, in the case of the string, the stretching is practically *nil*, and has, therefore, no perceptible tendency to fly back. Of course, it stretches a trifle, and if the weight rested on the table it would compress that a trifle; but it would not jump up if weight were suddenly removed, however light the table.—T. C., Bristol.

[61321.]—**Brake Failure.**—The vacuum brake failed to act promptly. Midland vacuum, engine 1748.—ROVER.

[61321.]—**Brake Failure at Appleby.**—The Midland up express ran past Appleby because the automatic vacuum brake failed to bring it to a stand at the platform. The number of the engine was 1748.—CLEMENT E. STRETTON.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

60763. Clarionet, p. 203.
60764. Pyrophorus, 203.
60769. Capell Fan, 203.
60777. G.N.R. Locos, 203.
60792. Achro. Objective, 204.

60990. Steel-McInnes Brake, p. 292.
60991. Brakes on the North-Eastern, 292.
60992. New Midland Engines, 292.
61014. Chocolate Glaze, 292.
61018. Optical Lantern, 293.
61029. Gourd Drinking-Cups, 293.
61037. Indigo-Dyed Serge, 293.

QUERIES.

[61322.]—**Induction Coil.**—To MR. BOTTONE OR E. CONRY.—I am constructing a coil; but when asked what sort of coil it is I cannot answer, as I get confused with the terms induction, medical, and intensity. Please say if they are all got up the same way. If not, what is the difference? I would like an intensity coil, also to be used as a shock coil. Can I use a tube regulator?—D. NICOL.

[61323.] — **Back Shaft for Sliding and Surfacing.**—To "J. H.," OR OTHERS.—Would it be asking too much if "J. H." would give particulars for applying a back shaft to the lathe he described in his articles some time back, or will someone do the same for a 6in. centre lathe?—T. C. C.

[61324.]—**Hardening and Tempering Small Saws.**—Would someone oblige with instructions as to the best way for doing this? Saws 1½in. in diam., and very thin. They are used entirely for cutting metal, and the difficulty is to avoid warping.—T. C. C.

[61325.]—**Fitting Glass Stoppers.**—Will someone instruct querist how to grind the stoppers of cruet bottles to make them a good fit?—W. CHICK.

[61326.]—**Pump Valves.**—May I trouble "T. C., Bristol," further to tell me the length of plug and shell of ¼in., ⅜in., ½in., ¾in., and 1in. steam cocks of first-class quality, with highest pressure they will work well? Is it better to screw them up in their place with a lead washer, or screw up with red lead and hemp?—YOUNG TURNER NO. 2.

[61327.] — **Potentiometer.** — To "SIGMA." — In measuring the E.M.F. of a cell by the potentiometer method, two other cells are usually employed—viz., a standard cell in series with a galvanometer, and a cell or battery having an E.M.F. greater than that of the standard cell, against which it is balanced by means of a variable resistance. Is this second cell essential? Would it not answer to connect the ends of the potentiometer wire with two Daniell cells in series, thus giving a difference in potential of $1{\cdot}079 \times 2 = 2{\cdot}158$ volts, and divide the potentiometer wire into 2,158 equal parts, so that by using one galvanometer in series with a cell, its E.M.F. could readily be determined to ·001 volt? I wish to fully understand this subject. Will you kindly assist me?—ELECTRICAL STUDENT.

[61328.] — **Electrical Measurement.** — To "SIGMA."—I am experimenting with different voltaic combinations, using for my experiments small single cells (elements about 3in. by 1in.), and wish to construct a compact form of instrument to measure the E.M.F. and current yielded by each combination. I have thought of a tangent galvanometer having a ring about 8in. diam., wound with one turn of copper band for measuring current in ampères, and a great many turns of fine insulated wire for measuring E.M.F. in volts. Would an instrument so constructed be likely to answer my purpose? A range of eight or ten ampères and three or four volts will be sufficient. What must be the resistance of the fine wire coil? Will 500 ohms be sufficient?—ELECTRICAL STUDENT.

[61329.]—**Dynamo.**—Many thanks to Mr. Bottone for his prompt and specific reply. I will follow his advice and make my dynamo of the A Gramme pattern. I mean to have the F.M.'s forged, and want to know the diameter, and whether there would be any advantage in forging the pole-pieces, or is cast iron better? If a casting, is it essential it should be soft? There appears in figure of Gramme a plate joining the pole-pieces. Is it of brass, and is it insulated from the pole-pieces? There also appears a rod from lower pole-piece to the right-hand side of frame. Is there one from upper pole-piece to left side of frame, and what is their use? How many sections should I have in the armature, and what the diam. of the commutator? Is it 3lb. of No. 16 on each magnet? 8lb. is what is recommended in 61119, where the power is only half. It will require 16lb. of No. 16 to give "a little more" resistance than the 4lb. on armature. No one will more gladly welcome your article on ring armature than—BRIAN BORU.

[61330.]—**Legal—Bad Dry Plates.**—I bought some plates for lantern transparency, and I found they had lost their sensitiveness. I returned them to the vendor, who said he was only an agent. He spurned the idea of allowing for them, or exchanging. He advised me to take them to the makers. I told him that as he had taken the money he was responsible to me, and not the makers. There was no fault in development. I am an expert hand at the same makers' plates. This is a question which concerns many besides myself. I believe the plates became damp while in the agent's warehouse. I shall be glad to know the law on this point.—J. W. ELPHEE.

[61331.]—**Electric Light.**—Will any kind reader of "Ours" inform me if a cable containing 19 copper wires No. 18 B.W.G. will supply more than twenty 20c.p. incandescent

lamps a distance of 300 yards from dynamo? Also what is the cause of filaments breaking in two, about ½in. from connection of platinum wire? I have two of Edison-Swan lamps gone in this way.—ELECTRIC.

[61332.]—**Speeding Millstones.**—To "T. C., BRISTOL," OR "GLATTON."—I have a water corn-mill. Water-wheel shaft runs 5 revs. per minute, which is unalterable. On the end of water-wheel shaft hangs a bevel wheel of 120 cogs, 3in. pitch, which works into a pinion on vertical shaft of 40 cogs. On top of vertical shaft is a spur wheel of 180 cogs, working into the stone pinions of 24 cogs equal to 112 revs. (I am aware the size of spur wheel must be guided to some extent by the number of stones placed around it); but if we leave this out of the question, it amounts to this: the power makes five revs. and the stones are required to go 112. How is this speed best obtained? I have heard some say they do not like to get up too much speed in the first motion; others that you cannot get it up too soon. Does it cause any waste of power whether you get it up in the first or last motions? If you will give me your opinion, and state your reasons fully for such opinion, I should take it as a very great favour, for I am at a loss to decide, and as I am about to have a new set of machinery in, I am anxious to obtain some reliable advice (which I cannot obtain in my neighbourhood), and the opinions of the men here who will do the job are so opposite.—A COUNTRY MILLER.

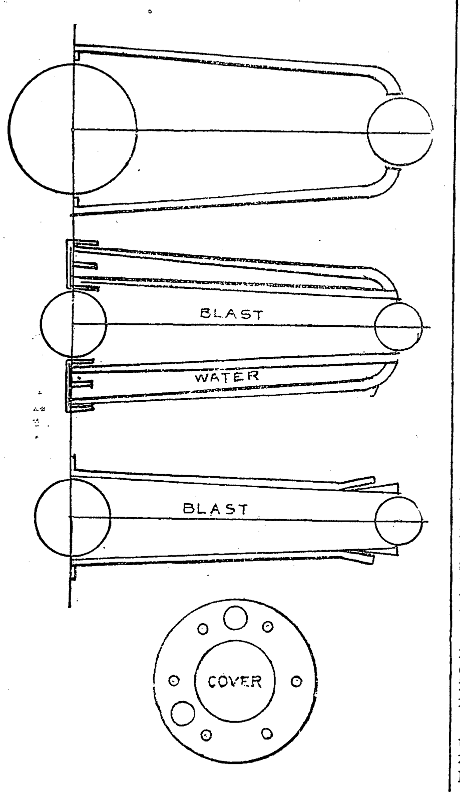
[61333.]—**Air Compression.**—I require an air-pump that will compress air to the highest pressure possible rapidly. Will your readers give me information how to make one, and the means usually employed to obtain the above results which I require? I have looked through "E. M." (as many as I now have of them) since it came out at a penny, but the information seems very imperfect. Also, will any reader give me his opinion which maker is the best for my purpose?—UNSUCCESSFUL.

[61334.] — **Preparation for Mixing Bronze Powder.**—Would "Nun. Dor." oblige by giving further particulars of the special varnish he mentioned in last week's issue, and is the powder mixed in the varnish, or is it simply varnished after the powder is on, and will you give proportions of lime and turps used?—R. BENNETT.

[61335.]—**Clark's Soap Test.**—Will any reader tell me how to use Wanklyn's standard soap solution and a graduated dropping tube? I have to ascertain the degrees of hardness in water, and how many grains carbonate of lime does one degree mean, and how much washing soda will precipitate one grain of carbonate of lime?—BOX 4, Northallerton.

[61336.]—**Geometrical.** — If the sides of a right-angled triangle which contains the right angle be the diams. of two circles, prove that the square on the part of the common tangent included between its points of contact with the two circles will be equal in area to the triangle.—PUZZLED.

[61337.]—**Brazing Copper Water Tuyers.** — Would some reader inform me the best appliances for brazing copper tuyers, as shown in drawing? There is a



ferrule fitted in the single tube, which I cannot succeed in brazing to circle. Could it be done in a forge fire, or is a furnace required for such class of work?—IMPROVER.

[61338.]—**Coiling Wire.**—Could any correspondent tell me how to coil a continuous length (or otherwise) of wire, rectangular in shape, such, say, as the coils used in the manufacture of the expanding metallic garter? When I wrap a piece of wire round a flat piece of steel (rectangular) I find I cannot get it off; but when forced off, instead of lying flat as the coils of Garter does, the "spring" comes out of wire, and they form a sort of Archimedean screw.—WILLIAM.

[61339.]—**Steam Boiler.**—Will any of "ours" kindly inform me what working pressure a vertical copper boiler will safely stand 3ft. high from crown to bottom, diam. 1ft. 6in., thickness of body, 4-16ths; crown and bottom, 6-16ths; 30 copper tubes, 1in. diam. Also, what power would it be considered?—W. F. D.

[61340.]—**Gramme Dynamo.**—I think of making a Gramme dynamo of the following dimensions: Armature, 3in. long, 4in. diam., ½in. thick, made of 18 B.W.G. iron wire, covered with tape, 3lb. of 18 d.c.c. wire on armature; F.M., 12in. long, with 3½lb. of 16 d.c.c. wire on each F.M.; pole-pieces, 5in. high, 3in. wide, 1½in. thick. The poles are 1½in. round, wrought iron, and 7in. long. Please say if it is as it should be, and what power I may expect.—ANXIOUS.

[61341.]—**Colouring on Parchment.**—Would any kind reader inform me how to colour plans on leases, &c., properly? My colour penetrates into the parchment here and there when it is an inferior skin, and looks patchy. Is it usual to damp the skin, or apply any kind of preparation before colouring?—T. GRIFFITHS.

[61342.]—**Problem.**—Will some mathematical reader kindly solve the following problem in solid geometry? Given three planes, A, B, C, cutting each other. The inclination of A to B is α, the inclination of B to C is β, and the angle between the line of intersection of A and B, and the line of intersection of B and C is ω. Find the inclination (θ) of A to C. Can any correspondent recommend a good work on the analytical geometry of—THREE DIMENSIONS?

[61343.]—**Milling Machine.** — Which is the best milling machine extant for brass tap and valve making? Sketch will oblige—BRASS FINISHER.

[61344.]—**Lathe Matters.**—Will any master of the lathe kindly instruct me how to chuck corozo (vegetable ivory) and coquilla nuts, and the best articles to turn them into and tools to use? I have had a few of such presented to me.—A NOVICE.

[61345.] — **Pneumatics.** — Given two air-vessels balanced in water (gasholder fashion), the larger of which contains 200 cubic feet of air at a pressure of 5lb. per sq. in., and the smaller 14 cubic feet at a pressure of 5¼lb. per sq. in. (both above atmosphere). If the two vessels are connected by means of a pipe, what would be the diminution of bulk in the lesser vessel due to the distribution of a part of its contents in the larger vessel, it being understood that before making the connections the larger vessel is full and unable to rise, and that any increase in pressure in it can only be met by displacement of a part of the water in which it is balanced? What is the specific volume of air at each 5lb. per sq. in. increase to 100lb. above atmospheric pressure, and what work is there on pneumatics dealing explicitly with the subject?—PNEUMATIC.

[61346.]—**Cementing Lenses.**—I am desirous of cementing together a 3in. Grubb view lens, which I have taken apart to clean. The Canada balsam I have seems to bear a yellowish tint. How can I decolorise it? Should I mix anything with it? Am I right in assuming the above lens will cover 12 by 10?—J. H.

[61347.]—**N.E.R. Locos.**—Could any correspondent give a description and dimensions of the new compound express and goods engines which have lately been built for this railway? A description of the cabs in particular would be acceptable; they seem just the thing that has been wanted. A sketch would interest many of our readers.—W. T. C.

[61348.]—**Length of Chord.**—Is there a simple arithmetical method of finding the length of chord when the radius and the length of arc are known?—J. F., Auld Reekie.

[61349.]—**Spinning Metal.**—Will one of these, our kind friends, give me a few hints on spinning metals in the lathe? Have heard of such a process, but am quite ignorant how to proceed.—A NOVICE.

[61350.]—**Air-Gun.**—A reader of the "E. M." has an air-gun. It is made of gunmetal, and shaped to imitate a walking-stick. There is a screw about 1ft. from the handle end of the gun. On unscrewing this, a nipple (like that of a pistol) is seen on the longer part of the gun. In the shorter part, or head, of the stick is seen a strong spring. Should this spring be close against the trigger? How is the air forced in to load the gun?—HEXHAMONIAN.

[61351.]—**Dip for Ironwork.**—Having a quantity of light wrought-iron work to black, would be glad if any reader would help me. Have tried dipping them in tar, but they take too long to dry. I want to do them cold, if possible, and dry quickly.—VILLAGE BLACKSMITH.

[61352.]—**Lantern Exhibition.**—Would some kind reader aid me in the following? I intend giving a magic-lantern exhibition, to last during three hours. How many slides ought I procure for that time, and what subjects would be most suitable? Can good slides be made from the "lithographic lantern pictures," which I see advertised?—TERRANOVA.

[61353.]—**Spiral.**—I would be much obliged if any reader would give me any formula, or describe any means of, estimating the length of a spiral. I have books showing how to estimate circumference of circles, &c., but no mention of a spiral.—SPIRAL.

[61354.]—**Photographs.**—(1) Why do photographs turn yellow after having been mounted? Red spots also frequently appear. (2) With what plates can moonlight photographs be taken?—DUSTY MILLION.

[61355.] — **Astronomical Photographs.** — Will "F.R.A.S.," or others, kindly give a little of the *rationale* of star photography—(1) an idea more or less of the photo. instrument employed, (2) length of exposure, (3) if for fixing position of a group of stars an instantaneous exposure would be sufficient, so as to avoid use of equatorial as in the particular case unnecessary? Whether, for instance, a Zenith arrangement is made so as to compare with star map after photo. is taken? Meaning of "southings"?—PYNX.

[61356.]—**Force Pump.**—I have an ordinary lifting pump, which I want to replace by a force pump, the water to be lifted from a depth of 25ft. and discharged to a height of 80ft. over a distance of 120 yards. Will some talented reader kindly say what kind of pump would meet the purpose best, what diam. of pipe would suit best, and diam. of pump barrel? Water required daily, say, 150 gallons. I was thinking of driving pump from a horizontal shaft with eccentric and flywheel, with two handles, one each side of framing, and put a couple of men at each. Would this do?—YOUNG MILLER.

[61357.]—**Shafting.**—I have ten brackets and shafting to fix to wall. Shafting, 13ft. from the ground. How am I to commence about the job and have shafting level and in line? Is such information to be had from any book?—ANOTHER WORKMAN.

[61358.]—**Dead Point.**—How am I to get the dead point of a horizontal engine, so as to test slide valves?—ANOTHER WORKMAN.

[61359.]—**Engine Brasses.**—How are the brasses accurately marked for boring in the bearings of triple expansion engines of the vertical type, and how are the tunnel bearings accurately lined for the shafting?—ANOTHER WORKMAN.

[61360.]—**Revolving Apparatus.**—I am using as an advertisement in my shop window an octagonal frame carrying panes of ornamental glass with lettering. Stands 9in. high, diam. 10in., weighs about 4lb., and revolves on a spindle worked by a band passing from the grooved wheel to an electro-motor. I wish to make something like clockwork, which can be wound up in the morning and run several hours without trouble, as I find the motor a trouble. Can any reader assist me? The simpler the mechanism the better, the motion to be very slow, so as to enable the lettering to be read as it revolves.—S. N. P.

[61361.]—**Orthographic Lens by Ross.**—I have seen one of these lenses, ⅝in. diam. (combination), and was struck with the marvellous definition and depth of focus. I am told by the makers they have discontinued to manufacture this kind of lens. Will any of your readers who know something about this lens kindly give me their opinion about its general usefulness? I am aware it is slower than the more modern lenses.—A. B. C.

[61362.]—**Faulty Dynamo.**—To MR. BOTTONE, OR E. CONRY.—I have made a series-wound dynamo, with upright wrought-iron cores and laminated pole-pieces top and bottom. The cores are 4in. by 3½in. by ⅜in., the yokes 8in. by 4in., weight 20lb. It is wound with 7lb. No. 16 d.c.c. wire. The armature is laminated, 4in. by 2⅜in., and wound with ¾lb. No. 20 d.c.c. wire. The insulation is all right, and when run at 2,000 revs. does not give as much current as a pint bichromate cell; but when the cell is coupled in circuit with F.M.'s it makes two 10c.p. lamps red, coupled in parallel. I have tried it coupled in every way I can think of, with no better results.—R. M. G.

[61363.]—**Decrease of Sun's Heat.** — Balfour Stewart says ("Elementary Physics," p. 220) that the decrease of the sun's heat when it is near the horizon is due to the greater obliquity of the surface of the earth to the sun's rays. Surely this can only account for a little of the difference, as a surface, held even perpendicular to the sun's rays, when it is low in the sky, is very little heated. Is not the absorption by a greater extent of atmosphere the chief cause?—J. C. O.

[61364.] — **Driving Lathe.** — Will some of our engineering friends give me the best practical way of driving a 4½in. screw-cutting foot lathe with a 2-man Bischop engine (gas)? The pulley on engine is 13½in. diam., with 5in. face. The lathe has V-pulley and wheel for gut. I am desirous of knowing size of pulleys, and best plan of placing them to get the necessary speeds for general turning of wood or metals, the shafting to be suspended from ceiling.—C. A. F.

[61365.]—**Paraffin.**—The other day I asked an old gunsmith what he used to keep his guns, &c., free from rust, to which he replied neatsfoot oil, and on my suggesting the mixing of a little paraffin with it, he said that all mineral oils turn more or less to water. Is there any foundation for this statement? I have used paraffin often enough on machines of my own without the least appearance of water.—G. M. S.

[61366.]—**Super-elevation of Railway Curves.**—Will any kind reader give simple rules for super-elevation of outer rail on curves? I note the Gov. Inspector, reporting on the accident on the G.N. of Ireland, talks of the "ordinarily received rule" giving for a 30-chain curve at 45 miles an hour 4½in. elevation. How to work that out in simple figures is what will oblige—A PLATE-LAYER.

[61367.]—**Weight of Engine.**—After the run off at Portadown, the engine was weighed with chimney towards Dublin and then towards Belfast. I see by the papers the engine was heavier when in one direction than the other. How can this be?—LOCO.

[61368.]—**Newcastle and Carlisle Ry.**—Wanted, the date when this line was opened and the class of engines first used on it.—INQUIRER.

[61369.]—**Gedge's Railway Coupling.**—Will any reader say what this coupling is, and also if it was tried at Nine Elms or Derby?—CAR. DEPT.

[61370.]—**Block Tin.**—What is it? Tin plate, we know, is iron or steel coated with tin. A block tin saucepan I have always understood to be the same, only better, and more thickly coated with tin; but a block tin pipe—what is it? Is it not a pipe made of tin, or an alloy of tin, for we seldom nowadays get anything made of a pure material?—R. S. T.

[61371.]—**Tempering and Doctoring Steel.**—Is not the compound of rosin, linseed oil, glycerine, and powdered charcoal (described in letter 26645) the same as charcoal and lime in its action, only in a liquid state? Charcoal and lime (CaCO), not really lime, but chalk, is a wonderful agent for steeling surface of iron.—R. S. T.

[61372.]—**Electro-Magnetism.**—Could anyone tell me how an electro-magnet could be constructed so that when Morse signals were sent through it at about 20 words per minute, it should remain permanently attracted, but should rise as soon as the sending was stopped?—A. J.

[61373.]—**Theatre.**—Would any of your readers oblige by giving information how scenes are rolled up—if they can be pulled up by one person, and how?—J. BEARD.

[61374.] — **Vegeto-Alkaloids.** — Can any correspondent inform me of a work that treats on the above, as to preparation, properties, &c.? Also the price?—G. J. MOULTON.

[61375.]—**Chemist (Dispensing).** — I shall feel obliged if any of your experienced correspondents will inform me of the course of training most suitable for, and required to enable, a person to qualify as a dispensing chemist; also a short statement of examination it is necessary to pass.—SCRUPLE.

[61376.]—**Moss.**—A very common plant used in ornamenting rockeries, &c., is called "golden moss." It bears yellow flowers. Is it really a moss, and what is its botanical classification? Give its life-history.—DISCIPULUS.

[61377.]—**Arc Lamp.**—Will one of our electrical contributors kindly give me the proportions between the wires of the main coil and the shunt coil in an arc lamp, taking 45 volts and about 15 amps.? It is to run sometimes with incandescent lamp and sometimes without. Under the present arrangement the current in the small coil increases when the arc shortens. Is that necessary when running glow and arc lamps together? How would it do if I arrange the wires that the current in the shunt increases with the main current, and, of course, reverse the action of the brake?—ARCHER ASHBY.

[61378.]—**Mechanics.**—Many thanks to "T. C., Bristol," and others, for noticing my queries. I should be pleased for help in the following questions: The breadth of a water passage closed by a pair of gates is 10ft., and its depth is 6ft. The hinges are placed at one foot from top and bottom. What would be the strain on the lower hinge when the water rises to the top of gate on one side? Also how to find the pressure on the internal surface of a sphere when filled with water? Is it equal to three times the weight of the water in the sphere?—NOVICE.

[61379.]—**Trocadero Organ.**—Would some correspondent give the specification of the concert organ at the Trocadero, Paris? There is, I believe, a very wonderful "Mixture," the details of which would be interesting to amateurs.—C. C.

[61380.]—**Engine Query.**—Will any reader kindly tell me if an engine with two cylinders, 2in. in diam., 6in. stroke, will turn a circular saw 12in. in diam., and how much steam I should require? I have had 15lb. of steam, and cannot get it to turn the saw. The band works off the flywheel. Flywheel is 20in. in diam.—R. S. C.

[61381.]—**Opal Plates.**—Will someone kindly give me a few instructions in taking pictures on the above plates? I have tried them with the Beach developer (by contact printing), and I obtained such extraordinary results that I am quite puzzled to know when exposure is correct and development complete; also when to tell when they are fixed?—A. P.

[61382.]—**Instantaneous Exposures.**—During the summer I tried a few, and was surprised to find them much under-exposed. I started at a view lighted up as strong as possible by the mid-day sun, using the full aperture of a R.R.S. lens and a drop shutter without a band, so that it only fixed slow-moving objects. I used the Beach dev., which I am told is well suited for all kinds of work and several kinds of rapid plates. Can anyone tell the cause of my failures?—A. P.

The Archæology of Artificial Limbs.—The history of medicine is all but silent on orthopædic surgery. And yet the Greeks and Romans, who, as archæology has shown, had anticipated much of modern dentistry, cannot have been without artificial substitutes for limbs lost in the vicissitudes of peace or war. Herodotus tells us of a captive who amputated his foot to free himself from the shackle, and thus escaped to his friends, who replaced the limb by a wooden one. The Elder Pliny ("Nat. Hist." vii. 28, ed. Mayhoff) records the case of M. Sergius, great-grandfather of Catiline, who lost his right hand in his second campaign, was wounded twenty-three times in two campaigns, and thus had the complete use of neither hand nor foot. Twice made prisoner by Hannibal, he twice escaped, after twenty months spent in chains. He fought four battles with his left hand only, and then made himself a hand of iron, which he fastened on to fight with, and, thus accoutred, raised the siege of Cremona, protected Placentia, and took twelve camps of the enemy in Gaul. Similar substitutes for amputated arms or legs must have been in use even before the time of Sergius; so, at least, we may infer from the treasure-trove turned up at Capua in 1885, in a tufa-grave. Among the contents of this tomb was an artificial leg, made of bronze, wood, and iron, the skeleton being entire, save the bones represented by the artificial limb. This (probably unique) relic is now in the Museum of the Royal College of Surgeons of London, and is thus officially described: "Roman artificial leg. The artificial limb accurately represents the form of the leg. It is made with pieces of thin bronze, fastened by bronze nails to a wooden core. Two iron bars, having holes at their free ends, are attached to the upper extremity of the bronze. A quadrilateral piece of iron, found near the position of the foot, is thought to have given strength to it. There was no trace of the foot, and the wooden core had nearly all crumbled away. The skeleton had its waist surrounded by a belt of sheet bronze, edged with small rivets, probably used to fasten a leather lining. Three painted vases (red figures on a black ground) lay at the feet of the skeleton. The vases belonged to a rather advanced period of the decline in art (about 300 B.C.)." Commenting on the above, General H. H. Maxwell says: "It is important to add, from other sources, that the upper third of the leg was hollow, while the lower two-thirds were filled with wood."—*Lancet.*

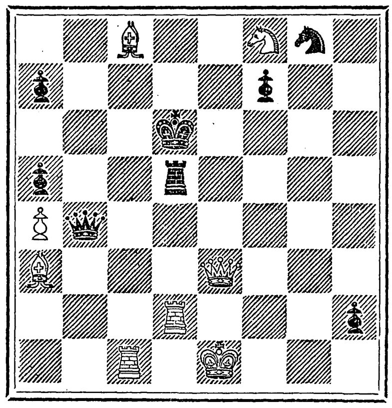
CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXV.—BY C. D. F. HAMILTON.

(From *The Wanderer.*)

Black.



White. [8 + 8

White to play and mate in two moves.

SOLUTION TO 1,023.

White.	*Black.*
1. K R to R 5 or R sq.	1. Anything.

(Twelve variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,023, by A. Bolus (duals if 1. Q takes P, B-Kt 8, or R-K 4), V. S. Pochin, F. Krasser, Link; to 1,022 by Link, W. Hewson-Kilbee, E. J. Cooper.

W. J. CARPENTER.—Name entered for Tourney B. The conditions are the same as in previous Tourneys, the principal being that full solutions must be sent to score full marks (see ENGLISH MECHANIC for Dec. 24).

E. G. COOPER.—Thanks for new two-er. It shall have due attention.

A. B.—B-Q Kt 3 was certainly intended. The problem is all right.

W. HEWSON-KILBEE.—We see no mate in your solution of 1,023 if 1. $\frac{\quad}{\text{P takes R}}$

V. S. P.—There is no objection whatever to your entering Tourney A on payment of entrance fee to it.

J. J. SPENCE.—We have entered your name for B 1. Kt-Q 4, discs. check.

T. H. BILLINGTON.—Thanks for problem and good wishes.

Taking Train Speeds in Prussia.—For the regulation and checking of train speeds, the Prussian authorities, after trying a number of speed recorders without full satisfaction, have concluded to introduce an "electric contact" apparatus, which has now been in use for nearly ten years, and on the Elberfeld system of Prussian roads is used on 144 miles of track. It consists of electric keys with strong springs placed outside the rails at regular intervals, the most approved distance being one kilomètre. The keys are depressed by each wheel, and the current thus sent through a wire to the next telegraph office causes a strip of paper moved by clockwork to be dotted for each depression. The paper moves at the rate of 4 centimètres a minute, and the distance apart at which the first dots of each two successive series appear shows the rate of speed at which the train is moving. When the operator at a station gets word from the next one of a train's departure, he sets the paper in motion, and lets it run until the train reaches his station. The strip of paper which has run off in the meantime is marked by cross strokes at its end, and the date, the number of the train and engine, and the name of the engine-runner are written upon it. The operator soon becomes accustomed to recognising the speed from the appearance of the spaces, and he is charged with the duty of noting any obvious excess of the speed allowed. At the end of the day the strip is removed and sent to headquarters as a part of the office report, the work of inspection being made easy by the notes on the strip. The runner is placed in position to check up his own speed, as the contact-keys are visible by day and recognisable by their click at night. This method is reported as highly satisfactory in checking the tendency of runners to save coal by "loafing" up hill and running down at full speed, the apparatus being arranged to show the speed for any desirable distance, or at any point shows whether express trains slow properly in passing stations, and it also indicates very closely the occurrence of a breakdown and its position.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: Nos. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 5, and unacknowledged elsewhere:—

S. W. PARTRIDGE.—E. R. Dale.—D. Capron.—P. Vallance.—F. Hotham.—R. Judd.—Pearl Assurance Co.—Rev. J. H. Cole.—E. A. Williams.—J. Mabson.—J. B.—Electrode.—Churchill.—G. S.—Wm. Hosken.—Colliery Manager.—Bewildered.—A. B.—Under Strapper.—W.—Arthur Mee.—Abergwili.—Wm. Tebb.—Nonconfident.—A Youth.—A. Stanley Williams.—W. Holden.—A. C. Chambers.—D. Grimshaw.—T. E. Espin.—Galen.—J. B., Leeds.—Hendon.—Williams.—A Fellow of the Royal Astronomical Society.—A. J. J.—Milverton.—G. A. Audsley.

H. G. J. (First query answered so recently as pp. 159, 178, this volume; but as a matter of fact the teacher of any class will advise you as to textbooks. There are now so many equally good that it is almost invidious to recommend any special works. Longmans, Lockwood, Cassell, Macmillan, and several others amongst the large publishers issue suitable textbooks.)—A. HENDRIE. (Are not the instructions on p. 53 of this volume sufficient? If not, you will find details of other coils in back volumes; but look at p. 53 first.)—DEFENDER. (We are not aware that any new rifle has been accepted; but experiments are in progress with several.)—PERPLEXED. (If the two are identical, the earliest application will be the only valid patent; but you say the inventions are different in detail, and one far superior to the other. If that is the case, the superior device could be made the subject of a valid patent; but it will be necessary to have the specification drawn by a skilled agent.)—INQUIRER. (The question was opened in an early number of this volume (see pp. 64, 84, 155); but so far does not seem to have attracted much attention. The only alleged advantage of a dome that is worthy of consideration is the facility it offers for obtaining dry steam—that is, steam with few, if any, particles of water; but Mr. Wilson, in his "Treatise on Steam Boilers," says pertinently, "Notwithstanding the general opinion that the presence of a steam dome is essential for obtaining dry steam, and as a remedy for priming, it should be regarded, as a useless and expensive appendage to a boiler, and as frequently applied a source of real danger.")—F. A. C. (When they are japanned or enamelled they are also stoved so as to set the varnish hard. If you want to do yours, try the best varnish paint, that is the ground colour mixed with copal varnish instead of with oil and turpentine. If it must be black, procure the best coachmaker's japan or one of the special enamels advertised by those who supply cyclists with their wants.)—LUCENDO. (The substance is not itself sensitive to light. The instrument is the radiometer, and the vanes are usually made of mica blackened on one side, and they revolve when exposed to either light or heat.)—YOUNG TURNER. (The articles on "How to Make a Cheap Lathe" appeared in Nos. 970, 972, 974, 977, 979, 980, 983, 985.)—17 YEARS' SUB. (We do not know; but no doubt the Secretary of the Amalgamated Society of Engineers, 90 Blackfriars-road, S.E., can give you the address.)—F. BAKER. (A meerschaum pipe is cleaned by plugging the mouthpiece and filling the bowl with spirits of wine—methylated alcohol will do; but see that you get it pure—that is, without any resin in it. Rub the outside of the bowl with white wax, or, preferably, with a little cream.)—J. G. G. (You can obtain instructions in electricity, with laboratory practice, at the Finsbury Technical College.)—R. (We cannot do more than refer you to the decisions. Apparently any telephone with a diaphragm, except the ENGLISH MECHANIC telephone, would be held to be an infringement. What is wanted is a legal definition of what is not a diaphragm. See "The United Telephone Co. v. Bassano.")—A. B. (Directions for making oxygen gas in any textbook of chemistry, in back volumes, and in all the magic-lantern manuals.)—PIVOT. (The query is not definite. Do you mean how are they compensated and regulated, or what?)—J. TOMS. (Probably because there is not suffi-

cient gold in the solution. See a reply on p. 376, ante.)—STICKFAST. (Put some acetic acid or nitric acid in the paste, or try the recipe given in No. 1030, p. 338, or that in No. 1039, p. 550. 2. See back numbers for brazing. We should not care to work a brass boiler at 75lb.)—PUZZLED. (A man can do what he likes with his personal property by will. He is not obliged to leave anything to his wife.)—T. MORRIS. (If you breathe through the nostrils instead of the mouth, probably it will not affect you so much. Strong coffee would, no doubt, prevent the nausea.)—H. T. W. (The composition of a multiplex copying apparatus has been given many times even recently. Four parts glycerine, one part glue, and sufficient whiting or baryta to colour. If any one prefers to use the best gelatine and chemically pure glycerine, there is no reason why he should not. It has been frequently stated that it is not necessary to wash off the ink.)—STORM. (What you refer to is not a chemical barometer, but a so-called "storm-glass" of no utility whatever. The solution is said to be composed of camphor 2 drachms, nitre 1½ drachm, sal-ammoniac 1 drachm, proof spirit 2¼fl. oz. Place in a thin glass tube 12in. long, ¾in. diameter, and tie over with bladder, or cover with a brass cap having a needle-point hole in it.)—PHOSPHORES. (The phosphorus bottles are usually made up in the proportion of 12 grains of phosphorus to ½oz. of olive-oil. Mix in an ounce bottle and immerse in hot water, shaking well until mixed.)—ANOTHER GAS-ENGINE. (Any patent agent would supply it, charging a small fee for finding the number and date. 2. The dimensions vary with different makes. See the illustrations of gas-engines in Vol. XXXIX. 3. The marks are not easily removed. Try strong vinegar or spirit.)—ELECTRIC. (Given many times. The Leclanché is the best battery for bell work, and that is excited by a solution of sal-ammoniac; about 2oz. to the pint of water.)—A SKATER. (There is a good deal about skates and skating in back volumes. See Nos. 828, 829, for instance; but for teaching beginners there are several little manuals which you can no doubt find at any large booksellers.)—ANXIOUS. (One would be required for each chimney in which there is a down draught. The cause is a difference of air pressure; hence, another remedy is to bring a pipe from the external air to the hearth immediately below the fire-grate.)—A. B. (In each case carbonic acid and water, with organic matter in the case of the breath, and a little sulphurous acid in the case of the gas. In the case of the fires the products of combustion usually go up the chimney, but dull fires no doubt produce some carbonic oxide, which may find its way, or a portion of it, into the room.)—JEPSON. (Is there not sufficient information in No. 1121, p. 53, this volume?)—OPERATER. (Two wires only are required, one going, the other returning. A sketch in No. 972, p. 225. The keys ought to work their own needle, as well as that at the other end of the line.)—FITTER. (You will find several in back volumes. See No. 1068, p. 40; No. 1008, p. 432.)—A. L. L. (They are made of rectified spirit; but trouble is incurred in removing the resins, which give rise to the muddy appearance when mixed with water.)—R. S. T. (Yes. We do not know where they can be obtained, nor the price; but we suspect that the common mussel-shell will answer the purpose.)—W. GEE. (Full directions for making an American organ were given in Vol. XXVI. It is out of print, but you can doubtless obtain it on loan or by purchase if advertised for.)—HUGH HUGHES. (We should not send sixpence for it!)—PATIENS. (We said the same week it was impossible for such a medical query to be answered satisfactorily in these pages. Why don't you submit your query to Dr. Allinson, the medical editor of the *Weekly Times and Echo*?)—PERPLEXED. (If the property is personal, the three sons, or their representatives, share equally—that is, the children of the dead sons take their fathers' shares; if freehold, the surviving son inherits all.)

Egg Explosions.—The following rather extraordinary paragraph appeared in the *Liverpool Mercury* as a "Science Note":—The explosion of an ostrich egg in the hands of a scientific man is not a common occurrence, and the recent accident at Yale College has excited considerable comment. Mr. Bauer, at the Peabody Museum, New Haven, Conn., was boring a hole in an African egg, weighing about three pounds, when it exploded and knocked him senseless, injuring him severely, and wounding some of the bystanders. Such explosions on a small scale are a common incident on the Chinese coast. A common fashion of preserving hens' eggs for sea use is to pack them in lime, and if properly packed they will keep sweet for months; but they are not always thus packed. Sometimes a vessel leaves a Chinese port with a large supply of eggs, warranted to keep all the voyage home; but in a week or two they begin to go bad in a most extraordinary manner. The lime has such an effect on them that it generates a peculiar foul-smelling gas, and the moment the shell receives a crack it explodes. At first the explosions are rare and very mild; but in a few weeks the "preserved" eggs go off with a report like a pistol, with an ever-increasing odour and frequency, and are finally relegated to the sailors, who find considerable amusement with them. The explosion at Yale, which has ended so disastrously to Mr. Bauer, is doubtless due to the same cause; but the strong shell of the ostrich egg has intensified the evil result.

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OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

What offers for 52in. **Bicycle**, in good condition, with lamp, bell, spanner, &c., strong, and suitable for a beginner. Can be seen by appointment. Wanted good air-gun, and part cash. For value see Sale Col. advt.—C. E. K., Lady Cross, Gayton-road, Harrow.

Wanted, modern half-plate folding **Camera** and LENS. Exchange perfect 20-candle-power Dynamo, with driving wheel, and cash.—LOWE, 11, Wills-street, Lozells, Birmingham.

Medicines (Homœopathic), strong tinctures, powders, exchanged for Belladonna Seeds by the DISPENSER, at the Medico-Botanical Gardens and Free Dispensary Company, Lydney.

Wanted, 1 H.P. **Engine and Boiler.** Exchange splendid Tandem Tricycle, cost £34, new condition.—Write, GRAY, 190A, Landor-road, Nottingham.

Magic Lantern, 10in. by 7½in. by 5in., 3in. condenser, movable o.g. in brass tube. Offers wanted in Leclanche Batteries.—ISHERWOOD, Somerton, Somerset.

Wanted, 7 or 8-horse nominal compound **Launch** ENGINE. Brotherhood 3-cylinder, 6in. by 7in., as part exchange.—S. S., 63, Palmerston-road, Southsea.

23 Vols. "**Encyclopædia Britannica**," first-class order, calf, for scientific, musical, domestic articles. Stamp reply.—SCOTT, 59, Queen's-crescent, London, N.W.

Wanted, 2 small **Lathe Heads** for housework, in exchange for set of Bottone's 20 c.p. Dynamo Castings, partly finished.—COLQUHOUN, 30, Scotia-street, Glasgow.

2 H.P. **Gas Engine**, complete, thorough working order. Will exchange for hand-power Band Saw and cash to value.—For particulars apply to C. E. CUTTING, High-street, Hanwell.

"**Photographic News**," 19 numbers of "The Amateur Photographer," "The Scientific American" for 1886, and five Plate Boxes to hold 12 doz. ¼-size plates, in exchange for plain light grey background, ½-plate Bath and Dipper, and folding Tripod Stand.—J. B., Tavistock-road, Westbourne Park.

Medical Coil, complete with battery, very powerful and compact, in mahogany case, with draw for handles, &c., cost £5. Wanted, Lathe for small metal work.—R. LEVERSUCH, Stanmore, Middlesex.

"**English Mechanic**," Vol. XLIII., in good condition, unbound. Anything suitable for a 2 man-power boiler taken.—W. MARTIN, 25, Willow-grove, Plaistow.

"**Boy's Own Paper**," Vol. VII., in good condition, and unbound. Take Fittings for a 2 man-power boiler in exchange.—25, Willow-grove, Plaistow.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Boston Lever, good timekeeper, worth 50s. Telescope, draws out to 16 inches, in good leather case, worth 20s. Roman Harp, quite new, 10s. Will take in exchange a good Photograph Apparatus, or good Magic Lantern (oil), with lecture slides, complete.—WILLIAM NICHOL, Castle Eden Colliery, Co. Durham.

4in. **Lathe**, Banjo, "Popular and Technical Educators," "Spon's Recipes," &c., for Lathe with slide-rest.—J. STEVENS, 83, Great Northern-road, Derby.

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Gladstone Bag, 20in. by 13 by 9, good as new, never been used. What offers?—THOS. ELLINGWORTH, as above.

One 6-hole **Pneumatic Indicator**, and one 3-hole, with pushes and pipe, all new. What offers?—BARNS, 13, Remington-street, City-road, London.

Engine and Boiler, drive lathe, half-horse, bargain; also splendid Greenhouse Stove with boiler, burns 24 hours once firing, cost £4 10s., quite new. Offers. Particulars sent.—MILLER, 1, Melbourne-square, Brixton-road.

Phonograph Clockwork. Exchange for Dynamo.—JONES, 346, Upper-street, Islington.

Dynamo, laminated armature, lights small arc, or 7 10 c.-p. lamps; worth £5; offers to value 60s.—A. J. SELLS, 104a, Mare-street, Hackney, N.E.

Sliding Resistance Box and Reflecting GALVANOMETER, by Varley; cost £9. Offers to value 60s., or ¼ Instantograph.—A. J. SELLS, 104a, Mare-street, N.E.

12 half-gallon **Bichromate Cells**, in first-rate order. What offers?—A. E. ROSE, 5, King-street, Kensington.

48in. **Bicycle**, ball bearings, hollow forks, equal to new. Exchange for Magic-Lantern and Slides, or Lathe.—ROBERT TURNER, 52, Peascod-street, Windsor.

Will exchange "**The Forge and Lathe**" for Holtzapffel's Fourth Vol.—Mr. E. CARKEEK, Vergan, Grampound-road, Cornwall.

Organ, 8 stops, 312 pipes, pedals, bourdon, composition pedals, interior new, noble mahogany case. Take Harmonium or American Organ, and cash.—J. HOLT, Ormskirk.

A 10 c.p. **Dynamo**, shunt. Wanted, Steam Engine Indicator.—Apply at once to JOHN R. KAY, The Camms, Helmshore, Manchester.

Wanted, a 4ft. 6in. **Vertical Boiler.** Advertiser would exchange for Gold Albert Pendant, 1½oz. weight.—Address J. B., 23, Skittle-lane, Plumstead.

Wanted, **Vertical Engine**, 1 H.P., with pump complete. Exchange Horizontal Engine, 1¾in. bore, pump, governors, and part cash.—ARTHUR KING, Pinxton, Alfreton.

Lathe, wood and brass, 5in. centre, 42in. bed, several chucks, box of tools, overalls, complete. Exchange for anything useful. Call by appointment.—J. SELLER, 4, Pond-place, Chelsea, S.W.

4½in. Screw-cutting **Lathe**, new, in exchange for Vertical Engine and Boiler Combined, 1½ to 3 H.-P., by good maker. See Sale Column.—64, Park, Eccles.

Treadle Lathe, iron bed and standards, 5in. centre, hand-rest and tee, complete, in exchange for Safety Bicycle, or offers.—GOUGH, 16, Haggar-street, Blakenhall, Wolverhampton.

Exchange magnificent 12-bore, double, modern, London made Breechloader, value 6 guineas, for Dog Cart. What offers?—C. E. HILLSDON, Woodman's-cottage, Sandgate, Kent.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Economic Cookery.—Patent Heat Conductors for roasting, 2s. 6d., baking, 2s. 3d.; boiling, 2s. per pair, carriage paid. See ENGLISH MECHANIC, Oct. 15, 1886, page 147.

The Patent Heat Conductors save a family pounds a year.—Agent, TALLACK, 28, Hatton-garden, London.

New Illustrated Price List of **Screws, Bolts, and** NUTS for Model Work, drawn to actual size, sent on receipt of stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

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Wimshurst Influence Machine.—Sole manufacturers of new and improved pattern. 12in. from 30s.—KING MENDHAM, and CO., Bristol.

Deposition of Smoke.—Complete Apparatus to perform this never failing experiment, with static electricity, 5s. 6d and 10s. 6d.—As above.

Standard Ohm, in boxwood cylinder, guaranteed correct to ten thousandth of ohm, 18s. 6d., with copper poles, 21s.—As above.

Galvanometer Cards for tangent and ordinary combined, vertical, astatic, reflecting, and unmounted compass cards.—As above.

Variable Resistance Incandescent Lamp STAND, invaluable for battery power, vide ENGLISH MECHANIC, Oct. 16, 1885, price 3s. 6d.—As above.

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Lathe Castings, &c.—See T. Taylor's advertisement in ENGLISH MECHANIC every other week. Established 1847.

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Second-hand **Phantasmagoria Lantern**, 3½ condenser, solar argand lamp, in case, £1 10s. Pair of Photogenic Lanterns, second-hand, 4in. condensers, rack and pinion, dissolving fans, in case, complete, with Aphengescope; cost £9 9s. £5 15s.—J. H. STEWARD, 406, Strand, London.

[*Continued on page* vi.]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 14, 1887.

MR. J. H. EVANS'S NEW BOOK ON ORNAMENTAL TURNING.

THE raison d'être of another book on the Lathe might well be questioned after the issue of Vols. IV. and V. of Holtzapffel's elaborate series. It must have needed no little courage on the part of Mr. Evans to persevere with such a volume as lies before us. But we venture to think that his energy will meet its due reward. In the first place, this handsome and beautifully-printed volume is not displaced by, any more than it displaces, its rival. There is of necessity some resemblance between the two; but there is an essential difference both in style and general arrangement. Mr. Evans dashes at once *in medias res.* His object is to treat of the modern lathe, and he therefore very sensibly ignores its past history. For him Plumier and Bergeron have no charm, and he is satisfied with the doings of his own times, and the very efficient products of his own workshop. The book commences, accordingly, with an illustrated description of a modern high-class lathe as manufactured by himself, the details of its construction, and the uses of its individual parts occupying a large part of the volume. Doctors differ, as usual, upon certain particulars; Mr. Evans upholding as his speciality the form of overhead which Holtzapffel condemns, and in this we entirely agree with him; but either pattern is adopted by turners of great experience, and we are happily engaged in discussing the merits of the book, and do not pretend to sit in judgment upon the apparatus which is therein described. At the same time a casual opinion may drop from our too-ready pen, which the reader is at liberty to accept or not at pleasure.

Passing over a short chapter or two upon chucking and adjustment of work, we come to a description of the Division Plate and Index—the latter in its simpler and also more complex forms, including one for automatic counting. In this chapter Mr. Evans speaks of a plan which we have seen nowhere else—viz., starting the zero points of the several circles of holes upon a curved line struck from the centre of the pin on which the index turns, instead of marking them on the usual radial line of the division plate. The exceeding advantage of this plan will be obvious to the ornamental turner, as he can shift the index from one circle of holes to another at any moment without endangering the accuracy of the work, and without any necessity for using the adjusting appliance commonly affixed to the bottom of the index. Mr. Evans illustrates the matter thus: "If, for example, a pattern has been started at the 192 division, it is possible that to suit the diameter of work, radius of cutter, or other of the various points to be considered, the exact distance required cannot be obtained in that particular circle; the index can then be moved to another without the necessity for adjustment in any way; whereas, if the starting points were drilled on a radial line, the point moving on a centre and describing an arc would consequently require adjusting each time a different division was employed on any similar object."

The automatic counting apparatus described is that of Mr. Ashton, a rather big-looking affair, but perfectly effective.

Grinding and setting ornamental drills and cutters is fully described and very clearly illustrated by accurate and effective drawings. A short chapter is devoted to overheads, to which allusion has already been made, and then the ornamental slide-rest and its fittings are fully and clearly treated—some improvements of great value being introduced.

We next have a chapter on cutter bars, of which several kinds are illustrated, each claiming some special advantage, and then we have illustrations of the usual fixed tools for plain turning with the slide-rest. From this point, the volume ranges through the whole scheme of ornamental turning, from simple drilling and eccentric work to the most elaborate results of combined apparatus. The specimens are beautifully illustrated by the autotype process, and with, perhaps, one or two exceptions, are as faultless in design as they are apparently in execution; but as Mr. Evans is well known as a master in this art, little need be said upon this point.

Naturally we seek novelty in such a volume, and therefore look beyond such well-known appliances as drills, eccentric and vertical cutters, the eccentric and dome chucks, and spiral apparatus, and we do not search in vain; for, in addition to various modified forms of older instruments and minor novelties, Mr. Evans gives us a description of a geometric rest, invented by Capt. R. Pudsey Dawson. This rest was very briefly described, if we rightly remember, in an early number of that fitful periodical, the *Amateur Mechanic's Journal*, which, comet-like, appears at rather lengthy and not easily predicted periods. Mr. Evans has here illustrated in a very effective manner a few of its capabilities. Its action is the reverse of the Rose engine, but similar to it—the tool with its holder oscillating under the action of cams or rosettes, while the lathe headstock remains immovable. Change wheels multiply these oscillations in any proportion as the work revolves, and the capabilities of the apparatus are capable of indefinite increase by using rotary cutters instead of fixed tools.

Such is briefly the nature of the volume which Mr. Evans has contributed to lathe literature, and having described its contents sufficiently for the purposes of a review, we feel ourselves called upon to add a few remarks upon its merits as a guide-book. Our idea of such a book is that it ought to be adequate for the instruction of those who were previously unacquainted with the art which they desire to practise. Apparatus should be clearly described, and its uses plainly shown, so that a learner may be able to ascertain what he will need, and how to set it up and use it when obtained.

If this view is correct, Mr. Evans's book fulfils the conditions. It does not, indeed, teach plain turning, which, as the author remarks, has been already treated so copiously that little can remain to be added to the volumes already published. But starting where these leave off, it commences with the easier examples and less costly apparatus and advances gradually to the more elaborate; and in each case instruction is given concisely and clearly in language that can "be understanded of the people." Comparing this book with its predecessors, we are confirmed in an opinion we expressed many years ago—viz., that the author of a volume on the lathe should be not only himself a skilful turner, but also a lathe-maker, acquainted with every detail of construction, and willing (as well as capable) to impart to others the knowledge which he has attained. No doubt there are trade secrets still; but there is not that reticence and unwillingness to give assistance to plodding amateurs that was almost universal half a century ago. Mr. Evans's book is no pretended help, but a real instructor of the ignorant; while even adepts in this fascinating art will find much to lead them yet further onwards. The volume is less comprehensive than Holtzapffel's, as it stands to reason that a book of about 300 pages cannot contain so much as one of 600; but the two cannot fairly be compared together. Mr. Holtzapffel's work was in a manner prescribed for him by the plan of the previous volumes written by his father, hardly leaving him a choice as to the method of treating his subject. Mr. Evans being untrammelled, was free to take a new departure, and was thus able to condense and concentrate where the former was almost compelled to an opposite course. Mr. Evans's book is therefore not smaller because of omissions, but by reason of conciseness and condensation. It is a handsome volume, worthy of the subject, and we heartly congratulate the author upon the satisfactory completion of a task, not only laborious, but necessarily expensive, and we trust that it will ultimately prove remunerative. A standard work deserves ample recognition.

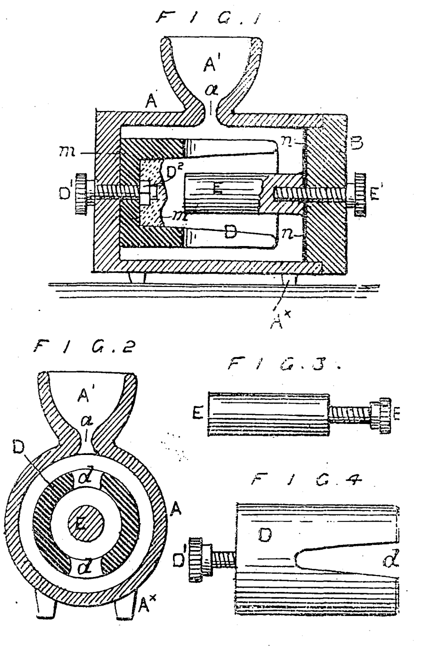
SOLDER FOR ALUMINIUM.

MOST of those who have had occasion to work with aluminium are aware that it cannot be easily soldered or joined, for reasons which Col. Ross pointed out in our columns on Sept. 30, 1881, the chief of which is that its heat-conducting power is so great that a part of a given piece cannot easily be raised to the fusing point. The only method is to coat the aluminium with some other metal or alloy which can be fused, and so made to unite two edges or two pieces of the metal. From time to time we have given various recipes, most of which consist of alloys of aluminium and zinc or tin, though some contain a variety of metals, including silver and copper. Thus on p. 510, No. 958, several alloys of aluminium and zinc are given as suitable solders, and the flux recommended is a mixture of copaiba balsam, Venice turpentine, and a few drops of lemon juice. M. Bourbouze told the Paris Academy of Science that he had discovered a suitable alloy, consisting of tin, bismuth, and aluminium; but we believe he did not present specimens of the work accomplished with it. In No. 1018, p. 99, we gave a solder for aluminium which Col. W. Frishmuth, of Philadelphia, was stated to have found practical; but it differed only in the proportions of the component parts from others well known, and it is probable that his alleged success was due more to the use of a suitable flux than to any peculiarity in the solder, for Col. Frishmuth used paraffin, stearin, vaseline, copaiba balsam, &c. Mr. J. S. Sellon, of the firm of Johnson, Matthey, and Co., Hatton-garden, E.C., has recently obtained a patent for a method of soldering aluminium which we must presume to be superior to the other known processes, as it has been thought worth while to protect it. According to the specification, Mr. Sellon's invention relates to a process and means for soldering the metal aluminium either to itself or to other metals or alloys. He provides an alloy preferably consisting of zinc, tin, and lead, which he applies to the aluminium at the part where soldering is to be effected, and employs as an intermediary a material which will prevent oxidation of the aluminium. If necessary, he first cleans by scraping the surface of the aluminium at the part where soldering is to be effected, and he then applies to that part paraffin wax or other suitable matter which will liquefy or flow at a low temperature. The prepared alloy is then applied with the help of heat; before the heating has reached a degree sufficient to injure or oxidise aluminium the paraffin wax or other equivalent will be melted, and will exclude air whilst and until the alloy becomes melted and attaches itself to the aluminium. Where aluminium is to be joined to aluminium both surfaces to be attached will be thus treated, but where aluminium is to be joined to other metal or alloy which can ordinarily be united by soldering, the aluminium only need be prepared in this way. The pieces of metal with the aluminium so prepared can be attached by any ordinary or suitable solder. It will be understood that if desired the alloy may be coated with the paraffin wax or its equivalent in substitution for or in addition to the coating of the aluminium surface. Whilst not limiting himself to the following procedure, the patentee gives it as the best means with which he is

acquainted for carrying his invention into effect as applied to soldering two pieces of aluminium together. He prepares an alloy of five parts zinc, two parts tin, and one part lead, and rolls it into thin sheets; he then scrapes the parts of the aluminium to be attached, and coats them with paraffin wax. On each of the surfaces to be united he places a piece of the alloy and applies heat. The wax first melts, and then when a higher heat is obtained the alloy melts, and on cooling will be found to be firmly attached to the aluminium surfaces, which can then be soldered together as ordinary soldering is effected. Where aluminium is to be soldered to other metals which do not require the foregoing preparation, such preparation is, of course, only effected with respect to the aluminium surface.

GATE'S PORTABLE BATTERY.

SOME suggestive improvements in portable batteries have been recently patented in this country by Mr. W. L. Gates, of Bayonne, New Jersey, who thinks the form shown may be used with advantage in many situations—e.g., as a portable battery for use by physicians and surgeons in various exigencies where electricity is required. It will serve well in sending or receiving telegraphic or telephonic messages on railway trains in motion. It is open, yet without danger of slopping or overflowing. In what the patentee considers the preferable proportions it may be inverted without spilling, because although the aperture is open the escape of fluid is prevented by the pressure of the air. The main body of the case or vessel in which the battery is mounted is a horizontal hollow cylinder, with one flat end formed in one therewith. Another corresponding flat end is fitted to extend a little way into the interior of the main part, and to form an absolutely tight-fitting plug therefor. The elements are bedded in pitch, and held by screws, which are kept out of contact with the exciting fluid by a covering of pitch. A screw holds one element against one end, and a corresponding screw holds the other element at the other end. The conducting wires are attached to the screws. When the removable end or plug is in place, the only orifice connecting the interior of the casing with the outer atmosphere is about the mid-length and connects with an open-ended funnel. The opposite side or lower side of the cylindrical case is provided with legs. Fig. 1 is a central vertical longitudinal section; Fig. 2 a vertical transverse section, and Figs. 3 and 4 are elevations representing certain parts detached. Similar letters of reference indicate corresponding parts. A is the body of the casing, made of hard rubber or other suitable strong non-conducting material in the form of a hollow cylinder, with one end closed and the other end open. A^1 is a funnel extending out at right angles to the axis of the cylinder A. The interior of A connects with the external atmosphere through a small orifice (*a*) at the junction of A^1 with A. B is a plane end or plug adapted to match tightly within the open end of A, and to form a practically tight joint all around. D is the carbon and E the zinc. Each is made in the form represented, the part D being a hollow cylinder, deeply notched as shown, and the part E being a solid cylinder of smaller diameter fitting within D, but out of contact therewith. The carbon D is held in place by a thumb-screw D^1 inserted through a hole in the closed end of the cylinder. The nut D^2 aids in making a strong and reliable job. Pitch (*m*) is applied between the carbon D and the interior of the closed end of the cylinder, as well as around and over the nut. The zinc E is held by a thumb-screw E^1 inserted through the removable end or plug B. Paraffin (*n*) is applied between the end of E and the adjacent surface of B. The positive conducting wire is connected by being wound around the screw D^1, and the negative wire is connected by being wound around the screw E^1. The pitch and the paraffin seal the joints around, and prevent leakage around the screws D^1 and E^1. The legs A* are formed in one with the cylindrical body A. The charge is introduced in the form of a dry powder, using one-third bisulphate of mercury and two-thirds sal-ammoniac, simply pulverized and mixed. When required for use, add sufficient water through the funnel A^1. Importance is attached to the fact that the body A is cylindrical, and that the plug B is of corresponding form. This form makes it easy to make and maintain a tight joint between A and B, while the orifice *a* being on the top side and about the mid-length, the battery may be shaken without much disposition of the fluid contents to escape through this orifice. The funnel A^1 is a convenience in filling with water, and a safeguard against overflow. In his experiments Mr. Gates has made the orifice *a* so small that the entire apparatus could be inverted without spilling, the fluid contents being retained by the pressure of the atmosphere, unless the device is shaken. Care should be taken in securing the carbon to have the



deep notches lie in the position represented, one at the upper side immediately under the orifice *a*, and the other at the lower side. These notches allow the upward escape of hydrogen gas, and serve, in a measure, to reduce polarisation. The notches also provide a clear space in line with the aperture *a* through which the powder may descend to the bottom instead of lodging on the carbon and obstructing the necessarily limited space which exists between the latter and the interior of the body A. These notches also, to a less degree, facilitate the emptying of the device. They should be so narrow as to subtract but little from the effective action of this element of the battery. The removable end B carrying one of the elements and making a tight joint with the part A enables the cell to be opened at any time with little trouble, and to exchange an element if such shall become necessary without damage to the body or cell A, or to any other part of the apparatus.

THE JUBILEE OF THE ELECTRIC TELEGRAPH.*

BY THOMAS MOY.

THIS is to be a Jubilee Year. We are going to do all sorts of wonderful things to impart renown to 1887, and our newspaper editors and others will boastfully write about the enormous progress of science during the latter half of the present century; but it may be wholesome to moderate our estimate of progress, and look hard facts in the face—not despising what has been done, but being careful to avoid boasting. As far as my experience has gone, I have found that the people of this country are very slow in making real progress, and very boastful when a persevering inventor has pushed his invention through the mountain of prejudice usually standing in his way, and that a man of progressive mind or a genuine inventor gets a great many kicks when living and a little posthumous praise when dead. When railways were in their infancy 50 years ago, I well remember the insane and ruinous opposition to their construction, and the immense efforts that were made in Parliamentary Committees to keep railway stations as far away as possible from the towns and villages, and to this day such places have suffered, and the shares of the companies have been heavily handicapped in consequence. When railways were pronounced a success, and John Bull's prejudice had been overcome, then came the jubilant fit, and the cant phrase was, "We have annihilated time and space by means of railways." But this boast, like a soap-bubble, has long since burst. And what is our position to-day, scientifically and progressively? We have learnt how to utilise a few of the materials around us. We have learnt to weigh, calculate, and estimate what is likely to happen if we put this and that together; but as to what the materials really are we are as much in the dark as ever. We give them names, and then persuade ourselves that we know what they are. The words written 2,500 years ago are still absolutely true, "That man cannot find out the work that is done under the sun, because, however much a man labour to seek it out, yet shall he not find it; yea, moreover, though a wise man think to know it, yet shall he not be able to find it." If an inquiring child asks, What is life? —Why do my lungs fill and empty themselves?—What is heat?—What is gravitation?—What is electricity?—What is light? —What is cohesion? we can only give vague answers, because we do not know. It seems as though the Creator had decreed that man should touch, taste, and handle these things, combine them, apply them to useful purposes, find new combinations, new uses, new results and applications, and there stop. Up to this time—this Year of Jubilee—we are compelled to admit, as Newton did, that we are but as children playing with pebbles on the sea shore, while the whole ocean of discovery lies before us. We live in the midst of mysteries, and, because they have become familiar to us, we forget that they are still mysteries; and one of those familiar mysteries is electricity, which, as it becomes developed, becomes still more mysterious. What is this which we call the electric fluid for want of a better name? If you think upon the subject you must wonder what it can be. We have found out various means of producing it, and have turned it to account in many ways, but without ever finding out what it is. The electric telegraph, with its various appliances, has grown, and is the result of the labours of many minds. We cannot say that so-and-so was *the* inventor; it did not burst upon the world as a complete discovery. Six hundred years before the Christian era it was observed that when amber was subjected to friction, it acquired the power of attracting and repelling light substances. This is, perhaps, the earliest record in existence. The next record is that Theophrastus, 300 years later, observed that a hard stone (supposed to be tourmaline), when rubbed, attracted light articles. Pliny, in the year 70, and others, noticed the same phenomenon. But none of these men appear to have possessed genius enough to follow up the inquiry, and it remained very obscure until Dr. Gilbert, towards the close of the 16th century, published in his work, "De Magnete," a list of all those bodies possessing the same property. Then followed Dr. Wall, about the middle of the 17th century, who succeeded in producing the electric spark by rubbing a cylinder of amber with flannel. Boyle and Otto Guericke followed, and added to the stock of knowledge. Then followed Stephen Grey, a pensioner of the Charter House, who appears to have been the first to discover the power of transmitting the electric fluid to a distance by means of an insulated wire. This was a great step in advance. Grey, in 1727, used a wire 700ft. long, suspended in the air by silk threads, to one end of which he applied an excited glass tube, while, at the other end, another person observed the effect. Grey and Wheeler, Desaguliers, Franklin, Dufay, Winckler, Dr. Watson, Muschenbroeck, with his Leyden jar, and Watson, all followed in building up the facts, and adding to the stock of knowledge. A person signing himself as "C. M.," in *Scot's Magazine* for 1753, suggested the idea of applying electricity to the telegraph; and his letter is such an admirable contribution that it is a great pity he did not sign his name to it. Lesage carried out, in 1774, almost the identical idea suggested by "C. M." I must pass over the doings of Lomond, Reusser, Don Silva, Betancourt, Cavallo, Ronalds, and others—who all used frictional electricity—to the period when voltaic electricity began to displace frictional electricity for telegraphic purposes. Sulzer, Galvani, and Volta carried on the progressive work, bringing it down to the year 1800. Then followed the discovery by Herr Sömmering, that water is decomposed into its constituents of oxygen and hydrogen by the voltaic current. Romagnesi discovered the phenomenon of the deflection of a magnetic needle by a voltaic current, an experiment which Oerstedt, and afterwards Ampère, vigorously followed up. Soon after Ampère the great Faraday entered this field of discovery, research, experiment, and invention, and paved the way for those two men, Cooke and Wheatstone, who combined great business capacity, energy, perseverance, practical ingenuity, and scientific attainments in their treatment of the subject. I ought here to mention that Bain at one

* A paper read before the Balloon Society, Jan. 7.

time lodged in Bream's-buildings, Chancery-lane, in a house kept by a gingerbeer manufacturer, and carried out many experiments in a garret, with batteries in gingerbeer bottles. Prof. Wheatstone worked at the subject from 1834, and in 1836 his acquaintance with William Fothergill Cooke commenced, followed by a partnership; the result of such partnership soon being made apparent by their jointly patenting, on the 12th day of June, 1837, the first really practical scheme in electric telegraphy. It is due to these men to say that 50 years ago they gathered up the facts that then existed, put them together in a practical form, added to them many valuable arrangements of their own, and thus presented to the world that which will ever make their names renowned. This patent was, of course, followed by others—the results of further experiments and discoveries; but the filing of their application on the 12th June, 1837—only eight days before Her Majesty's accession to the Throne—marks this year, not only as the jubilee year of her Majesty's reign, but also as the jubilee year of the practical application of the electric telegraph. You will bear in mind that I do not call Cooke and Wheatstone the inventors of the electric telegraph; but I do claim for them that they first established a telegraph for practical purposes on a large scale, and, whatever were the merits of less conspicuous workers, we must accord very high praise to those who apply the results of centuries of observation, and add thereto no small amount of invention, whereby mankind becomes permanently benefited. Wheatstone patented, in 1840, his well-known dial instrument, in which he established the principle of sending, from the transmitting station, a series of alternate currents through the line, which, passing round the soft iron of an electro magnet, moved an armature, and regulated the motion of an escapement similar to that of a clock. I think it was Steinheil who first discovered that the earth might be used as part of the circuit of the electric current. This was really a great discovery, and I remember it very well. It astonished everyone who was interested in the subject, and it remains a marvel to this day that all the conflicting currents thus carried by the earth should be effectual in completing millions of electrical circuits without any detrimental action arising therefrom, thus saving half the quantity of wire previously deemed necessary, and effecting enormous economy in telegraphy. A very bold and original attempt was made in 1862 by a gentleman named Haworth. This gentleman conceived the idea that the earth might be used as a substitute for both wires. The title of his patent (No. 843[62]) was "An improved method of conveying electric signals and telegrams without the intervention of any continuous artificial conductor." I felt certain at the time that it could not succeed, although encouraging signals had passed from England to Ireland without cable. But, although it failed, it was a meritorious experiment, and is well worth recording to his credit. It is also valuable to inventors and experimenters to know what has been tried in this direction. Although I have had to omit much that I might have said regarding the merits of Faraday, it must not be thought that he holds anything but a very high place in every one's estimation, and always will do so, as I am sure he does in mine; and at the end of this half-century of telegraphy there is very little that he did not forecast. In the year 1853, that which had been considered impossible was actually accomplished. I refer to the methods of telegraphing in opposite directions at the same time on a single wire. An Austrian gentleman—Dr. Gintl —was the first to solve this problem; the manner in which he effected this object is well known to electricians, and the details would be uninteresting to a popular assembly like the present. Frischen, Siemens, and Halske followed with improvements. This advance was followed in 1855 by another Austrian gentleman named Stark, who invented and carried out a method of sending two messages along a single wire in the same direction at the same time. In estimating and describing the force of electric currents, I think that electricians have made a great mistake, and the sooner it is remedied the better. I refer to such words as ampères, ohms, volts, and other terms taken from men's names, as descriptive of the amount of electric force. Surely some better names and methods of calculation may be found. It is bad enough to put Greek letters into algebra in order to mystify any practical man who may wish to learn it; but to call the amount of electric force so many eminent men is, to my mind, simply absurd. Suppose, in describing a steam-engine, we were to say, the steam pressure in the boiler is 140 "trevithicks," instead of pounds; the vacuum is 27 "watts," instead of inches of mercury; the power is 2,000 "stephensons," instead of horse-power: could anything be more out of taste? and yet all the talented electricians follow this clumsy and illogical apology for scientific terms, like sheep over a five-barred gate. Having thus very imperfectly dotted down something like a general outline of the progress of the science, we see that at a very early period in the history of the science the idea existed of using electricity for telegraphic purposes, all the proposals for effecting it were wanting in simplicity and practical contrivance, until Messrs. Cooke and Wheatstone, having succeeded in their experiments, patented their ideas, and placed them before the world in 1837—50 years ago. Since that time the telegraph has been extended enormously, and carried to almost all parts of the world. The ocean does not bar its way. The *Agamemnon* and *President* steamers crossed the Atlantic with the first cable, the *Great Eastern* followed with another, and many cables have been laid in the Atlantic. Other seas have also been successfully conquered, and we can now "wire" to almost the whole of the habitable globe. But on land there is something immediate to be looked after. There is much to be said in favour of overhead wires; their economy and efficiency under ordinary circumstances are very great. But we are beaten by storms. This danger must be either met or avoided—it cannot be shirked. The production of the philosopher's brain is a mere idea to-day: it is a necessity tomorrow, and we must not be deprived of our necessities by snowstorms. If we have blundered into a wrong groove, the blunder must be remedied. We cannot go back, we cannot even stand still: we must go forward; and even a seeming failure must be made the means of greater progress. The recent inconveniences arising from the breaking of telegraph wires show that we have erected them on the assumption that fine weather must prevail all the year round. That the wires will bear the strain put upon them by supports a great distance apart, in fine dry weather, has been amply proved; but that they will give way during a snowstorm has been also amply proved. The remedy therefore seems likely to be found in shorter lengths of stretch, in underground wires, or in some new arrangement. Now underground wires are expensive, and when a fault occurs it is troublesome to find its position, and other objections are urged. I would therefore throw out the hint that it is possible a middle course could be found in towns, by suspending the wires at about, say, 20ft. from the ground, with ornamental supports attached to the houses. The railway companies will also have to put up more numerous supports, or adopt the underground system; and here I do not see much difficulty in the latter arrangement, as most railways have an ample margin of unoccupied banks which might be utilised for the purpose. During the last 50 years many men of talent have come to the front with their ingenious inventions relating to electricity. The telephone was invented by Reis in 1861, improved by Graham Bell in 1876, and afterwards by Edison, Dolbear, Hughes, and others. Then in 1878 the microphone was invented by Hughes, an invention which quite startled the world at the time, but which has hitherto been only used as a scientific toy. At the present time a whole army of intellectual men are working hard in order to increase the usefulness, cheapen the production, utilise by-products, and discover new sources of electricity. Long before the invention of the dynamo, making possible the lighting of incandescent and arc lamps, and the propulsion of motors by means of the electric currents, great attention was paid to primary batteries by electricians and chemists; but it was deemed impossible through these means to devise any feasible plan for sustaining sufficiently steady currents to produce and maintain incandescence in lamp filaments, or to run motors for more than a few hours; and even now it is said to be impossible, and sometimes laughed at by electricians who stand high in their practical knowledge of other systems of light production; and thus a certain amount of prejudice may have arisen, and, in consequence, a promising, if not the most promising, scope for the development of the electric current has been neglected and comparatively undeveloped; but, at least, one gentleman with whom I am acquainted has been following a different course, and I believe that his system of producing electricity by his improved primary batteries will prove an important step in the forward march of the science. If this inventor had joined the majority I should be at liberty to mention his name, and perhaps even propose the erection of a stone monument; but as he happens to be living, his name must not be mentioned in a lecture. His first patent was taken out in February, 1885, and although the invention is not of a startling character, yet, the inventor having fully understood what is necessary, the result will be a simple, cheap, effective, powerful, and complete primary battery, and I think it will take its place as one of the "things of the age." I will only just say of this battery, that by means of very careful calculations and experiments carried on for weeks by capable men, the electric light can be produced at a farthing per hour per lamp. Now, I think, I must have exhausted your patience, if I have not the subject. We have been considering *one* of the mighty forces of nature: one of the invisible things of the Creator. We have, as it were, just touched the "fringe" of this force. We have glanced at the last 50 years of its practical application. What will the next 50 years bring forth in the further development of this power? Who would have dreamed 2,400 years ago, when the first piece of amber was rubbed, that that would lead to what we see to-day? Who can say that there are not other forces in the world, as yet undreamed of, the existence of which will be discovered in the next 50 years, and become absolute necessities to mankind. I think it will some day be discovered that gravitation is closely allied to electricity and magnetism: if I may venture to put the idea before you, it may be that the revolutions of the planets are analogous to the action of dynamos, and that the various fields and currents in which the planets revolve, and by which they are interlaced, may possibly produce that mysterious force which we call gravitation. When I contemplate the great forces of nature, their invisibility, their grandeur, their resistless and ceaseless operations, their harmony, our tiny knowledge of them and utter ignorance of what they consist, our pursuit of knowledge for a few years, and then our inevitable departure without attaining a deeper knowledge of even our common surroundings, I not only think of Sir Isaac Newton's celebrated saying already quoted, but I go farther than that and ask myself: "Are three score and ten years to be the limit of man's existence, and is there to be no future development of our powers, our knowledge, our investigations, our appreciation of real good?" And the inevitable answer comes, trumpet-tongued: No!—a thousand things contradict the possibility of such a result; for, to quote again from another author: "God hath set eternity in man's heart," and nothing less can satisfy his reasonable aspirations.

ACCURATE LATHE WORK: WHAT IT IS, AND HOW TO DO IT.*

THE process of turning and then "filing up to size" has been abandoned in nearly all progressive machine shops. Instead of that ancient "hit-or-miss" method, the latheman is now expected to turn up short, stiff pieces of iron and steel to within the ·00025th part of an inch, or, as usually called in the shops, "one-quarter-thousandth of an inch." It is just as easy to turn up work which will be a "good fit" within the above measurement as it is to turn up by guess and a pair of rickety calipers, and then file and try, and try and file, until the work goes together an approximation only of the poorest kind of a "fit." It is usual in ordinary turning to grind the tool up sharp. See that the tail stock is set accurately by the marks thereon, then gauge the cut by the calipers and let it run half-way across the work, testing the size meanwhile by frequent use of the calipers. When the middle of the work is reached the carriage is run back to the tail stock, the work turned end for end, and the turning process repeated until the two cuts meet at the centre of the shaft, perhaps coming together in an eccentric fashion, leaving two shoulders diametrically opposite each other as a result of slipshod turning. To do a nice job, the lathe must be accurate. The bed must be straight, and without worn places therein. There must not be the least trace of lost motion. The tail stock must fit tight, every part of the lathe in first-class condition, and, above all, perfectly clean. The best workman in the shop cannot do nice turning with a slovenly lathe, and the least dust or dirt in bearings or on the V's will defeat the purpose, so far as accuracy is concerned. See that the centres are perfect and clean, both in work and in the lathe. Make a special tool for taking finishing cuts, and keep it for that exclusively. Make the tool stiff enough to practically eliminate springing tendency. Grind said tool so that it will cut upon its side, close to the point, and cut twice the width of the feed used at least. A diamond-point tool, set to cut with the side parallel to the work, instead of with the side usually used, will give a fair idea of the tool, but is not the exact shape. A tool is often used for working into corners which is almost exactly the shape intended to be described. Do not pick up an old tool and remodel it. Get a piece of nice new steel, forge it carefully, and harden in a bath of cool, clean water. Now heat the tool slowly until it is at a temperature of about 300°F. This point will be reached when water will flash off into steam, and is just about as hot as a laundry iron when it will "hiss" loudly as Ah Sing touches the iron with his wet finger. This degree of heat should not start the colour in the slightest degree, but it changes the structure of the steel to an extent that wonderfully toughens the steel, without decreasing its hardness in a measure anyway appreciable. Steel thus treated will stand nearly as great strain as that having its temper drawn down to a straw colour.

After making a tool to your satisfaction, grind it nicely, and then whet it sharp on an oil-stone or a slip. A tool for a finishing cut on iron needs as keen an edge as for cutting wood, and for our pur-

* By JAMES F. HOBART, in *Manufacturers' Gazette.*

pose the tool must be sharp. Place the tool in the tool-post, and adjust it precisely as high as the live centre, and this adjustment must be exact; make sure that the two lathe centres are exactly of a height. Any variation in this adjustment is also fatal to exact work. Put the work between centres and adjust tail centre nicely. See that it is well oiled and tightened up. Set the micrometer caliper to the exact size of the desired finished work, and turn a spot at tail stock end of work sufficiently large to measure. Adjust tool by cross-feed screw until the tool cuts exactly, as near as can be determined by human touch, the desired size, then change work end for end, run the tool to head stock end of work, and see if it is in position to cut to required size when in that place; and if so, you may be assured that the lathe will turn a piece of metal with both ends exactly of the same diameter. If the tool is found to cut too large or too small when at head end of work, adjust it to required size there by means of the cross-feed screw; then reverse work once more, run tool back to tail stock, and adjust it to the place already turned by means of the tail stock off setscrews. Move the tail stock until the tool is in exactly the same position relative to diameter of work that it was in after adjustment was made at head end of work. Now start the cut, and set up to size if necessary by testing by the micrometer calipers. After getting the right size, run the tool the entire length of cut, if possible, without a stop. Do not even oil the lathe spindle while making the cut, or you will change the size of cut. Don't oil the ways on the tail spindle, or shorten the belt, or put resin on it. Don't let any heavy weight be placed near or removed from the floor near your lathe, and do not try to keep up to size by calipering the work and making necessary adjustment of tool by moving it back or forth, up or down. Let the tool alone until it has cut as far as desired, then remove the tool and measure the work as much as you wish. There will be some variations in size in different parts of the work, according to truth of the lathe and uniform density of stock; but both ends will be so near one diameter that it is hard to measure the difference. A piece turned in this manner will need little, if any, filing to fit into a collar. A lap and a little grinding therewith will readily reduce the large places, and a dead smooth file will reduce them without appreciable loss of cylindrical truth. For a finishing cut by this method, leave only one-half the stock usually left by the average workmen to "file up" on. Just ·001 of an inch is enough to do good work in with fast speed.

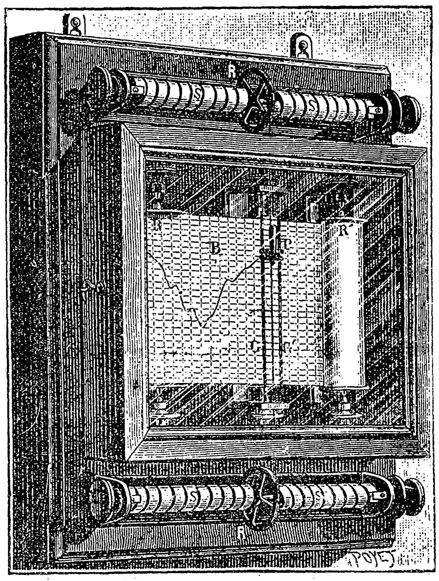
NODON'S GELATINE HYGROMETER.

METEOROLOGY already owes a great part of its present progress to registering apparatus that permit of following the phenomena of the atmosphere step by step, so to speak. Among all such instruments, hygrometers alone have been uncertain in their operation, and their indications subject to numerous causes of error. It will be understood, then, how profitable it would prove to have a registering hygrometer that should be accurate in its indications, sensitive, and prompt in its action. This is a desideratum that appears to have been supplied by Mr. Albert Nodon, as it seems from a note recently presented to the Academy of Sciences by Mr. Lippmann. There are, as well known, two very distinct kinds of hygrometers. In the first place, we have condensation ones, such as those of Daniell, Regnault, Alluard, Bourbouge, and others, which furnish very accurate indications, but which, unfortunately, necessitate quite a delicate manipulation, and which are scarcely utilisable as registering apparatus. The second are absorption hygrometers, the action of which is based upon the property possessed by certain substances (such as hairs, horn, wood, ivory, &c.) of becoming more or less distorted in an atmosphere of varying humidity. These devices are easily used, and can be readily employed in the construction of a registering apparatus. Unfortunately, the distortions that they undergo are in most cases variable with the temperature, and the material of which they are formed undergoes an alteration in time that falsifies the instrument's indications. It became a question, then, to find a hygroscopic substance that should permit of constructing a hygrometer giving just as accurate and rapid indications as are furnished by condensation apparatus, and being as simple as absorption ones, and, in addition, a substance that should undergo no distortion under the influence of the temperature, and that should last as long as possible, its hygroscopic properties not being modified by time. There is one material which possesses all these properties to the highest degree, and that is gelatine. This substance, which can be rendered unchangeable by adding to it a small amount of salicylic acid, absorbs an amount of water that is proportional to the hygrometric state of the air, and increases in weight and bulk proportionally to such state. These properties are independent of the temperature between the observed limits of from 10° to 35° C.

These remarkable properties of gelatine have been applied by Mr. Nodon in the construction of a hygrometer as follows:—If we spread gelatine over a strong paper or Bristol board spiral, whose interior is protected by some hygroscopic substance, such as bitumen, we shall obtain a device which is sensitive to variations in the hygrometric state of the air, and one which is analogous, as regards operation, to the spiral of Breguet's metallic thermometer. When the hygrometric state rises, the gelatine elongates and the spiral unwinds.

It will at once be seen that we might obtain analogous results with hygroscopic substances other than gelatine—such, for example, as gum tragacanth, gum arabic, dextrine, &c., spread in thin coats upon some support other than paper, such as celluloid, ebonite, glass, and the like. But, among all the substances that are applicable, gelatine and paper have given the best results, and so Mr. Nodon has elected them to the exclusion of all others.

His registering apparatus consists of four gelatine paper spirals, S S S S, mounted in pairs upon the same base. One of the extremities of each is held in a clamp, while the other and free extremity acts directly upon a pulley, R. These four spirals, with their combined action, constitute, as a whole, a device that operates with greater regularity than would one with a single spiral. Over



the two pulleys, R R, which are arranged in the same vertical line, runs a silk thread, to which is attached a small and very light slider, P, that moves between two guides, G G'. It is upon this slider that is arranged the inscribing style. The whole is balanced by a small counterpoise on that portion of the thread that is in the rear.

We thus have a contrivance that is movable in a vertical direction, and capable of obeying the least rotary motion of the spirals. The style bears against a band of ruled paper, B, which unwinds from the roller R', and winds upon the roller R, which latter is slowly moved by a clockwork that causes the paper to advance ⅜in. per hour. By selecting a sufficiently thin paper, a great enough length can be wound upon the cylinder to allow the apparatus to operate for ten consecutive days. As the thickness of the paper wound around R increases very slightly with respect to the latter's diameter, we may admit with sufficient approximation that the lengths of paper unwound during an hour's time remain constantly equal to one another. The clockwork is inclosed in the base of the apparatus. The paper, roller, and pen are protected by a glass plate that can be removed at will. The four spirals operate in the atmosphere; but may, however, be protected by means of wire gauze or a jacket perforated so as to allow the air to circulate freely within.

After plans by the inventor, Mr. Ducretet has constructed a model provided with a dial, which is very convenient for use, and the simplicity of which permits of its being offered to the trade at so low a price as to put it within the reach of all. The external extremity of a sheet-gelatine spiral is fixed in a small metallic box, while the inner extremity of the same causes a needle to move over a dial. This apparatus, which reminds one, externally, of aneroid barometers, is remarkably sensitive and accurate. An analogous model, constructed by the inventor in April, 1885, was left till June, 1886, in a laboratory, and was, during this epoch, frequently compared with an Alluard hygrometer. The indications were found to be exactly the same, and the spiral had, therefore, during this space of time undergone no change in its hygroscopic properties. In another model, provided with a spiral of very numerous revolutions, the sensitiveness so increased that the least variations in the hygroscopic state of the surrounding air, which had absolutely no influence upon other hygrometers, even the most sensitive ones, caused a motion of the needle. From numerous observations, it had been concluded that the indications furnished by the hygrometer are in most cases more certain than those given by the barometer. This important fact has led Mr. Ducretet to inscribe the probable state of the weather opposite the graduations on the dial of his hygrometer, thus allowing of the apparatus being used as a weather indicator.—*La Nature.*

FIXTURES FOR MAKING TWIST DRILLS ON THE UNIVERSAL MILLING MACHINE.*

VARIOUS conditions may arise in most shops which render it desirable to make small twist drills in moderate quantities with, at least, some approximation to the prices at which similar drills may be purchased. Any shop having a universal milling machine can undoubtedly do this by taking the little trouble necessary to "rig up" so as to make the best possible use of the machine. If drills are to be made at an economical rate, the milling of the spiral grooves must be done rapidly enough to make it necessary to support the drill at all times directly under the cutter, so as to prevent all springing of the drill blank; and things must be so arranged that there will be no tendency for the cutter to lift the drill from the rest, either at starting the cut or at any other time; for if there is any such tendency it will be found rather an arduous undertaking to counteract it by pressing the blank down with the handle of a brush, as has been suggested. Then, too, a chuck will be needed which will hold the blanks much more securely than most chucks can be made to hold. For this purpose the one shown in Fig. 1 can be recommended; the spring collets for which, shown by Fig. 2, should be made with a hole through them just the size of the drill to be held. They should be given a spring temper, and the lower end of the nut, and also the end of the body of the chuck where the collet comes against it, should be tempered. This chuck, when well made, is excellent, not only for the purpose for which it is here shown, but for use in the drill press as well, and may be provided with a collet long enough, so that no more of the drill may project from the chuck than is necessary for the depth of hole to be drilled. The next thing is to provide a rest which will always support the drill blank directly under the cutter, and allow no yielding of the blank, no matter how heavy the cut, nor how fast the feed may be. A rest which seems to fulfil these conditions perfectly is shown by Fig. 3, in which a is a casting fitted and bolted to the platen of the machine in the same manner as the regular rest; b is a piece of steel having its upper face provided with a V-groove in which the drill blank rests. It is fitted into a, and is slotted where the screws c and d pass through it, so that it is free to move vertically at either end, except where the screws c and d are tightened. It will be seen that the piece b may be set at any angle within certain limits, as well as adjusted for height, which makes the rest useful for many purposes. The facility with which it may be adjusted to support any slender piece of work for a considerable portion, if not all of its length, and inclined either way to support taper work held between the centres, or anything held in the chuck at an angle, either above or below the line of centres, makes it, though simple and strong, almost a universal rest. Its base should be arranged, as shown, so as to form a basin for the reception and disposal of oil and chips. This feature should always be looked after in the designing of milling machine fixtures, because when milling steel such an abundance of lard oil should be used upon the cutter as to make it necessary to catch and use it repeatedly.

The way things look when rigged up is shown by Fig. 4, the spiral head being elevated about one-half degree, to make the centre of the drill the thinnest at the point, and the grooved piece b of the rest adjusted so as to support the drill its entire length. Now, if the motion of the machine be reversed, and the cutting commenced at the upper end of the groove, and feeding out to the end, it will be found that there is no tendency to lift the drill from the rest, and things may be crowded up to the limit of the capacity of the cutter.

When milling work having only two grooves, a considerable portion of the time is consumed in indexing, since the index pin must be turned

* By FRED. J. MILLER, in the *American Machinist.*

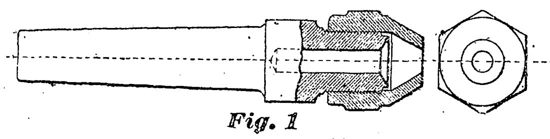


Fig. 1

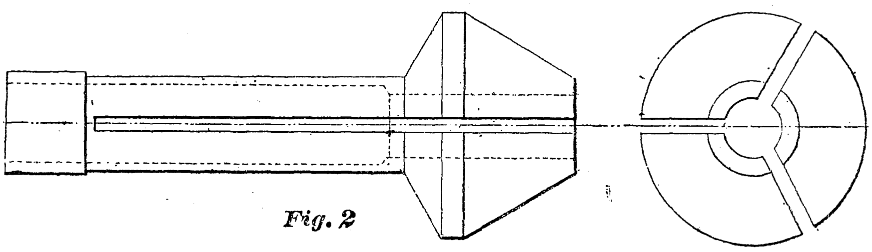


Fig. 2

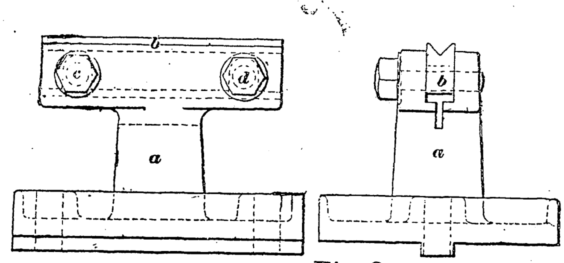


Fig. 3

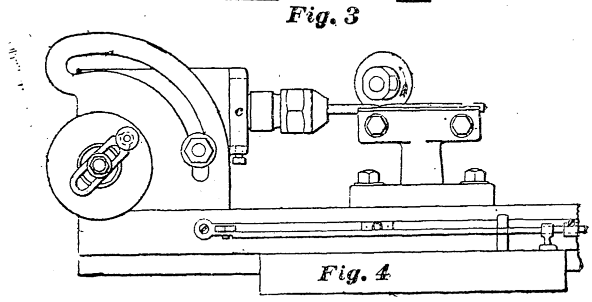


Fig. 4

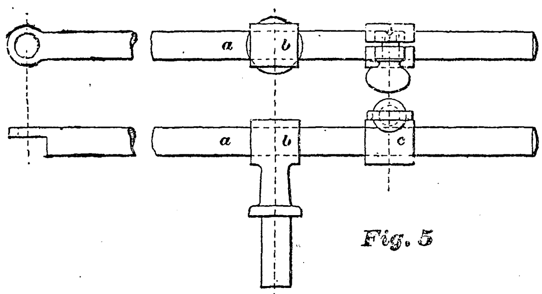


Fig. 5

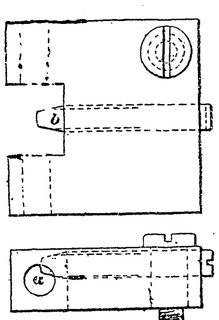


Fig. 6

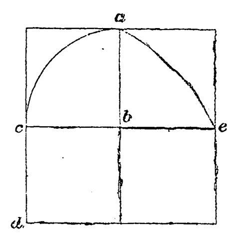


Fig. 8

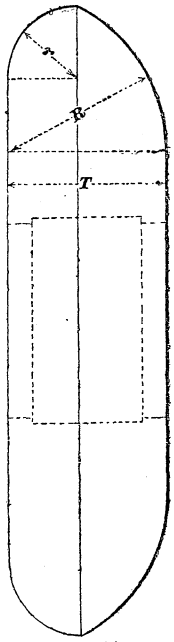


Fig. 7

twenty revolutions to turn the work from one groove to the other. Most of this time is saved by the use of the collar marked *c* in Fig. 4. It is made to turn freely upon the collar which screws on the spiral head spindle, and is held in proper position by the milled head-screw, as shown. It is provided with four numbered lines or graduations, 90° apart, which, when the spindle is revolved, successively come opposite a mark placed upon the spiral head, and thus indicate when the spindle has been turned one-fourth, one-half, or a complete revolution. If, in starting the first cut, one of these lines upon the collar be brought fair with the line upon the head, then in starting the second cut it is only necessary to bring the opposite line into the same position, so, in running back after taking the first cut, the index pin is left in the plate until the desired line comes into position, when the pin is pulled out from the plate, and held in the right hand, while the backward motion of the slide is continued, until it is arrested by the stop. The pin can then be put into the proper hole, and the work is indexed without loss of time, and without liability of mistakes made in counting.

When the motion of the machine is reversed, something is needed for throwing out the feed at the end of the cut. For this purpose the device Fig. 5 is presented. The piece of polished drill rod *a* is flatted and drilled at one end, and is fastened by a screw to the underside of the lever by which the feed is manipulated, the other end sliding freely through the stud *b*. The clamp collar *c* may be tightened upon the rod at any point by the thumb screw, and when, by the backward motion of the slide, it comes in contact with the stud *b*, the lever is drawn forward, and the feed thrown out. When fixed up for work in this way, the machine will be found very effective, since the cutter can be sunk into the blank the full depth at once, and only one cut taken in each groove, and that one at a rapid rate. In this way drills ·225in. diameter, and with grooves 3⅝in. long have been milled at the rate of 170 per day. The advantage of having things fixed up solidly for such work was plainly shown when a lot of ⅜ drills were wanted, and two machines, one small and the other the large back-geared machine, were rigged up for the job. The small machine ran at a speed of 60 revolutions per minute, and the large one at 68. The arbors were the same size, and yet, notwithstanding the higher rate of speed at which the cutters ran in the large machine, they invariably ran longer and did considerably more work at one grinding than when used in the small machine, and the cutters were frequently interchanged without altering the result. This can only be attributed to the fact that the outer end of the arbor is supported in the large machine, and that the entire machine is much heavier and better able to absorb vibrations. This would almost seem to indicate that no matter how rigidly we may seem to have things fixed, there is an advantage to be gained by having them still more so.

Fig. 6 shows a device by which the drills may be backed off very rapidly, and in good shape. It consists simply of a flat piece of steel provided with a hole *a* just large enough for the drill to slide through easily. As the drill is pushed through this hole, the edge of the spiral groove comes in contact with the end of the screw *b*, which causes the drill to rotate, then an emery wheel is so adjusted as to come in contact with the drill through the square opening shown.

The device may be fastened to the ordinary flat rest of a grinder by the screw shown, and upon which it swings against a stop pin.

Though many twist drills are seen having curved cutting lips, it is not generally considered a desirable form, and the "straight lip" drill is usually much preferred.

If the angle of the spiral be 20° and of the lip of the drill 30°, and the thickness of the drill at the centre one-tenth of its diameter, all of which are probably pretty near what they should be, then the form of cutter shown by Fig. 7 will produce a straight lip drill. Referring to Fig. 7 and letting D represent the diameter of the drill, then

$$r = {\cdot}375\ D.$$
$$R = {\cdot}338\ D.$$
$$T = R = \text{thickness of cutter.}$$

A convenient method of obtaining this form is shown by Fig. 8. A square is drawn one side of which equals three-quarters of the drill, then divide the square into four equal parts. The point *a* is where the arcs which form the shape of the cutter unite; *b* and *d* are the centres from which the arcs *a e* and *a c c* respectively are described. These arcs are the nearest approximations to the true curves, which were developed by Mr. Chas. A. Bauer, to whom the craft is indebted for this presentation of them. I infer from his remarks that the development of these curves will prove quite an interesting study for those who are fond of such things, and that it is not nearly so simple as it seems at the first glance.

With this cutter and the other devices which I have shown, twist drills, admirable in every respect, may be made at a rate which will often be surprising.

THE HOUSEKEEPER AS A CHEMIST.

THE substances used as food belong mainly to the class of organic bodies. They are composed principally of carbon, hydrogen, oxygen, and nitrogen, and are of a very complex constitution. The action of heat upon them is often to change their character very decidedly, and yet in many cases the chemist cannot perceive any difference in their composition. Take the case of albumen, for instance, which forms the white of an egg, and is also present in meats of all kinds. Its chemical formula is approximately $C_{72}H_{112}N_{18}O_{22}S$. Upon heating to 163°, the watery liquid becomes changed into a tough, white solid, more or less difficult of digestion; but the change appears to be only a physical one, and the chemical composition remains the same. This property of coagulation is made use of in clearing coffee from its sediment. When the liquid white of egg is stirred into the boiling coffee, it solidifies at once, inclosing in the mass all the particles held in suspension, and leaving the liquid beautifully clear. The action of fish-skin is similar, only in this case the gelatine of the skin unites with the tannin of the coffee to form a leathery substance, which acts like the coagulated albumen.

Gelatine is made from the bones and tissues of animals, and is of considerable importance in the domestic economy. In its coarser forms it is known as glue, but when properly refined forms the bright, clear, cooking gelatine. Its most characteristic property is that of gelatinisation. It is insoluble in cold water, but absorbs it, swelling up, and becoming soft. Upon heating the

water, it rapidly dissolves; and upon cooling again, after a while sets into a more or less firm mass, known as jelly. Prolonged boiling of the solution causes it to lose this property, as housewives frequently discover to their sorrow when the jelly absolutely refuses to "jell." The addition of a small quantity of strong acid, like nitric, also destroys this property, without injuring its adhesive qualities; and the familiar "prepared liquid glue" is made in this way. Fruits contain a body known as *pectine*, which also possesses the property of gelatinising, although its composition is very different from true gelatine, which is found only in animal organisms.

The stimulating effects of coffee and tea are due to an alkaloid known as caffeine or theine, according to the source from which it is obtained. Its composition is the same in both cases ($C_8H_{10}N_4O_2$), and the pure alkaloid is frequently used in medicine. The agreeable flavour of these beverages is due to various aromatic substances which are extracted by the boiling water from the leaf or berry; but the restorative and exhilarating effects must be credited to the alkaloid, which seems to bear some resemblance to the well-known cocaine.

Flour is one of the most indispensable articles used in the family. It consists principally of starch, with more or less gluten and inorganic or mineral constituents, according to its coarseness or fineness. Some of the finest bolted flours consist almost entirely of pure starch, and are inferior in nutritive value to the coarser varieties, although they make a whiter and more attractive loaf of bread. The raising of "dough" is a true process of fermentation, precisely similar to that of the brewer or whiskey-distiller. The yeast-plant, when mixed with the flour, acts in some mysterious way upon the starch, first transforming it into grape sugar, and then breaking this up into alcohol and carbonic-acid gas. The alcohol is partially driven off by the heat of the oven, though in a freshly baked loaf its odour is quite evident; and the carbonic-acid gas permeates the dough, its expansion causing it to puff up, or "rise," rendering it light and spongy.

Two molecules of starch $(C_6H_{10}O_5)_2$, with the addition of a molecule of water (H_2O), form a molecule of cane-sugar ($C_{12}H_{22}O_{11}$), another substance in universal use. Unfortunately, it is only in the wonderful laboratory of the growing plant that this combination can be effected, or the price of sugar would be even less than at present. It readily crystallises, forming either granulated sugar or rock candy according to the size of the crystals. By heating it melts, and upon boiling is changed into a pliant, uncrystallised mass, known as barley-sugar or sugar candy. At a somewhat higher temperature it becomes partially decomposed, and a dark brown substance, known as caramel, is formed, which is sometimes used for giving a rich colour to soups and gravies. Granulated sugar is seldom or never adulterated, the peculiar form of the crystals rendering any foreign admixture very easy of detection. In the cheaper forms of coffee-crushed and brown sugars much moisture, molasses, and glucose are frequently bought at a high price.

The term "salt" is a familiar one, and is applied not only to the condiment of the table, but to all combinations of an acid and base. Chemically speaking, tallow and the various greasy substances used in soap-making are true salts, consisting of palmitic, stearic, oleic, and other fatty acids, as they are called, united with glycerine as a base. Upon the addition of caustic soda or potash, the acids separate from the glycerine, setting it free, and unite with the alkali, forming soap. Hard soaps are made from soda, and soft soaps from potash. The cleansing action of soap is not well understood, but is doubtless due to the action of the alkali contained in it. Additions of soda-ash, borax, resin, &c., are often made to soap, but are of questionable advantage.

This list of the applications of science to domestic affairs might be extended indefinitely; but enough has been said to show that the great principles of nature control the most common affairs, as well as the experiments of the chemist or physicist.—*Popular Science News* (U. S. A).

ACNE.*

ACNE (the Greek original means the "bloom of anything") is the term given to a retention of the secretion of the sebaceous glands of the skin, with secondary inflammation and deposit in them and in the hair follicles. It is characterised by red conical or hemispherical elevations or nodules; some are solid, others are filled with pus; they are found everywhere except upon the palms and soles, and affect chiefly the skin of the face, chest, and back; and they occur mostly in young persons. The disease appears to be due to the occlusion of the orifice of the hair follicles or of the ducts of the sebaceous glands opening into them. The retained secretion then becomes a source of irritation and inflammation, and suppuration follows in and around the hair sac and its appendages. This, expressed in the fewest words, is the pathological anatomy of simple or uncomplicated acne.

Omitting for the sake of brevity and clearness all the intermediate forms, we may go at once to a type of disease at the other end of the scale, and speak of the so-called acne rosacea. This attacks the face and scalp alone, and is characterised by an intense reddening of the skin, due to an injection of the blood vessels, without much swelling or tension. The serpentine vascular lines, the blood in which may be momentarily driven out by pressure, are most abundant on the sides and the bridge of the nose. This is an obstinate disease, occurring chiefly in advanced age, though not unknown in youth. However great may be the hypertrophy of the skin the disease never extends deeper than the skin, nor does it lead to ulceration. Between the extreme phases of local disease thus delineated there are countless grades and shades which ought to be recognised; for they are so many tokens of constitutional power or inertness, as the case may be.

My notes of treatment profess, then, to deal only with acne punctata, acne vulgaris or indurata, and the acne rosacea, which betrays a grave alteration in the nutritive function of the skin.

The object of the practitioner should be to prevent acne punctata from passing on to acne vulgaris by getting rid of obstruction in the glands and checking the hyperæmia condition; in acne indurata, to lessen hyperæmia and promote the absorption of inflammatory products; and in acne rosacea to destroy the new growth of connective tissue.

The therapeutic points may be expressed thus:—Quiet dormant acne requires stimulation and a spur to more healthy action, while those species of acne which are marked by heat and tension call for soothing local measures. In the one case the medicinal and dietetic plan should be tonic and supporting; in the other we should advise a combination of tonic and aperient remedies and a cooling abstemious regimen.

In order to promote a healthy action of the sebaceous glands, and to prevent the formation of what are called "comedones," the following plan should be adopted, as originally described by Dr. Liveing. The steps of his method are as follows: (*a*) Steam the face every night by holding it over a basin of hot water for a few minutes. (*b*) Rub the skin for five or ten minutes with soap (I prefer terebene soap) and flannel, or with a soft nail-brush; then sponge off the soap with warm water. (*c*) When the face has been dried, a lotion should be thoroughly applied, composed as follows: half an ounce of precipitated sulphur, two drachms of glycerine, one ounce of spirits of wine, with three ounces each of rose-water and lime-water. This is allowed to dry on the skin and to remain on all night. In the morning the face is cleansed with warm oatmeal and water or weak gruel. If, for any reason, an ointment seems preferable to a lotion, a combination of precipitated sulphur and vaseline is very useful. The treatment must be modified or suspended for two or three nights if the skin becomes sensitive and somewhat tender. Dr. Liveing contends that the most common cause of failure is want of perseverance or timidity on the part of the patient or of the doctor; and that we ought not to be frightened from continuing efficacious remedies by a temporary increase in the redness and irritability of the skin. If, by any chance, this plan be unsuccessful, nothing is so effective as the application of potash soap in the form of a lotion. The lotion is composed of one ounce of soft soap, one ounce of rectified spirits of wine, and seven ounces of rose (or distilled) water. This should be rubbed in vigorously with a piece of flannel for a short time, taking care not to make the skin sore. According to Dr. Liveing, the worst cases of acne will yield to the soft soap treatment if practised with necessary caution.

For eight years and more I have followed in its main outlines Dr. Liveing's plan, and with great success. But, the experience which only actual work brings has led me to make modifications to suit the various susceptibilities and irritabilities of human nerves and skin. Some of these modifications I will now relate in the fewest words. In the first place, something is often required to be done during the daytime to pacify the heat and throbbing, which are part of the usual history of acne. An excellent lotion, the heritage of nearly every dermatologist, is made by combining oxide of zinc, calamine, prepared chalk, lead lotion, and lime water, to which may be added a small quantity of glycerine. Let the bottle containing this be gently waved about so as to diffuse the materials, which are only held in suspension; then pour a little into a saucer, and with a sponge (reserved for the purpose) sprinkle the face from time to time. Wipe off, when necessary, with a bit of fine muslin the powder which remains on the skin after the evaporation of the fluid, and the face may be washed occasionally with a little starch gruel. In the second place, the cases are not a few in which it is better not to use any kind of soap as part of the evening ceremonial. After the face has been steamed, we may put on a medicated jelly composed of oxide of zinc, gelatine, and glycerine. It must be liquefied by putting the vessel that holds it into hot water, and then applied with a brush. Then, thirdly, there are some sensitive skins intolerant of sulphur in any guise. When this is so, we should think of combinations of lead and chalk and zinc, blended as a quasi-ointment with the finest vaseline. There are several pharmaceutists in London and the provinces who prepare oleate of lead and oleate of bismuth; and Dr. McCall Anderson's formula of oleate of bismuth with vaseline and white wax has beeu aptly described as "one of the most healing of salves." Sometimes nothing agrees better than the old-fashioned but capital substance called Kirkland's "neutral cerate," which is composed essentially of lead plaster and olive oil.

* Extracted from a paper by Dr. JOHN KENT SPENDER in the *Lancet*.

SCIENTIFIC SOCIETIES.

WESTERN MICROSCOPICAL CLUB.

ON Monday week this club met at the house of Mr. E. E. Halford, of 18, Leinster-square. The subject of the evening was the "Radula of Cephalophorous Molluscs," that is the apparatus by which such creatures as the snail break up their food. In the mouth of these is found a muscular mass, stiffened by two so-called "cartilages"; to this mass Mr. B. B. Woodward, who officiated as demonstrator, would restrict the name of "odontophore." Over this is stretched a horny membrane, bearing on its upper surface numerous horny teeth disposed in rows. The inner end of this membrane, known as the "radula," is encased in a sac, arising beneath the œsophagus. The teeth are hook-shaped, their points curving back towards the throat. They are secreted by certain cells at the posterior extremity of the radula-sac. As those in front are worn away by use, the whole radula moves forward, just as the human finger-nail, secreted in the fold of the skin enveloping its base, grows forward to replace the waste at its tip. The radula is found in Cephalopods, Pteropods, and Gastropods. It is so distinctive of these, that those strange, worm-like animals, Neomenia and Chætoderma, are relegated to this last group, mainly because they possess a radula. The diversity in number, shape, and arrangement of the teeth gives rise to an almost endless variety of patterns, hence their popularity as microscopic objects. Mr. B. B. Woodward pointed out the system by which the various patterns of these are expressed by sets of numbers. The length of the radula varies greatly, though not at all in proportion to the size of its possessor. It attains its greatest length in the common periwinkles and limpets, being found in the latter sometimes nearly 3in. long. In the edible snail (Helix pomatia) it is very little longer than its breadth, about ¼in. But here what it needs in size is made up by the number of minute teeth, amounting to 21,000. In the slightly larger radula of the big slug (Limax max.) there are 27,000 teeth.

A classification of the Mollusca, according to the arrangement of these teeth, has been attempted. It is, however, now acknowledged that they cannot be depended upon for such a purpose, though they are still an aid to the relationships and derivations of the Mollusca.

After reference to the literature of the subject dating from the time of Aristotle downwards, Mr. Woodward concluded an exposition listened to with great interest by the members. A discussion ensued, in which Prof. Stewart gave a number of interesting facts and theories to account for the extraordinary boring powers of some of the molluscs. Dr. Thudichum took exception to the statement that the teeth contained chitin; in his experience, this substance was not found in any creatures above the Arthropoda. Numerous beautiful sections of whole molluscs were shown by Mr. M. F. Woodward. Microscopes and illustrative objects were contributed by Messrs. Bartlett, B. F. and E. E. Halford, Moore, Nelson, Snow, E. Swain, Stokes, B. B. and M. F. Woodward.

The next meeting of the club will take place on Feb. 7, when Mr. F. Crisp, LL.B., Secretary to the Royal Microscopical Society, will open to the club his unrivalled Museum of Microscopes and Microscopical Apparatus.

A RUSSIAN engineer claims to have discovered a process of reducing petroleum to the form of crystals, which may be easily and safely transported to any distance and then reconverted into liquid form.

SCIENTIFIC NEWS.

THE death is announced of Mr. John Arthur Phillips, F.R.S., F.G.S., the well-known mining engineer, chemist, geologist, and metallurgist. Born in Cornwall sixty-four years ago, he was destined for the profession of a mining engineer; but as no mining school then existed in this country, he received his technical education at the Ecole des Mines at Paris. It was here that Mr. Philips imbibed that taste for original research which never deserted him, and which led to his numerous investigations, bearing, for the most part, upon the application of chemistry to mineralogical and petrological questions. His works on mining and metallurgy have long been regarded as standard textbooks, and at the time of his death he was engaged with Mr. Bauermann on a new edition of his well-known "Elements of Metallurgy."

Col. Sir Francis Bolton, founder of the Society of Telegraph Engineers and Electricians, inventor of the system of telegraphic and visual signalling introduced into the Army and Navy, and well-known in connection with the illuminated fountains at the series of exhibitions at South Kensington, died last week, in his 55th year. The deceased had filled the office of Water Examiner under the Metropolis Water Act since 1871.

Mr. John Roach, the well-known American shipbuilder, is dead, at the age of 73 years.

Father Denza, of Moncalieri, gives in *Cosmos* the results of the watch kept in the Italian observatories on Nov. 27 for meteors. He concludes that the majority radiated from Perseus and Taurus, very few from the radiant of the Andromedes. The stream is therefore probably of small extent but very dense, and also has its origin in the disintegration of Biela's comet.

The *Journal* of the Liverpool Astronomical Society for January, 1887, contains, as usual, a number of interesting papers, with a variety of notes, &c.

A meeting was held last week in Glasgow with the view of forming a Scottish Astronomical Society, but acting on the suggestion of the chairman those present decided to seek connection with the Liverpool Astronomical Society, leaving the formation of a special society in Scotland until such time as a sufficient number of members could be got together. It appears, however, that an effort will be made to form a Scottish Society at once; and all interested in the movement or willing to become members are requested to communicate with Mr. William Peck, F.R.A.S., 6, Hanover-street, Edinburgh.

The lectures founded by Sir Thomas Gresham will be read to the public gratuitously on the following days at Gresham College, Basinghall-street, in the subjoined order, beginning each evening at six o'clock:—Rhetoric (Mr. J. E. Nixon), Jan. 18, 19, 20, and 21; law (Dr. Abdy), Jan. 25, 26, 27, and 28; geometry (Dean Cowie), Feb. 1, 2, 3, and 4; physic (Dr. Symes-Thompson), Feb. 8, 9, 10, and 11; divinity (Dean Burgon), Feb. 15, 16, 17, and 18; astronomy (the Rev. E. Ledger), Feb. 21, 22, 23, 24, and 25; and music (Dr. H. Wylde), March 1, 2, 3, and 4.

In reference to the new storage battery, which we referred to on p. 367, brought out by the Union Electrical Power and Storage Company, of 127, Cannon-street, it may be as well to say, in answer to numerous inquiries, that all the available particulars concerning it will be found in No. 1107, p. 316, and No. 1128, "Lithanode," p. 208. It is stated that the new storage cell gives 50 per cent. more work for its weight than other batteries.

An improved battery, which is said to be capable of maintaining a constant current, has been patented here by Dr. Lugo, of New York —9403, 1886. The carbon element is in a porous cup containing a solution of chloride of copper. The zinc element is immersed in an alkaline solution in the outer jar. The carbon element is made in the form of a cup containing free hydrochloric acid, which immediately dissolves the precipitated copper, and prevents it from being deposited upon the carbon. A new supply of chloride of copper is thus constantly formed, chlorine is supplied to the zinc, and the action of the battery is kept up.

With reference to the placing of the telegraph wires underground some experiments have been recently made at the Borough-road works of the Anglo-American Brush Co. with a system devised by Mr. T. O. Callender and Major-Gen. Webber. The wires in this system are laid in cases of bitumen concrete made in 6ft. lengths, and jointed with molten bitumen. At intervals of about 100ft. "flush-boxes" are provided for examination and repair. Each cable has a separate "way," and is completely separated from others by the bitumen concrete, which is an insulator, and very strong, so that it may be laid near the surface, while it can be moulded of any required shape.

Mr. R. S. Culley, the author of "A Practical Handbook of Telegraphy," says that more than thirty years ago underground wires were tried in this country—one system running along the London and North-Western Railway from London to Manchester, Liverpool, and Leeds; another along the high road from London to Carlisle. Neither worked more than five years, although constructed with the greatest care, and at much expense. The method adopted in Germany is to form a complete cable, just as for submarine work, with a sheath of galvanised steel wire, and to coat it with bitumen while laying it in a deep trench. The cost is great, but so is that of the annually recurring break-down of overhead lines, not only on account of repairs, but also because of the loss of business.

The subject chosen by the Paris Academy of Sciences for their "grand prix des sciences mathématiques" (3,000fr.), was "the perfecting in some important point of the theory of the application of electricity to the transmission of energy"; but only one memoir was sent in, and the committee of adjudication (MM. Levy, Becquerel, Bertrand, Fizeau, and Cornu), have, without prejudice to the author of the paper received, determined to leave the competition open for the present.

Prof. Perry, F.R.S., will commence at Finsbury Technical College, on Jan. 20th, a series of six special evening lectures on the "Steam-engine Indicator Diagram," to be continued on Thursdays, the laboratory demonstrations being given in alternate weeks. A number of special pieces of apparatus have been devised by Prof. Perry on purpose for this course.

Explosions of gas and of kitchen-boilers have been rather frequent of late, and have, as usual, been caused by a want of care. Mr. L. E. Fletcher writes once again to urge the necessity of fitting all such boilers with a safety-valve, for it is not only when the water freezes there is risk. An instance occurred on July 21st last at Stoneleigh Abbey owing to the stop-taps on the flow and return-pipes being shut.

At a late meeting of the Vienna Chemico-Physical Society, Dr. Hans Molisch described two distinct tests for sugar in liquids. Half a cubic centimétre of the liquid is mixed with two drops of a 15 to 20 per cent. alcoholic solution of alpha-naphthol, and concentrated sulphuric acid is added in excess. If the liquid is then shaken, a deep violet colour appears when sugar is present, and on the addition of water a blue-violet precipitate is formed. The other test is similar, but with thymol instead of naphthol, and the colour assumed by the liquid is carmine-red.

The "Year-Book of Photography" for 1887 is, as usual, full of interesting matter, and contains, amongst other illustrations, an example of "pin-hole photography," or photography without a lens—a subject of discussion in our last volume, pp. 289, 307, 330, 354. The subject is the façade and dome of the Invalides at Paris. Pinhole, 1-80th of an inch; distance of plate from hole, 5in.; exposure, 20secs.

It has been resolved to erect a monument to James Watt in his native town of Greenock.

SOCIETIES for the advancement of dress reform for women have been established in Sweden, Norway, Denmark, and Finland. They intend to work on the same lines as the English Rational Dress Society, and, as far as possible, in connection with it.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

SATURN'S RING—DARK TRANSITS OF JUPITER'S IVth SATELLITE — A VERY NOVEL FORM OF OBJECT-GLASS — A MARE'S-NEST IN THE CAMERA—POPULAR SCIENCE—THE OCCULTATION OF ALDEBARAN — STOPPING A FOOTPATH—KEEPING TRUE TIME—M. FOLIE "NODDING."— OF A VERY INFERIOR STAMP—ROAD REFORM — NAVIGATION — LENGTH OF CHORD—ASTRONOMICAL PHOTOGRAPHY—DECREASE OF SUN'S HEAT WHEN HE IS NEAR THE HORIZON.

[26685.]—I DO not know whether any public institutions in England receive the *Bulletin* of the California Academy of Sciences; but, if so, I may commend its perusal to such astronomers as may be able to obtain access to it, containing, as it does, much that is interesting in connection with the study of the Heavens. A notable contributor to its pages is Professor George Davidson, of the United States Coast and Geodetic Survey, whose descriptions of planetary detail, &c., as observed with a 6·4in. equatoreal, form really valuable contributions to our knowledge of the physical structure of the members of our Solar System. Going back to the year 1883, I find that this practised observer speaks so definitely of the existence of Encke's division in Ring A. as to predicate pretty definitely the distance to which it extends on the ring. Now, as I have before remarked, it is of no use for any one to oppose to an observation of this kind (made under a combination of peculiarly favourable circumstances) the allegation that he has scrutinised Saturn with a bigger instrument and has *not* seen the division! No one can read Professor Davidson's papers and doubt that at all events it existed at the date of his observation. Can this anomalous mark be variable? Another matter of considerable interest is the dark transits of Jupiter's IVth satellite in 1884, which was observed by Mr. Charles Burckhalter, of the Chabot Observatory, Oakland, Cal., employing a $10\frac{1}{2}$in. Brashear reflector; by Mr. C. B. Hill, at the Davidson Observatory, and by Professor Davidson himself. An observation of Mr. Burckhalter's which seems eminently worthy of attention would appear to indicate that the IVth satellite of Jupiter is divided into bright and dark areas, the south pole being the dark one. As was remarked by the President of the Academy, a careful watching of a satellite thus marked right across the planet's disc might even lead to the determination of its rotation period. This would, of course, apply equally to Satellite III., which also presents a partly bright and partly dark disc to us. (See, too, p. 168 of "Celestial Objects for Common Telescopes.")

A description appears on p. 126 of certain microscopic objectives manufactured from a new glass discovered or invented by Prof. Abbe. Judging from a passage in a letter received recently from a friend of mine, this remarkable material would seem to have been applied to the construction of at least one object-glass for a telescope; and the details are to me so curious and inexplicable that I propose to quote *verbatim* from the letter in question, and ask Mr. Penny, for one, what his idea of the matter is:—"C'est," said my friend, "le nouvel objectif fait avec le verre d'Abbe. Dans ce système l'objectif ne le compose plus que du crown seul; le flint est supprimée; la correction est obtenue par une lentille placée devant l'oculaire et les deux corrections seraient realisées d'une manière *absolue*. Enfin à diamètre egal, l'objectif donne quatre fois plus de lumière. Il existe un six pouces ainsi construit à Potsdam. Le cout en est formidable sans doute. . . . . N'en a-t-il donc pas encore été question en Angleterre?" Have any of my brother readers heard previously of this remarkable object-glass at Potsdam, which, consisting simply of a disc of Abbe's peculiar crown-glass, is rendered abso-

lutely aplanatic by means of a small lens in front of the eyepiece? The whole thing seems so entirely opposed to all one's preconceived ideas of the optics of the refracting telescope, that details cannot fail to be of the highest interest. Pending an attempt I shall make to get them from the Continent, any information on this subject cannot fail to be valuable. For aught I know, such information may already exist in accessible form in this country; but if so, I unfortunately do not know where to lay my hand upon it.

From time to time astronomical *canards* are started, which take in a limited public for a short period, and then die a natural death. Visible inhabitants of our own Satellite; lights moving about on the surface of Mars, as an obvious attempt on the part of its population to signal to and communicate with their fellows in other members of the Solar System; and Wiggins's "Dark Moon" afford illustrations of what I mean. As a cock-and-bull story of the first magnitude, however, it is long since I have come across anything to surpass the announcement, reproduced in your "Scientific News" on p. 387, that Mr. Roberts had photographed 20 planetoids in the neighbourhood of θ Orionis! Mr. Roberts is a persevering man with an ample fortune, and doubtless possesses everything in the shape of apparatus that money can buy: but to ask astronomers to believe that he has succeeded in photographing twenty asteroids at once is a demand upon their credulity which will, I fear, be but feebly met indeed. The mere fact that the mass of star discs upon his negative are elongated in a north and south direction, shows that apparently the driving clock of his equatoreal is far from perfect. That it should have stopped altogether during a short temporary accidental exposure, that the plate should have slipped (the most probable supposition), or even that a shower of meteorites should have left short traces on the plate;—one and all of these explanations are infinitely more credible than the one put forth. I do not wonder half so much, however, at Mr. Roberts, with his imperfect astronomical experience, fancying that he had lit upon a new planetary system, as I do at the Astronomer Royal for Ireland giving this wild idea the sanction derivable from his ridiculously flattering speech. Whether Sir Robert Ball made it with his tongue in his cheek, the reporter wholly omits to mention. If this sort of thing is to go on, we shall be able to shorten the term "mare's nests," as applied to quasi-miraculous discoveries in the sky, into "Roberts's." (Since this was written, I have seen an engraving from part of Mr. R.'s plate in the *Journal* of the Liverpool Astronomical Society, whence it appears that all the lines are close to bright stars, exactly at the same distance apart, and of the same relative brightness as the stars they accompany. This settles the question.)

The paragraph on "Popular Science," extracted from *Engineering*, on p. 388, reminds me that a few days ago one of the leading morning papers came out with an account of the utilisation of the sun's rays by their concentration on a steam-boiler as a bran-new scientific invention! I thought at the time that it was a great pity that the writer was so indolent a student of his ENGLISH MECHANIC as to have forgotten (or never known) that this device was described and illustrated on p. 444 of your XXIInd volume.

The occultation of Aldebaran by the moon last Friday night (concerning which "A. W." put query 61307, on p. 399) might have been observed with a first-class hand telescope quite within 1 second, at the star's disappearance at the dark limb of the moon. As for getting "the correct time" from this, though, it would involve a great mass of very complicated calculation, obviously quite beyond the power of your correspondent. A few elementary considerations may serve to show him why. The moon is so comparatively close to the earth, that, as viewed from stations separated by a very few hundred miles, she is sensibly displaced in the sky. At Bridlington Quay, for example, she would appear quite perceptibly to the south of that point of the celestial vault upon which she would be centrally superposed as seen from Greenwich. Hence Aldebaran disappeared at a different (and more northerly) part of her limb to that by which she was occulted as viewed from the Royal Observatory. The small difference of longitude, too, between Bridlington and Greenwich would involve another, though comparatively trivial, correction. What "A. W." will have to do, in fact, should he observe either of the occultations of α Tauri in the evening of March 2nd or the early mornings of July 17th and October 7th, will be to compute the phases of the occultation *de novo* for his own locality—a work, as I have previously hinted, of a very elaborate and operose character. Of course, if the moon were so far off that a star was covered by her advancing limb at the same absolute instant as viewed from every part of the earth whence it was visible, then, knowing his longitude, your querist could find his time with the utmost ease and simplicity; but as this is, as I have tried to explain, very far indeed from being the case, he can only do so approximately at the cost of a very great deal of real hard work.

In reply to query 61314, p. 399, if the footpath concerning which "G. F. O." inquires is a public right of way, he clearly can *not* plough it up; or, if he does and sows it, with the rest of the field, the public, to whom it has been dedicated, are clearly within their right in trampling down so much of his crop as covers the ancient pathway. The law is righteously jealous of right of way, and the closing of a road or pathway is a very elaborate process, as "G. F. O." may discover from the perusal of the Act 27 and 28 Vict. c. 101, secs. 84—93.

Among the many gratifying proofs of the silent but rapid spread of a taste for applied astronomy, may, I think, be reckoned the fact that Mr. Latimer Clark's little book of *Transit Tables* has become "a hardy annual." Obviously it must address a sufficiently numerous public to render it remunerative; and, as surely, that public must purchase the work for *use*, and by no means for amusement, or for reading in railway trains. I am very glad, indeed, to find that people are becoming more anxious to obtain and keep accurate time; and are no longer content to trust to a station clock, to which the time is "brought" once a week, as well as a £3 watch (as probably as not itself wrong) will carry it. If we consider how much may hinge upon the correctness of a public timekeeper such as the clock of a parish church, I almost wonder that, in these days of grandmotherly legislation, a short Act has never been passed to render it compulsory for the custodians of such clocks to possess some independent means of deriving true time from the heavens. I have myself known the church clock in a large country parish, after being sometimes five minutes slow and sometimes five minutes fast, to stand at 10h. 55m. for nine days consecutively. If I had my way, I would compel the churchwardens in every parish in the kingdom to provide one of Mr. Clark's excellent and economical transit instruments, and the small book of tables which have formed the text of my remarks, for the use of the clerk, verger, or sexton, whichever has control of the church clock. It would really, though, almost seem as though voluntary action will before long abrogate any necessity for compulsion—a consummation most devoutly to be wished.

Following up the remarks I made in letter 26389, p. 171, in connection with the theories of the Belgian Astronomer Royal, I may say that I was highly amused at a little paragraph in the current number of *The Observatory*, in which it is pointed out that in a communication to the *Comptes Rendus* for Dec. 13th, M. Folie gives practical illustrations of results obtained by adopting his theory of the diurnal nutation of the earth's axis. "So far," says the author of the notice in *The Observatory*, "as we can gather, his method is to obtain from a series of observations of a star a certain constant of diurnal nutation, then, by substituting in his formulæ this value, he obtains a correction to each observation"! I call this delicious. Probably as an example of the circulus in probando, it is unsurpassed. Where ignorance is bliss 'tis Folie to be wise.

What a golden opportunity has been lost in the new issue of postage stamps of rendering them of some historical value. I have, so far, only seen the threepenny one, which is as mean and vulgar a production, with its staring black and yellow, as could well have been devised; but what I most especially refer to is this—and if it appears in one stamp of course it has been repeated in all—the ridiculous head of the Queen, which is represented as that of a girl of 19! If this is meant by some snob for flattery, it is flattery of the very poorest description. From every almanac that is published, from *Whitaker* down to the penny *Moore*, we may learn that Her Majesty is in her 68th year; and to represent a rather stout elderly lady of that age as a slight girl not out of her teens is too coarse and gross a piece of sycophancy to delude anybody. On the half-crown of George III., of which so many are still in circulation, we may still discern the honest likeness of that monarch as an old gentleman. I cannot and will not believe that it is by the desire of the Queen herself that this twopenny-halfpenny piece of flunkeyism has been perpetrated. If on each fresh coinage or issue of stamps the head of the Sovereign were accurately represented from a strictly contemporary likeness, a valuable contribution would be made to the history of the future; as it is, the supposititious profile of the Queen possesses about the same amount of historical value and interest as the Roman toga on the idiotic image of George IV. in Trafalgar-square.

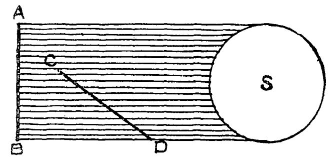
I wonder what "Norfolk" (letter 26677, p. 414) is prepared to pay annually in Highway Rate towards the attainment of his charming little scheme of road reform? To cut bodily through a hill of any magnitude would entail enormous expenditure; while to divert a road through people's parks, farms, and pleasure-grounds would probably involve an even heavier cost still. No doubt roads have been laid out, in the dim and distant past, in defiance of any scientific principles; but there they are, and unless we submit to an impossibly overwhelming amount of local taxation, the only thing we can do is to make them hard, firm, and sound. The jobbery incident on our existing system of appointing parochial highway surveyors has much more to do with the unsatisfactory character of many country roads than the existence here and there of an awkward gradient. I should really like to see "Norfolk's" estimate of the cost of reducing the roads of (say) Devonshire to anything approaching a series of gentle slopes.

In connection with reply 60092 (p. 415), it may not be out of place to inform Mr. Shearer that in the very rough-and-ready formula I gave I treated the earth as a plane: or, perhaps it would be more correct to say, gave the distance between the observer's eye and the base of the mountain through the intervening convexity.

The most simple way for "J. F." (query 61348, p. 420) to find the length of the chord of any given arc is by the formula: Chord of arc = 2 sin. of $\frac{1}{2}$ arc. This really requires no knowledge of trigonometry, although a table of natural sines must be used. For example, What is the length of the chord of an arc of 13° 30′ in a circle of 4ft. 6in. radius? Half this arc is evidently 6° 45′. Now, the natural sine of 6° 45′ is 0·117537, and if we multiply this by 4·5 we get 0·5289165ft., the length of the sine to this radius. Doubling this, we finally obtain 1·0578330ft. as the length of the chord we require.

In reply to query 61355 (p. 420), astronomical photographs are taken in a camera fixed in the focus of the object-glass or mirror of a telescope. Sometimes (as in Mr. Robert's photographs) the sensitive plate is placed directly in the primary focus of the mirror; in other cases an enlarging lens is interposed. The length of exposure varies from a fraction of a second to an hour and a half, or longer: the longer the exposure the larger, more blurred, and indistinct do the discs of bright stars become, but the greater the number of previously invisible stars which impress their images on the plate. Instantaneous exposure then would only avail in the case of bright stars. The concluding part of the query I fail to understand, "Zenith arrangement" being a wholly novel idea to me. "Southings," if used in connection with photographic plates, can only mean fixing the north and south points, or direction of meridians upon it.

In connection with query 61363, p. 420, it may suffice to remark that obliquity of the sun's rays does make a very material difference in the number of them which fall upon any given area, as "J. C. O." may see from the subjoined simple sketch:—



where S represents the sun from which rays are falling square on to the surface A B. If now we tilt that surface as at C D, it will be seen at once how considerably the numbers of incident rays is decreased. In short, they form nearly a tangent to that part of the earth's surface where he is rising or setting. Of course, atmospheric absorption does come in too to diminish the sun's heat when he is close to the horizon.

A Fellow of the Royal Astronomical Society.

A NEW SPECTROSCOPE, AND SOME ACCOUNT OF WORK DONE WITH IT —U CYGNI.

[26686.]—DURING my search for new red stars I frequently wished that I had a spectroscope to examine the spectra. I purchased a McLean star spectroscope, and found it showed the spectra of the bright stars very beautifully; but as the majority of the new red stars detected were faint ones, this spectroscope was quite incapable of doing the work which I had hoped for. For some time I was much puzzled what to do, till I happened to find in a note at the end of Dr. Huggins's address on "Spectrum Analysis applied to the Heavenly Bodies," delivered at Nottingham before the British Association, August 24th, 1866, the following passage:—

"In order to see the spectrum of a star, it is not necessary to do more than to place a prism behind the ordinary Huyghenian eyepiece, and to give a little breadth to the spectrum by placing the star a little out of focus. For such an apparatus, a small compound prism which gives direct vision is convenient. The prism may be placed within the converging pencils of the object glass immediately before they fall upon the field lens of the eyepiece." Happening to have two

compound prisms of five prisms cemented in the ordinary manner made by Elliot and Co., I proceeded to devise a spectroscope after the manner above described. I tried various eyepieces, and found that a medium-powered one gave the best results.

The accompanying figure will enable any brother reader to make one for himself. A is the ordinary adapter for the telescope into which the eyepiece E, magnifying 200 times, screws; B is a second adapter, fitting inside the first. It is prolonged at each end so as to protect the prisms, which are shown by P.

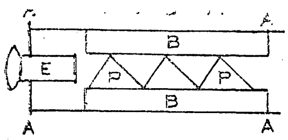
As soon as a red star is swept over, the sweeping power can be changed for the spectroscope as easily as one eyepiece is changed for another. With this instrument attached to the 17¼in. reflector the spectra of stars down to the 9th magnitude can be observed. Some idea of the ease with which it is managed, and the work it is capable of doing, will be best obtained by tabulating the work done on the nights of Nov. 24th, 25th, 29th, and 30th—four in all.

New stars of IV. type	15
New stars of III. type	31
Type doubtful.....................	7
	53

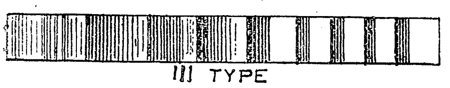
The greater part of these were not set for, but were actually swept for, so that the number of stars actually examined on these nights would be probably three times as many at least. Dr. Dunér, in the *Memoir* "Sur les E'toiles a Spectres de la Troisième Classe," gives only 55 stars of the IV. class discovered up to the present time. During November seventeen new ones were added. Perhaps the best testimony to the excellency of the instrument will be given by showing the number of stars of the IV. class detected by those who searched for them:

Dunér	27
Espin....................................	17
Secchi	14
D'Arrest	7
Pickering	4
Vogel....................................	3
	72

Of course, we must not forget the large light-grasping power of the telescope. I have headed this letter a "New Spectroscope"; but this must be understood as referring to the making up of it, as it is clear Dr. Huggins has already used something of the kind, as has also, I believe, Professor Pickering. I have tried in Fig. 2 to give some



F I G. 2.



III TYPE

IV TYPE

idea of the appearance of the stars of the III. and IV. type. The figures are freely copied from those of Dr. Dunér; but his do not give the columnar effect in the III. type stars, which I have tried to represent.

As regards U Cygni and the colour of the 8-mag. companion, I have never seen the blue colour mentioned by your correspondents. With a small aperture it had certainly a bluish look, due mainly to contrast with the beautiful red star; but with the larger aperture, the star has invariably been found to be yellowish. The blue companion to β Cygni loses nothing of its colour in the 17¼, showing that it is not the increase of aperture which diminishes the colour of the companion to U Cygni. This red star shows a weak IV. type spectrum. The neighbouring variable star, B 535, which is now approaching a minimum, shows a much more strongly marked IV. Your readers must not suppose that Fig. 2 represents the spectrum of all III. or IV. type stars. Very few stars have the whole of the bands there shown.

T. E. Espin.

The Liverpool Astron. Society's Observatory, Wolsingham, Darlington, Jan. 4th.

THE LUNAR RAY SYSTEMS.

[26687.]—ON p. 368 of the "E. M.," Mr. Gemmill has an interesting letter on the vast ray systems which form so striking a feature in the full-moon aspect of our satellite. It is remarkable how these features should have been so neglected as they have been, in common with all full-moon markings, especially by those selenographers devoted to the idea of real changes being still in progress upon the moon's surface; since there is every reason to believe them to be amongst the most recent of lunar objects, and therefore one would be more likely to find changes still going on in them than in the older formations. It is a fact, however, that not a single one of the great ray systems has ever been more than very superficially studied, and we do not yet possess a map or chart of one sufficiently exact or detailed to be of much practical use. The best maps of the ray systems, and the full moon markings in general, which we have are undoubtedly photographic; but the best photographs hitherto produced give but a very poor and incomplete idea of the real objects, and are often difficult to interpret, even as far as they go.

With regard to classifying the different ray systems into Tychonic, Copernican, and the Messier rays, I think our present knowledge is scarcely sufficient yet to authorise us in doing this. The Proclus rays are clearly not all "Tychonic," as Mr. Gemmill points out; nor are the Tycho rays themselves all "Tychonic." There are undoubtedly other rays of a similar character to the two bright streaks starting from Messier A. One will be found issuing from Pico, and forming part of one of the Tycho rays, is almost a facsimile of the Messier system.

A *complete* list of ray systems, however desirable, will, I think, in practice be unattainable, for it will be found that nearly every walled-plain, crater, craterlet, mountain, and bright spot, are centres, more or less complex or important, of a system or systems of light rays; and that there is no visible line of demarcation between the bright rays and the ordinary bright streaks which cover the surface of the moon. Still, a catalogue of the more prominent systems, embodying in it a short description of the principal characteristics of each one, would be of much use. It would not necessarily require also great instrumental power for its formation. Some of the best lunar photographs would here no doubt be of much assistance, since it is chiefly in the minuter details that these break down.

Mr. Gemmill does not say whereabouts he thought he saw portions of several great systems curving round from the invisible hemisphere. More information upon this subject would be interesting, as throwing some light upon the condition of the invisible side of the moon, though there can be little real doubt but that it resembles the visible one. **A. Stanley Williams.**

COMET F, 1886.

[26688.]—NO doubt both you and your correspondent, B. J. Hopkins, will have thought it strange of me not writing before now to explain the mistake I made in my letter of December 9th, 1886 (26572, page 322) in my description of the position of the small tail of this comet; but the reason is I have been so very busy during the last few weeks with removal to a new house, and other matters, that I have had very little leisure for letter writing, so I desire to take this, my first, opportunity of expressing my regret for having accused Mr. Hopkins of error when I was in error myself.

My previous letter was written in a great hurry, and in the hurry I thoughtlessly described the position of the small tail with reference to the actual direction of the comet's movement across the sky, instead of with reference to its apparent movement across the field of view of my telescope, therefore, I was both right and wrong in saying it was on the following side: right, because it was on the following side with reference to the comet's real motion, but wrong because it was on the preceding side with reference to the comet's apparent motion across the field of the telescope, and as the latter is the very motion which is ordinarily referred to in using the terms "preceding" and "following," I frankly admit the mistake was mine, and not Mr. Hopkins's.

I have made several evening observations of this comet since writing my previous letter, and found its general form remains much the same as there described, the only appreciable change being the gradual diminution of its brightness.

I have also swept several times for "Finlay's" comet (*e*, 1886) but without success, and as I have been previously very successful in picking up faint comets, &c., I suppose it must be beyond the reach of my 3in. glass. Is it so?

Huddersfield, January 7. **Excelsior.**

VACCINATION AS A PREVENTIVE OF SMALL-POX.

[26689.]—THE Vaccination Acts were passed in England through the instrumentality of the Epidemiological Society, whose report (since shown to be full of fallacies) was accepted by Parliament unexamined and unchallenged in the year 1853. It is rather singular that this period should have been chosen for rendering the Jennerian prescription obligatory, as there was no epidemic of small-pox, and the mortality was greatly below the average. In London for that year there were only 211 deaths from small-pox, and the indifference to vaccination was increasing all over the country; in some districts the practice had been virtually abandoned without any increase of small-pox. Immediately after the passing of the Act of 1853 small-pox began rapidly to increase in the Metropolis, as will be seen by the following annual summary of the Registrar-General for the last 30 years:—

Decades.	Estimated Mean Population.	Small-pox Deaths.
1851—1860 ...	2,570,489 ...	7,150
1861—1870 ...	3,018,193 ...	8,347
1871—1880 ...	3,466,486 ...	15,551

the lowest decade averaging 200 per cent. more than the year this law was passed by Parliament. This increase is attributed by some medical authorities to be in part due to the contamination of the blood by vaccination and variolation; but it is alleged that the mortality amongst the small-pox patients registered in hospital as unvaccinated is eight times as great as amongst the vaccinated; but this, allow me to say, is not a fair way of drawing conclusions. The prime factors of vaccinated and unvaccinated are, it should be known, a variety as well as a quantity. The unvaccinated are: Firstly, the neglected classes, whom Mr. Bright once called the "residuum"; secondly, the unhealthy, whom the vaccinators dare not operate upon. The *British Medical Journal* for Oct. 23, 1881, says:—"It is probable that a large proportion of unvaccinated persons is to be found among the ignorant, dirty, and wretched inhabitants of the slums in London, and very few among the educated and better-fed members of society. The disease (small-pox) is much influenced by overcrowding." In short, the unvaccinated in the metropolis are a class more amenable to disease generally, and are the first to succumb to all zymotics, not because of non-vaccination, but by reason of non-sanitation. This is not the case with the children in unvaccinated countries, as in the cantons of Garus, Appenzell, Basle, Lucerne, Zurich, and Schaffhausen, Switzerland; in some of the provinces of Spain where vaccination is not enforced, and amongst the sect of the Lippovians in the Baltic provinces of Russia, whose religion forbids the operation, and where all are unvaccinated. These are found to be not more, but less liable to disease (small-pox included) than vaccinated children generally, and the same may be said of the now large unvaccinated populations in Dewsbury, Bingley, Keighley, Leicester, and other districts of England. **William Tebb.**

7, Albert-road, Regent's-park, London, Jan. 4.

VACCINATION.

[26690.]—I SHALL be obliged by your giving me space for a few lines in answer to "W. H.'s" letter.

I had at first intended to leave it unanswered, as there is not much use in replying to anyone whose line of argument seems to be—We differ, therefore you are wrong. The doctors' reports confirm what you say, therefore doctors are interested parties, and their reports not to be trusted.

However, as I may not have made the matter as clear as it might be made, I will endeavour to make it clearer.

I may mention here that there is an error in my former letter which I should have written to correct had I not thought the meaning was obvious. The 6th paragraph should have been as follows:—

"The last year's return for London was as follows:—

Deaths from small-pox		899	
Of which	unvaccinated	330	
	vaccinated	218	569."
	not stated:................	351	

No one, that I know of, ever stated that every person vaccinated is exempt from small-pox, as "W. H." would have seen if he had read my letter with care before answering it, as I pointed out that the protection afforded by vaccination decreased after a lapse of some years. What I asserted, and repeat, is that the proportion of vaccinated persons who die of small-pox is very greatly less than amongst the unvaccinated.

There are in London, within the Registrar-General's tables of mortality, in round numbers, 3,800,000 persons. Of these, $\frac{19}{20}$, or 3,610,000, are vaccinated, and $\frac{1}{20}$, or 190,000, are not.

Now, if we divide these numbers respectively by 576 and 330 (the number of deaths amongst the vaccinated and unvaccinated) we find that one person in 6,344 died amongst the vaccinated, and one in 576 amongst the unvaccinated.

Again, if we divide 3,610,000 by 576, we get the number of persons who would have died amongst the vaccinated if the same rate of mortality had prevailed amongst them as amongst the unvac-

cinated. This gives 6,267, and, deducting 569, the actual deaths, we find that 5,698 persons owe their lives to vaccination, for if vaccination were no protection there could be no reason why the vaccinated should not have suffered in the same ratio as the unvaccinated.

The worst epidemic in London of late years was in 1871, when the deaths from small-pox amounted to $2\frac{1}{2}$ per 1,000; this is probably the worst "W. H." has ever seen, and is trifling to some of the epidemics which have occurred in countries in which vaccination is not practised, the deaths being from 10 to 15 per thousand.

I add an extract from the tables for 1882, to show that there is nothing exceptional in the returns for 1885.

It is to be regretted that in so many cases it was not possible to ascertain whether the case was one which had, or had not, been vaccinated. I have in every case considered the doubtful cases as vaccinated, only calculating those deaths unvaccinated about which no doubt existed. The deaths registered since 1882 were as follows:—

Deaths.	1882.	1883.	1884.
Unvaccinated	184	55	319
Vaccinated	108	42	250
Not stated...........	139	37	344

I would have wished some abler writer had taken this matter in hand; but in default I have used my very best endeavours to show the real state of the case, and as I hope very few of your readers share "W. H.'s" opinion regarding medical men, I hope I may be successful.

Mr. Young refers to an increase in the number of deaths from small-pox during the 15 years from 1869 to 1883; this would be in part accounted for by the increase in population, and in part by the year 1871 having been one in which small-pox was unusually prevalent, the number of the deaths reported as unvaccinated being unusually large.

I have just been referring to an account of the statistics of small-pox towards the end of the last century in the "Encyclopædia Britannica," Vol. II. page 95, previous to the discovery of vaccination. The report states that the deaths from small-pox in Great Britain and Ireland were annually from 40,000 to 45,000; whilst in London, with a population of over 1,000,000, the deaths for a period of 75 years averaged 2,020 yearly, and that one in ten of all the deaths in London was from small-pox. It was also stated that in Chester, Liverpool, and Manchester one person in 205 died of it yearly.

I think this record of the past, compared with Mr. Young's statistics of the present, is a sufficient proof of the fallacy of his argument against the value of vaccination as a preventive of small-pox.

Lavant.

ANTI-VACCINATION.

[26691.]—IN 1819 I and an older brother and sister were vaccinated with vaccine taken from a cow in the parish. Eight years afterwards we were each of us inoculated for the small-pox, and slept with younger brothers (who had also been inoculated) while they had the small-pox, without acquiring the disease. I have several times since been with persons suffering from small-pox, but have never caught it. Only one puncture was made in my arm, and that was the custom during the early years of my life; but as vaccine became more and more diluted by transmission more punctures were deemed necessary. Next, the seven years' limit was instituted. It is nearly seventy years since I was vaccinated, and I am safe from small-pox now.

"W. H.'s" wholesale condemnation of the honesty and veracity of medical men reminds me of the sore-backed horse, who, when turned into a field where there were other horses, would not believe, until he had examined each one of them, but that all horses were, like himself, sore-backed. How is it that the anti-vaccination maniacs so utterly failed in Paris? Because, in my opinion, in France all the vaccine is used immediately after being taken from the cow.

I have heard much from mothers who had marriageable daughters of what has followed vaccination; but in every instance I have ascertained that the so-called consequences of vaccination have been hereditary, and generally proceeded from inherited syphilis or scrofula (parent and child, in my opinion); but many mothers will not hesitate to be untruthful rather than that a fact should be known which would militate against their daughters' chance of getting married.

I recollect the time when scarcely a year passed that there was not one or more towns within a few miles of my home "shut up," as it was then called—that is, the markets, fairs, schools, &c., were closed on account of small-pox being there. Is there anything of the kind now? Where are the men and women with their faces a mass of pits, or blind of one or both eyes, from the small-pox, that were so numerous sixty or seventy years ago? If vaccination propagates diseases so frequently now, how was it that inoculation for small-pox did not do the same?

I hope our Government will never be such cowards on the vaccination question as they were in reference to the Contagious Diseases Act.

Jan. 4. **Abergwili.**

A QUESTION IN COAL ECONOMY.

[26692.]—I AM obliged to "Chemical" (p. 415) for his notice of my remarks on this subject; but I hoped that some of your West Ham readers would have replied, for it is not unlikely that a few of the coals may be used in the manner suggested by your correspondent, as, indeed, I hinted. But if all the coals which Mr. Cook mentioned are used in one street in West Ham, I ask what business such "factories" have in that locality? I answer the question at the same time, by supposing that the manufacturers find it advantageous to be near a market, and that what they lose in paying extra for coal is more than recouped by the saving on the carriage of the manufactured products. Unfortunately, that does not touch the real pith of the question, which is, Why are so many coals used to produce such results? I can quite believe that as many as 170,000 tons of coal are used at the works in which your correspondent is engaged, for I know that steam-engines are not the only wasters of coal. As a matter of fact, several million tons of coal are annually wasted in this country, more especially in districts where coal is cheap, although the fact is staring us in the face that as soon as coals become scarce and dear, our manufacturing industries will stop, and England will progress on the downward gradient. The late Sir C. Siemens did what he could to hammer these facts into the minds of the leading men of this country; but still the waste goes on, and there are many steam-engines, furnaces, &c., using even as much as ten tons to do the work of one—there are thousands of instances where 50 per cent. more coal is consumed than need be. It is only the other day that the secretary of some league (the title of which I forget) drew a dreadful picture of a former sugar-refiner in London who paid £2,000 annually to the coal dues. Here evidently was a "hampered industry"; but it is quite clear that if it did not pay to remain in London that sugar-refinery would have been shifted. Two thousand pounds a year in coal dues represents 37,000 tons of coal, or over 100 tons a day; but since the original statement another has been forthcoming—viz., that the sugar-refiner used 900 tons of coal per week to refine 1,800 tons of sugar, and I appeal to all who know what can be done towards economising coal to say whether it is not swallowing a very large camel and straining at a gnat to talk of a "hampered industry," when a ton of coal is used to refine two tons of sugar. To take steam-engines alone, there are plenty of firms in this country who will make engines of 40 horse-power and upwards, and guarantee them to give an economy of 3lb. of coal per I.H.P., so that a ton of coal would yield 700 horse-power, say, for an hour; but it is well known that there are thousands of engines which consume 7lb., 10lb., ay, even 20lb. of coal per horse-power. Is not that a deplorable waste? And yet those who permit that waste to go on are the first to cry out about foreign competition, and howl for "fair" trade as they call it—meaning protection for their special industry. My contention is, then, that if Mr. Cook's statement is a fact (and there is some doubt) it is so much the worse for the fact, and the manufacturers who are using coals so wastefully should be improved out of West Ham.

Nun. Dor.

PHOTOGRAPHS ON GLASS, POTTERY, &c.

[26693.]—AN improved process of producing photographs on pottery-ware, glass, &c., known as a photo-ceramic process has been patented by the Hon. Denis Lawless, of the Barracks, Aldershot, and a few notes concerning it may be of interest to your readers. The patentee says (I quote from his specification which is No. 358, 1886):—

"My invention relates to a photo-ceramic process for producing pictures, photographs, or other designs on tiles, plaques, or other objects of pottery-ware, or on plates or other objects of glass, metal, or other similar substances, by impressing on them a raised and depressed surface corresponding to the lights and shades of the picture, photograph, or other design, by means of a die or mould into which, or with which, the clay, glass, metal, or other material used for making the object is pressed or moulded. The die or mould is made by casting in metal, or by electrotyping from a reverse mould, or it may be made in plaster, wax, guttapercha, or other material, the mould being taken from a 'gelatine relief,' or from a reverse mould thereof, or the 'gelatine relief' itself may be used direct for impressing the object with the raised and depressed surfaces. After the object has been moulded or impressed it is glazed or enamelled with a coloured glaze, enamel, or other vitreous substance which is more or less transparent, and is then 'fired' or heated to a temperature sufficient to melt the enamel, which then runs into the depressed parts of the object, which correspond to the darker or shaded parts of the picture or design, leaving the raised parts, corresponding to the lighter parts, thus producing the original picture or design, with all its graduations of shade, in whatever colour the glaze or enamel may be, if the body of the object is white, or modified if it is coloured according to the colour of the glaze or enamel. By the use of various coloured enamels the picture or design on the object may be produced in colours. The 'gelatine relief' may be made according to Poitevin's process by allowing the light to act through a negative or positive transparency of the picture, photograph, or other design, or in some cases the picture or photographic print may itself be used as a transparency, on to a surface of bichromated gelatine of such a thickness as will be necessary for the amount of relief required. The bichromated gelatine is made by adding bichromate of potassium or ammonium to a warm solution of gelatine and afterwards allowing it to set and dry on a level surface, such as a glass plate, or the gelatine mass may be bichromated after it is set by soaking it in a solution of bichromate of potassium or ammonium. After the dried surface or film of bichromated gelatine has been sufficiently exposed to the light under the transparency of the picture or design, it is placed to soak in water, which causes those parts which have been protected from the light to swell up by absorbing the water, while those exposed to the light remain unswollen in a greater or less degree, according to the transparency or opaqueness of the various parts of the negative or positive transparency. The mould is then taken from the 'gelatine relief' while the mass remains in a swollen condition. The 'gelatine relief' may also be produced according to the 'Stannotype' process by washing away in hot water those parts which have not been rendered unsoluble by the action of light. In this case some pigment such as Indian ink should be added to the bichromated gelatine forming the surface or film. In making the bichromated gelatine mass I find a suitable proportion of quantities to be ten grains of potassium or ammonium to 1oz. of gelatine; or, instead of using only gelatine, I sometimes use a mixture of sugar and gelatine in the proportion of one part of sugar and eight parts of gelatine. In the application of the process to metals or other substances that can only be moulded in a molten condition or stamped or impressed under great pressure, I prefer to take an electrotype of the cast or mould from the 'first' or gelatine mould, and then proceed as hereinbefore set forth."

The patentee says that "he is aware that it is not new to produce 'first moulds' by the bichromatised gelatine process; neither is it new to glaze articles by dipping them in, or coating them with, glaze or enamel, and then firing them. But by the combination of these known processes, carried out in the manner described, he produces artistic results never before attained by a purely physical process. **J. T. N.**

HOW TO MAKE GOOD BLUE PRINTS.

[26694.]—ALTHOUGH directions how to produce good blue prints have been given from time to time, I often find men expressing a difficulty, which may probably vanish if they will try the plan I have found successful. The solutions are made with filtered rainwater, or preferably with distilled, but boiled water will do. They consist of one part red prussiate of potash (ferricyanide of potassium) in six parts water; one part citrate of iron and ammonia in four parts water. The proportions are by weight. Mix equal parts of these solutions before applying; keep the mixture away from sunlight; apply with soft brush, and use as soon as dry. The sensitised paper will be nearly useless if kept for twenty-four hours even in the dark. When freshly prepared it is yellow, with greenish tinge, but gradually becomes grey, and is then of no use. The best paper to print from is parchment tracing paper. Drawings can be made in pencil on white paper; the parchment tracing paper is then damped and stretched over the pencil drawing, and the tracing preserved as original. This paper will stand one erasure of ink, but not more. To get a clear white line, the ink used must be very opaque. Time of exposure, from $4\frac{1}{2}$ to 6 minutes to clear sunlight; more if somewhat overcast, and remember it is no use trying on a very cloudy day. Begin with $4\frac{1}{2}$ minutes' exposure. If print is too light a colour, leave exposed longer next time; if lines are not clear white, the ink used is not opaque enough, or the papers have not been pressed together sufficiently—i.e., you need more blanket backing. A little experience will show the proper colour of print when it has been exposed long enough. Wash prints immediately on removal from printing frame, and wash thoroughly, or else the white lines will not remain white. A porcelain-lined sink is best for washing, but the important thing is to use plenty of water. Any white paper of sufficient weight to stand the washing is good. For small sheets paper such as that

which this is printed on will do well. A lighter blue will be produced by anything which partially intercepts the light—a double thickness of tracing paper or a flat tint, for instance. Perhaps if any of your readers try this method, they will report results. M. I. M. E.

ESTIMATION OF DIABETIC SUGAR—PREPARATION OF FEHLING'S SOLUTION—VALUE OF FEHLING'S SOLUTION—CONSTITUENTS OF BEET-JUICE—IRON COMPOUNDS IN TEA—ARROWROOT AS FOOD.

[26695.]—THE letters of Mr. Stokes and "M. O. H." (pages 347 and 389) on the subject of the estimation of diabetic sugar by Pavy's ammoniacal cupric solution deserved a more prompt reply from me; but I hope the writers will accept my excuse of "Christmasing" as a sufficient one.

Any description of his experience in the employment of Pavy's solution which Mr. Stokes may be disposed to communicate will be read with pleasure by myself as well as others; but I must protest against being supposed to be aware of the private experience of any chemist before he has published his results. My book is necessarily a compilation of published facts, supplemented with the results of my own experience in certain directions, and if Mr. Stokes has hitherto preferred to keep his special knowledge to himself, instead of placing it before chemists in the ordinary manner, surely I am not to blame.

In my last letter (p. 302), I stated that "Pavy's solution may be used for the determination of the glucose in diabetic urine, though it cannot be used for the detection of small quantities of the sugar." This Mr. Stokes interprets as, "Mr. Allen states that in the case of diabetic urine containing but little glucose the Pavy blue liquid cannot be employed." Mr. Stokes goes on to show that Pavy's solution can be employed for the determination of very small quantities of sugar; but "is too delicate for qualitative use, for it shows the minute proportion of glucose normal to all urines." Just so. I said it could not be used for the detection of small quantities of sugar, and after traversing this statement Mr. Stokes ends by exactly endorsing it. As to the determination of small quantities of sugar in urine by Pavy's solution, Mr. Stokes is well aware that it is one thing to determine the true sugar in urine, and another to ascertain the reducing power of the urine on Pavy's solution, and express the results in terms of sugar. There are other constituents of urine, such as creatine and creatinine, which are credited with the power of reducing alkaline cupric solutions, and as the amount of these non-glucose reducing bodies is variable, and even their nature to some extent uncertain, it is evident that the accurate determination of small quantities of diabetic sugar by its reducing power is impossible. That Pavy's solution possesses some practical advantages over Fehling's solution in *comparative* estimations of diabetic sugar, I am prepared to admit on the authority of Mr. Stokes; but the influence on the results produced by varying quantities of salt and other conditions, must militate against the absolute accuracy of its indications. As a rule, however, it is practically far more important to watch the increase or diminution of the diabetic sugar from day to day, than to ascertain rigidly the amount present, and for such purposes Pavy's solution is well suited. Short of the tedious purification by basic acetate of lead, evaporation, and re-solution in alcohol, I am not aware of any method by which the non-glucose reducing bodies of urine can be eliminated so as to allow of a rigidly accurate determination of the sugar.

It is a matter of indifference chemically whether the alkali metals in Fehling's solution be potassium, sodium, or a mixture of the two. Practically, the use of a tartrate at all may be considered a "dodge" for keeping the copper in solution in presence of caustic alkali. Tartrate of sodium is made by neutralising tartaric acid with sodium carbonate. Potassio-tartrate of sodium (Rochelle salt) is made by neutralising cream of tartar with sodium carbonate and filtering from the precipitated calcium carbonate. Hence it is cheaper than the sodium tartrate, to produce which tartaric acid must be previously isolated.

I presume the reason why "Knapp's" process of determining reducing sugars has not come into general use is that given me by the chemist of a leading firm of Burton brewers for not employing it. "I know Fehling's solution, its faults and advantages, and I understand its indications; but I have no time to learn the use of a new tool, the results obtained by which might not be directly comparable with those hitherto obtained." This reasoning may not be very logical or scientific, but there is a good deal of human nature in it.

If I understand "M. O. H." rightly, he proposes to destroy grape sugar by boiling with caustic soda, and then estimate the residual non-glucose reducing bodies by a cupric solution. But he here assumes that the products of the action of alkalies or glucose are not themselves incapable of reducing such a solution—an assumption which I think he will find quite unjustified by the fact. It seems to me that the weak point in all determinations of reducing sugars by alkaline cupric solutions is that two distinct actions are going on simultaneously—namely, the destruction of the glucose by the alkali, and its oxidation by the copper. The error due to this cause is to a great extent avoided by Soxhlet, who by a series of approximating experiments arrives at the exact amount of cupric solution capable of reacting with the sugar. My impression is that, while very constant results are obtainable by employing alkaline cupric solutions under constant conditions, the accuracy of the indications when these conditions are modified, as constantly happens in practice, is by no means so great as could be wished.

"M. O. H.," in his last letter, travels from the non-glucose reducing substances present in urine to those existing in beet-juice. This is a very large subject. Asparagine is notably present, and by treatment with alkali this yields aspartic acid, which reduces cupric solutions, as does, doubtless, its homologue glutaminic acid, which is also present in beetroot molasses. Raffinose, the sugar of high rotatory power present in beet juice, also reduces Fehling's solution after being heated, and there are doubtless other bodies capable of reducing cupric solutions.

In reply to "A Grocer" (letter 26652, p. 393), I have found a sample of commercial tea adulterated with a soluble salt of iron; but that was many years ago, and I believe the legislation against adulteration has put an end for ever to such practices. Such a sophisticant as sulphate of iron would have to be used very sparingly, or the inky appearance of the infusion would certainly attract attention. To detect it, the powdered tea-leaves were treated in the cold with dilute acetic acid, and potassium ferrocyanide was added to the filtered solution, which also contained sulphates. By operating in this manner there is no chance of error from the solution of ferric phosphate existing as a natural constituent of the leaves. Of course, magnetic iron ore (often titaniferous) was formerly frequently used for weighting caper and lie-tea, sometimes in considerable proportion.

Of course the statement on p. 342, that starch is not nutritious, is erroneous, unless the term "nutrition" is applied in the very limited sense of something which will support life unaided. It is quite true that starvation may ensue on an exclusive diet of arrowroot or other pure form of starch; but, on the same ground, we might describe sugar and fat as non-nutritious. Butter might be described as "simply salted fat and water." Although a certain amount of nitrogen in the food is necessary for the support of life, it is ridiculous to class all non-nitrogenous foods as non-nutritious. If albuminous foods were solely used, such as lean meat, much more would be required to be eaten, and a large proportion would be used in keeping up the animal heat, which can be done equally well and better by the non-nitrogenised proximate food constituents.

Sheffield, Jan. 8th. Alfred H. Allen.

THE PATENTS ACT, 1883.

[26696.]—I LEARN from an article in the *Times* that the Patents Act of 1883 is still "upon its trial," and from one of your contemporaries that if a patent is worth anything it is worth £25—the old price. It has always seemed to me that the correct policy for any Government in connection with patent law, is to make the preliminary fees as low as possible—just sufficient to cover the expenses of the office; for if nothing comes of a patent, no one is injured except the patentee, and he only loses then a small sum, whereas it is notorious that many inventors had a grievance because they could not pay the fee demanded a few years ago. The number of applications for patents during the past year has, I see, reached the "record" of 17,162—that is, it is a larger number than in any previous year; but I learn from the *Times* that a large proportion of the inventions are valueless. That has always been the case. What the *Times* should show, to make the argument worth anything, is that the proportion of valueless patents is greater now than it was when the fees were higher. After all, what is the reduction? It is £4, instead of £25, for the preliminary stage—that is four years, which is a "preliminary" stage for the majority of inventions, most of which, no matter how useful, have to be thrust, as it were, down the throats of those who will derive most benefit from them. It seems that with all that has been written on the subject, old ideas still prevail, and there are some writers who still contend that the old fees were not exorbitant.

But there is this to be looked at. If an invention is of no use, the mere fact of its being patented is of no interest to the public: the patentee loses what money he has paid. If it is of use, the public will pay for it, and not a farthing more than it is worth; but if it is of use and not patented the public knows nothing about it, and is probably deprived of the advantage which a patent gives—after 14 years. I have never been able to comprehend the justice of the patent and copyright laws when compared with those which relate to the ownership of land. For instance, a man might be the owner of land which, from no labour of his, becomes worth a hundred times its previous value in the course of a few years, and he derives all the benefit in perpetuity. Another man discovers something, or invents something, or writes, say, a book, and his ownership of that terminates in the case of a patent after 14 years, and in the case of a book after 40; but the patent has been taxed in the mean time and then becomes public property, while the land remains private property for all time, although the owner has done nothing whatever to enhance its value. This, however, has nothing to do with the effects of the Patents Act, 1883. It is asserted that a large number of the patents taken out since the reform are of no use whatever. Suppose that is so, Who is injured? Considering the small protection you give the inventor, it is no loss to the State if the whole of the patents granted in any year are useless, for the fees charged cover the expenses of the office; while if any invention is useful the public benefits after 14 years, because the patentee has been compelled to disclose "how he does it," and his invention then becomes public property. No doubt it is very annoying to people who were just about to discover this or that, to find that someone else has obtained a patent, and that they cannot use it without making terms; but who suffers? No one uses a patented invention, and presumably pays a royalty, unless it enables him to do what he wanted to do more cheaply than he could by other means; and surely if a patented invention is worth using, the patentee should have a share in the profits. It seems to me that a Patents Act should be very useful to the Chancellor of the Exchequer. It should put the fees as low as possible for securing a patent: it should secure that patent to the inventor as his property, to be disposed of by will in perpetuity on payment of an annual tax, which need not be very heavy. That, however, should hold good only while the present laws referring to other kinds of property are recognised. It is satisfactory to learn that under the present system the Patent Office will "pay its way" and have a respectable surplus every year. It would be as well, however, in the interests of future patentees, if the money now expended on a scheme of examination which is of no benefit to anyone were utilised in completing the "Abstracts," and in bringing the indices up to date. The only information a would-be patentee needs from the office is an intimation when a similar invention is in the office, for under any conditions he cannot otherwise know that until some time after he has taken out his own patent. Every facility is offered to the searcher in the library, the officials of which are deservedly noted amongst Government servants for their courtesy, and it will be a pity if the legitimate work of the office is hampered by the expenditure of its funds on a more or less useless system of examination. As an instance of how "slow" everything connected with our Patent Office is, the committee appointed to inquire into the working of the new Act has not yet made its report. Saml. Ray.

THE ELECTRIC LIGHT ON BOARD A SALVAGE SHIP.

[26697.]—SEEING a notice in your paper of the salvage ss. *Hyæna* being fitted with electric light, I venture, with your permission, to send you short description of the installation, which may prove of interest to your readers. The boat belongs to the Liverpool Salvage Association, and is employed for the purpose of salving wrecked goods and all the multifarious duties that such a vessel may be called upon at any time to assist in. Recognising the enormous utility of the electric light for such purposes, the committee of the association were pleased to order an installation of arc lamps, incandescent lamps, and submarine lamps of the latter type for divers' use. The work was intrusted to the firm of Perry and Cox, Liverpool, and they put down a Gwynne Invincible type vertical steam-engine and a Phœnix compound dynamo, driven by an endless rope and grooved pulleys. The dynamo develops 94 ampères with 65 volts, runs at 900 revolutions, and the engine at 330 revolutions.

The two masts of the vessel are each fitted with wrought-iron arms, and carry one Pilsen arc lamp, taking 26 to 30 ampères each, and developing nearly 4,000c.p. Spare cable is also supplied, so that either or both the lamps can be disconnected and hung in the rigging of another vessel if necessary. The submarine lamps are Edison-Swan 100c.p., inclosed in Delta metal watertight holders, which are permanently attached to a cable composed of two strands, each of 130 No. 26 wires, insulated and made specially waterproof by the London Electrical Wire Co.

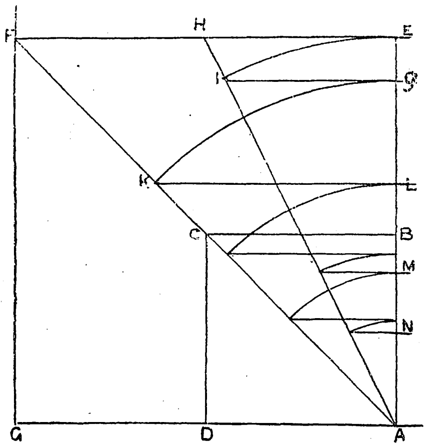
I need scarcely point out the great flexibility of such a cable. There are from 100yds. to 200yds. of cable to each lamp, and the ends are fitted with a straight, round terminal, so that by simply pushing them into the switch-boxes arranged around the ship they are connected. Twenty-candle lamps are fixed throughout the cabins and different compartments, and the whole are regulated from one switch board by side of engine. The engine governs so well, and the compounding of the dynamo is so effective, that whether one lamp, or any part of the installation, is turned off or on, their burning leaves nothing to be desired. The arc lamps are simply perfection, and the engineers to the association have expressed themselves more than satisfied with their working. The divers report on the submarine lamps that, at night, in tolerably clear water, they must prove of immense service, enabling them to examine and properly inspect any part of a ship's keel, besides their great use in a vessel's hold or deck. The varied uses and application of such installations as the above must naturally draw attention to the vast field that exists for their practical use, especially when it can be adopted so simply and so effectively.

On board a steamship, where a few horse-power taken from the boiler is never missed, and where an engineer is always at hand to look after any electric plant, the cost of any installation is really nothing in comparison to the advantages bound to accrue from its use.

50, Bedford-st., Liverpool. **Chas. W. Cox.**

THE DUPLICATION OF THE CUBE.

[26698.]—I WISH to submit a method of duplicating the cube, which I believe to be absolutely correct, for the investigation of some of your numerous correspondents. It is thus: First form a square to represent a 3in. cube, as in the accompanying figure, A, B, C, D; prolong the line A B



and A D to twice their length, and form a 6in. square, A, E, F, G, representing a 6in. cube, it being equal in bulk to eight of the former. Draw a line from point A to point F. On larger square another line is drawn from point A, cutting line E F at point H, in direct line with C D. Then, with compass, from point A to E, draw an arc cutting line A H at point I. Then draw a line from I parallel with line E H, cutting line A E at point J. Then again, with compass, from A to J, form another arc, cutting line A F at point K. From point K another line is drawn parallel with line E H, cutting line A E at point L. Line K L gives the base of duplication of cube A, B, C, D. The further lines and arcs are intended as a way of proving the accuracy of the above method, inasmuch as line A E gives the quadrupling base of A L, and A L gives the quadrupling of base of A M, and A M the quadrupling of A N. A N should be (to be correct) in length one half the length of base A B. Points being indefinitely fine, it is impossible to apply to them correctly. Figures will give the duplicate much finer. I, therefore, give the duplicate of 3in. in figures as far as necessary, which is 3·77976315, being in proportion of 1·25992105 to 1. The same theory will duplicate globes. **Williams.**

MOISTURE IN COAL.

[26699.]—FROM time to time letters have appeared in "Our" journal dealing with the economic value of various substances in common demand. I do not, however, remember that coal has been dealt with, so far as its value is affected by moisture or absorbed water. As next month (February) is, I believe, generally admitted to be the worst in which to raise water-absorbing minerals, may I suggest that some of our readers make some determinations of moisture and report? The method usually adopted is so simple as to be undertaken by many who are not in the strict sense of the word chemists.

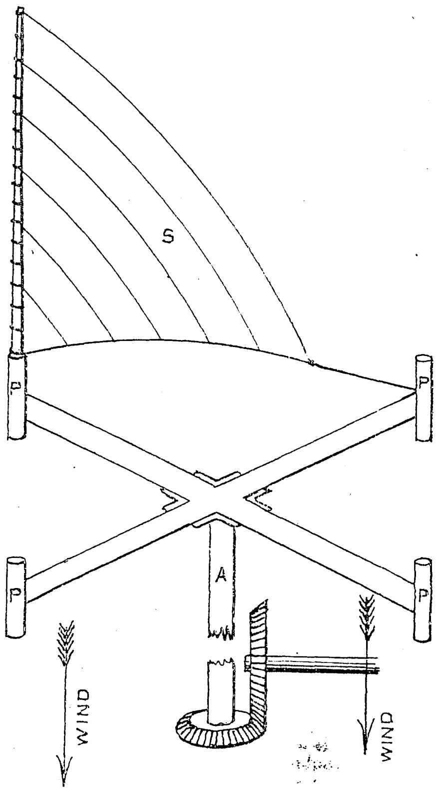
For those who may be of the latter class the following will suffice:—Finely-powder, say, 30 or 50 grains of coal picked from the heap, and dry between watch glasses at 105°, 110° for one hour, allow to cool, and again weigh; loss = moisture.

In years gone by, I remember being struck with the amount of water some coal taken from exposed situations contained, and I venture to think that, with your kind permission and the help of your readers, data collected over a wide area would be valuable. **Francis M. Rogers.**

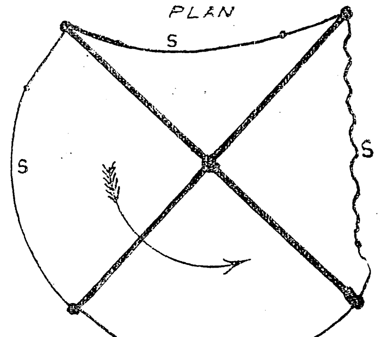
21, Finsbury Pavement, E.C.

HORIZONTAL WINDMILL POWER.

[26700.]—THE greatest amount of power to be got out of a horizontal windmill is, I believe, obtained by means of four sails, set as shown on sketch S. From experience, I fear it will hardly



PLAN



give satisfactory results; but as the question is again before the readers of the "E.M.," I roughly sketch a design, which can be easily tried by any one interested. The weak point is, securing the pieces of pipe, P P P P, to ends of crossbeams strong enough. This done, the light spars with sails of sailcloth lashed to masts, may be placed in their steps, the sheets (or ropes holding sails) made fast to the following beam, or arm; but not taut, leave slack. The support A, of any required length, strongly fastened to crossbeams, having a bearing at bottom (say, a steel cone), and a slack bearing or support near the crossbeams, concludes explanations. Now, observe the plan, and you will see that three out of four sails are always pressing towards the direction required. Square-headed sails, as sprit sails, would have more power, and take stronger gear. **Wm. Hosken.**

[26701.]—BEFORE this discussion drops into limbo I should like to make a few remarks on some of the points raised.

It seems generally acknowledged nowadays that no motive power is worth a moment's consideration but steam power, as though those "Wooden Walls" that contributed so largely to make the British Empire each burnt 200 tons a day of that precious stuff that is too often "human creature's lives."

By all means use coal legitimately, but not waste a 1,000 tons to enable a vessel to cross the "Pond" in three or four days' less time, nor shut up so many water-mills and windmills merely because it is the fashion to live in close quarters, where a steam or a gas-engine is the only motive power that can be crowded in.

I suppose this waste of coal will be only checked by its becoming scarcer and dearer, and then wind power will be commonly used. There is no reason why wind power should not be more often used now but fashion and prejudice.

There is a windmill in sight of where I write that is working at least one pair of stones nearly every working day in the year, for in good positions the power is more available than generally stated.

Now, a horizontal motor has many advantages over the vertical: First, it is cheaper in construction, the tower has not to be so high, and has no fan-tail or gear to bring it up to the wind. Secondly, being on top of the mill it takes up less room, for the swing of the whips of the vertical curtails the space inside while preventing any adjoining buildings. And, again, it takes better advantage of the wind, as being blown away from the wind at half the speed of it, the sails take half of the pressure; whereas, the vertical only takes one fifth, and (*pace* Mr. Browne) it comes up to the wind at *less* resistance than the vertical, for, as I bevelled the forward edges of all my sails they only took the *same* pressure as the wind was travelling at, and that on only *two* of the sails at the time, as the four others were doing useful work. And, please notice the tips of the vertical whips travel at more than twice the speed of the wind, continually cutting their way with four arms, on an average 8in. thick, with the addition of 12in. caused by the angle of the sail 15° (average) with the plane of revolution.

In answer to Mr. Browne (p. 413), first "where is it to be seen at work?" At present I have not any mill erected, but hope to have one before long. But why make a point of that? I never saw one before I made it, and anyone interested can experiment for himself, for he will reap the profit. Mr. Browne's second stumbling-block is, "It is difficult to understand Mr. C.'s excuse for not increasing the power of his windmill." Is it? Well, if Mr. Browne is good at persuading landowners that commerce and trade benefit by sacrificing park-like appearance, and cut down some old elms 75ft. high, I can with pleasure give him a job.

Mr. Browne says, "In my mind the weight is the greatest barrier of all." Not so. Mr. B. will find that the wind blows in gusts, never steadily, and weight *is* necessary to act as a flywheel, to keep the motor going when the trough of the wave comes, and yet not allow it to start off in the crest of the wave; and when in work, a part of the weight is taken off the step brass by centrifugal tendency.

One word more: canvas sails will not do; how can you regulate the speed without automatic shutters, the same as the vertical mill?

Albert Collingridge.

ORGAN WINDCHESTS.

[26702.]—IN reply to "W. H. H." (letter 26537), there can be no question that the "patent windchest" of Mr. Roosevelt is the most perfect thing of its class ever invented; but I should hesitate in recommending its adoption for a Chamber Organ of the ordinary size. The windchest has to be made of a much larger size than an ordinary slider windchest planted for the same number of pipes, and it is almost invariably a matter of great difficulty to get space enough for the ordinary windchests in a Chamber Organ. Beyond this one matter of size there is no objection to the Roosevelt windchest; indeed, in every other respect it is immeasurably superior to the slider form. I do not think the invention is protected in this country in any way. It has been adopted by Mr. T. Casson, of Denbigh, in his new organs.

I am asked to give "the size of the feeders" for an "organ of ten stops"; but it must be obvious that the mere statement of the number of stops conveys but little notion of the wind required. Had the names and scales of the stops been given, I could readily have furnished exact dimensions for a suitable bellows. Taking an imaginary specification, such a one as should be prepared for a Chamber Organ of ten stops, as a guide, the bellows receiver should measure about 7ft. by 3ft. 6in., and each of the three feeders about 3ft. 6in. by 2ft. I can assure "W. H. H." that he cannot have too large a bellows. The larger it is, the steadier the wind will be, and the easier the supply will be kept up.

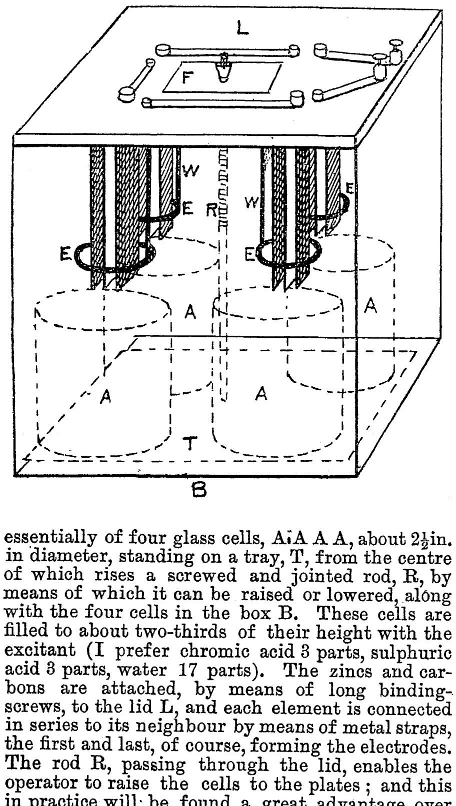
If the crank-shaft and all its accessories are properly made, and fitted with a flywheel of

moderate weight, about 4ft. in diameter, the blowing should be quite easy. It is advisable to let the shaft (for hand-blowing) have its bearings on friction-wheels. I am pleased to learn that my "Notes on the Chamber Organ" have proved interesting to "W. H. H." and others, and that there is a prospect of a practical book on the organ being well received, for such a treatise I have long been preparing for press. **G. A. Audsley.**

ON A SIMPLE MEANS OF INCREASING THE EFFICIENCY OF THE CHROMIC CELL.

[26703.]—IT is a well-known fact that the remarkable fall in current strength which takes place in the single-fluid batteries of this class depends to a great extent on the absolute immobility of the exciting fluid. This is due to the fact that as the hydrogen is absorbed by the oxidant (chromic acid, bichromate of potash) as fast as it is generated, no mechanical movement is produced in the mass of the liquid, so that the liquid near the zinc plate becomes quickly charged with sulphate of zinc, thus protecting the plate from the farther action of the acid. Many schemes have been proposed to avoid this, such as setting up circulatory currents in the fluid by the external application of heat (Sprague), or by means of an aspirator (Courtenay), &c., &c. These methods are excellent in their way, but are rather inconvenient of application by the amateur, who has only to deal with a few cells—and fewer shillings.

A very simple mode, which is quite effective, which gives no more trouble than snuffing a candle, and which could be made automatic if desired, is one which I have adopted in my own 4-cell batteries for temporary lighting purposes, &c. The battery (which is figured below) consists



essentially of four glass cells, A A A A, about $2\frac{1}{2}$in. in diameter, standing on a tray, T, from the centre of which rises a screwed and jointed rod, R, by means of which it can be raised or lowered, along with the four cells in the box B. These cells are filled to about two-thirds of their height with the excitant (I prefer chromic acid 3 parts, sulphuric acid 3 parts, water 17 parts). The zincs and carbons are attached, by means of long binding-screws, to the lid L, and each element is connected in series to its neighbour by means of metal straps, the first and last, of course, forming the electrodes. The rod R, passing through the lid, enables the operator to raise the cells to the plates; and this in practice will be found a great advantage over lowering the plates into the cells. The arrangement for setting up movement in the fluid consists simply in ebonite rings, E E E E, which encircle the plates, and which are attached to the ends of guttapercha-covered wires, W W W W, the upper extremities of which pass through the lid of the box, and are soldered to the four corners of a flat square of wire, F, which, on being raised and depressed, agitates the fluid in the cells, and thus prevents the accumulation of zinc sulphate round the plates. For the convenience of carriage, &c., the lid L is fastened to the box by means of two rings and catches, and is furnished with a central handle, not shown in the sketch.

S. Bottone.

LATHE MATTERS.

[26704.]—I FEAR our lathe correspondents are taking a holiday in the middle of the lathe season: we generally have some interesting matter to discuss about this time.

I have been reading over some of the late Mr. Hartley's letters, and particularly the one on page 315 of Vol. XXV., in which he speaks of his book I have also a letter from him on the subject, and it appears that the book was only waiting for more subscribers. It would be a great pity if that book were lost to the world. Can nothing be done to prevent this? Will Mr. Hartley's executors tell us how many more subscribers are required to justify publication, and will any who wish for the book to appear send in their names?

On page 416 of the same volume Mr. Jesse Lowe concludes a letter by promising to "communicate further." May I venture to remind him of his promise? We have never had in the "E. M." any detailed account of the medallion machine of which he is the inventor, nor has there yet appeared any complete working drawing of a geometric chuck.

"Tuebor" sent us two good things last winter, and could, no doubt, send more; so did "W. R. W." Where, too, are our old friends "O. J. L.", Dr. Edmunds, "Vulcan," and others? **F. A. M.**

ROAD REFORM—PYROLOGICAL FOOT-BLOWER.

[26705.]—IT is a pleasure to see the subject of road reform brought into the pages of the "E.M.," for it is a matter that can well bear a little intelligent discussion.

My knowledge of the subject is confined to that arising from my travels as a cyclist, which teach me that, though there is little hope as yet of getting the short-sighted local authorities to lay out capital in easing gradients which are a continual tax on the community at large, yet it is possible to induce them to improve the surface—which is so frequently villainous — by representing that the present system of repair (so-called) is not only inefficient, but also uneconomical. I inclose a tract on the subject for the Editor's perusal, which is excellently lucid, and I cannot do better than quote a few extracts from it.

"The causes of roads being bad and yet ruinously expensive may be any or all of the following:—

"(1) The material is unsuitable, local material, of whatever kind, being used to save carriage.

"(2) It is excessive and irregular in size; McAdam's rule that every stone that exceeds 1in. in its largest diameter should be rejected, being ruthlessly disregarded.

"(3) The road is of bad transverse section, hollow in the middle, or possibly inconveniently convex.

"(4) The surveyor is ignorant or indifferent, being appointed without consideration of his fitness for the office.

"(5) It is repaired at the wrong time of year, in too wholesale a manner, and by the aid of "binding material" which is worse than useless.

"(6) Too much is spent on materials.

"(7) Too little is spent on skilled labour."

As regards the last two the following may be given as an example:—

"As an instance of the saving which may be effected by proper supervision, I might quote a case from Lincolnshire, where the Donnington turnpike roads were, during the last seven years of the trust, placed in the hands of Mr. Wheeler, a civil engineer. From 1868 to 1874 he effected an annual saving of £276 over only 26 miles of road, while at the same time these roads were so much improved that a horse could draw along them nearly double his former load." The Roads Improvement Association, of 57, Basinghall-street, E.C., issue the little work from which the above matter has been condensed at a nominal price for distribution, and invite inquiry and co-operation from those interested.

With regard to the second part of my heading, I strove to construct such an apparatus as was described in the Reply column some time back. The plan was to use three bellows; two to blow—each taking alternate strokes—and a third having its upper board weighted to serve as a receiver, and deliver the air under a constant pressure. I failed to get this third sufficiently air-tight, and suspect that it would be necessary to make a pair with special care in constructing the joint by the nozzle if the ordinary form of bellows was adhered to; but I also found an omission in the design of far greater moment. It is that each of the blowing bellows sends the greater part of its wind, not into the weighted receiver, but into the collapsed pair, which is its colleague. A valve at the nozzle of each of the blowers is necessary to prevent this, and with this addition the result is excellent.

B. B.

MICROSCOPICAL NUMERICAL APERTURE.

[26706.]—WILL Mr. E. M. Nelson, and any other microscopical reader of "Ours" accustomed to testing glasses, kindly inform us whether they observe any difference in the performance of objectives of the same N.A., but the one a water and the other an oil immersion.

Theoretically, they should be alike; but in practice, both from what has been written and from my own experience, I should say there is a difference.

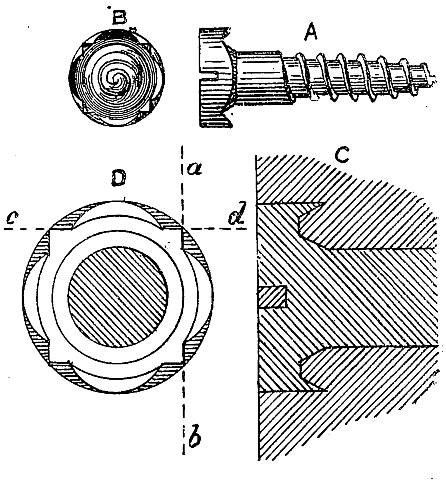
Thus, Dr. Dallinger, in his last address to the Royal Microscopical Society on the cell nucleus, says: "The highest and latest class of water immersions, as made by Powell and Lealand, proved a large gain over all their predecessors in searching into minute living structure; and then followed the early homogeneous lenses of Abbe and Carl Zeiss, which showed great advance in the direction needed" (N.A.).

Now, it happens that the N.A. of these two sets of lenses is almost exactly alike—Powell and Lealand's water immersion being 1·26 and Zeiss's 1·27. Consequently, if the performance of one is superior, it must be from other causes than N.A., and should be due to the medium oil instead of water.

My own experience confirms this, as I find that my Swift's last new oil immersion, $\frac{1}{12}$in., will pick up much finer detail with central light than my Powell and Lealand's water immersion $\frac{1}{8}$in., although the N.A. of the oil immersion is a little less of the two. Of course, there is the question of workmanship; but it cannot apply here, as the latter's name is sufficient guarantee that it is not inferior to any other maker. **T. F. S.**

A SCREW THAT WILL DRIVE IN FLUSH WITHOUT A COUNTERSINK.

[26707.]—I SEND drawings of a screw that will drive in flush (in pine and deal) without a countersink, making a neat job with less work than an



ordinary screw. The shaded portions in D represent the flat facets on the outer ring formed by cutting four nicks across as indicated by *a b*, *c d*.

Silke.

TRICYCLES.

[26708.]—WHILE thanking R. G. Bennett for his remarks (26635, p. 390, No. 1136) relative to the alleged greater ease in propelling small geared-up driving-wheels of bicycles as compared with large wheels geared even, I fear the theory propounded will not stand the test of examination. Mr. Bennett says that "the larger the front steering wheel is, *compared to its driver* (the italics are mine) the less it strikes and jumps." Now, had he omitted the words I have italicised, I should have "been with him"; but I submit that the relative sizes of the steering and driving wheels have nothing to do with the question. There is no downward thrust, as is evidently intended to be inferred by the diagram.

Suppose the axle of the driving wheels is supported, so that the rims are not in contact with anything, and suppose that force is applied to the pedals as usual, the wheels will then simply spin round without communicating any progressive motion to the axle, and this will occur all the same, whether the axle of the pedals is above or below the axle of the driving-wheels; but let the rims of the wheels be put into contact with a plane or other surface, and immediately the axle is propelled in a line *exactly parallel with the surface*, no matter in what direction the surface lies. The same holds good with the steering-wheel, whether larger or smaller than the driving-wheels: its axis moves in a line *parallel with the surface* on which it rolls, and also *parallel* with the lines of motion of the axle of driving-wheels.

Of course, a small driving-wheel strikes and jumps over the irregularities of the surface more than a larger one; but I am perfectly satisfied that anything like the digging action supposed by Mr. Bennett is not produced by large driving-wheels, and that consequently smaller ones cannot cure an imaginary defect.

I now begin to think that the explanation of the

alleged facility of working the machines with small geared-up wheels will be found in the fact of these machines having as a rule *larger steering* wheels than has been customary with the older type of tricycle, and that it is to this fact alone, or chiefly, that the greater ease of propulsion is due. This would tell with especial force in those machines in which a considerable proportion of the weight of the rider is placed on the steering-wheel whether front or back. I can well imagine that much of the freedom from concussion provided for by the use of large driving-wheels may be neutralised by a small front-steering wheel, and that in reducing the size of the former, while at same time increasing the diameter of the latter, an amelioration as regards vibration may be the result; but the cause would be the increased size of the steering-wheel, not the gearing up of smaller drivers. It may be, indeed, that facility of propulsion with any given power may be governed, *cœteris paribus*, by the diameter of the smallest wheel, and if so, that would be a sound reason for reducing the superfluous diameter of the driving-wheel without this in any way conducing to the greater ease of propulsion.

Gamma Sigma.

GOODS TRAINS PARTING COUPLINGS.

[26709.]—"NUN. DOR." (26662) seems to consider my last letter to be so curious as only fitted for a daily newspaper. How odd it is that I hold precisely the same opinion concerning his. I will not stay, however, to wrangle upon a side issue of this kind, but would state that my twenty years' experience of practical railway working through tunnels and over hills and down holes, and the study which I have all along given to questions affecting the safety of railway working, enables me to judge of the practical utility or otherwise of a system which will merely acquaint a driver of the fact of his train breaking loose. I did not, in my former letter, approve of the suggestion which was made. I admit it to be very good, so far as it goes, but it does not go nearly far enough; and I repeat that the engine driver of a parted train is powerless in preventing the hindmost portion running back, and in no case can he prevent a following train from running into the detached portion. "Nun. Dor." seems to imagine that the sounding of the whistle would be heard in the rear signal-box; but if he has had any experience of tunnels or signal cabins, he should know that the chances are 50 to 1 against such.

In regard to Mr. Stretton's proposals, they certainly would be the most effective; but I am afraid that the whole of us and the rising generation will be laid beneath the sod before the companies even begin to consider the fitting of their goods stock with automatic brakes.

I might, however, be allowed to mention the matter of runaway switches. They are used on a great many inclines throughout the kingdom, where in case of a train running back, it is turned off the line on to a rising bank, with effective stop-blocks, sometimes composed of earth, into which the vehicles bury themselves without doing much damage, and entirely clear of the opposite set of rails. As my work lies beyond the radius of the Underground Railway, I cannot speak of its adaptability for an arrangement of this kind. Perhaps some Underground Railway man will enlighten us.

It will be understood that it is only goods trains that I refer to, for I consider the automatic brake should be fitted to all passenger trains.

W. F.

ELECTRIC LOCKING FOR RAILWAY SIGNALS.

[26710.]—IN a reply which appears on p. 416, No. 61171, your correspondent "Electric" gives a brief account of the Spagnoletti system of signalling used on the Severn Tunnel section of the Great Western Railway; but there is one most important and vital point which requires to be made clear.

The object of electric locking is to prevent mistakes of signalmen, and to establish an absolute mechanical block system which cannot fail in its object or break down by the mistake of one man. "Electric" states that *after* the signal lever is put back to danger it is locked. I have examined the system, and I have also pointed out the important and serious defect which exists. Suppose that the signalman has his attention directed to the signalling of another train, or to the telegraph instrument, or that perhaps in consequence of a long term of duty he makes a mistake and omits to put the lever back again, or does not do so until the man at the next box in advance has sent the electric current intended to lock the lever in its normal position of "on," what is the result? The lock would be actuated by the electric current; but the lever not having been put back to danger would not be "locked," as, in fact, it would be on the wrong side of the lock, therefore the arrangement would fail in its object. Mr. Spagnoletti, writing to *Iron* upon the subject, admits this fact; but contends that signalmen do not omit to put the lever to danger; but I know from my own experience that such omissions or mistakes *do occur* in practice, therefore some appliance is required which renders it necessary for the lever to be put back to danger after the first train, before the "be ready" or "is line clear" signal can be accepted for the following train; or, perhaps even a better arrangement is to place the starting "signal" electrically under the control of the signalman at each end of the block section, so that no train can enter such section without the consent of two men, and in case one fails to place the signal to danger, the other can do so. It will at once be seen that it is not sufficient to lock a signal when it is "on"; but power or control is necessary to be able to put it on, if by error it has not been so placed after the passing of every train. The defect having been pointed out, I trust the inventor will take steps to improve and perfect his system. For many years I have urged the adoption of the system of electric interlocking in order to prevent the very serious accidents which result from the mistakes of signalmen.

Clement E. Stretton, C.E.
Consulting Engineer Amalgamated Society of Railway Servants.
40, Saxe Coburg-street, Leicester, Jan. 7th.

DOUBLE ENGINE RUNNING.

[26711.]—"M. R. SHAREOLDER" records a reduction of 30 tons in the dead weight of the Midland Scotch day trains, and on the 3rd January another reduction of 10 tons occurred as the small third-class coach to Glasgow was taken out of the train; but there is yet plenty of room for reduction. There is a large heavy "bogie" from London to Leeds, and another from Normanton to Carlisle: these should be replaced by small carriages, as they are not necessary for the traffic.

I agree with all Mr. Stretton and others have said against drawing a lot of empty rolling stock about the country for no purpose, and at great expense.

Locomotive.

PASSENGER TRAINS AND PARTING COUPLINGS.

[26712.]—UPON reading the remarks made by Mr. Stretton and "W. F." in the ENGLISH MECHANIC of Dec. 31, I was at first tempted to reply; but as "Nun. Dor." has disposed of them, it only remains for me to add that I endorse his remarks in the main. Those of our readers who have had to do with heavy mineral traffic will be able to judge how far any existing automatic brake system, depending mainly upon well-made joints, would stand under the severe handling a railway waggon is exposed to; and since a fair proportion of the waggons composing every goods train belong to private owners, the augmentation of maintenance charges, to say nothing of capital expended in outlay, would handicap most trades in a time of unwonted prosperity, and in these depressed times is out of the question. If, however, a system can be introduced which will, without entailing unreasonable first cost, apprise both driver and rear guard, first, that all couplings are properly made, and also when by accident or in ordinary shunting operations the waggons are disconnected, it would not be too much to expect the Board of Trade to interfere, and insist upon its introduction for the protection of the public. Apart from this, coal-owners and others employing large numbers of waggons would soon take a personal interest in its adoption, on account of the saving of time effected in making up their trains. Personally, I regard a railway whistle as an instrument of extreme torture; but since it exists, and probably will for many a year yet to come, nothing can be easier than to operate it by a modified electrical arrangement such as I have described, if the disc and bell arrangement is objected to. The public have no notion of the wholesale manner in which couplings part, and draw-bar hooks are wrenched off; and this does not arise from bad workmanship, or poor material, but from the excessive and sudden strains to which both are exposed. The powerful coupled engines now employed are more than a match for the couplings and drawhooks in use, and yet these former are about as heavy as it would be safe to make them unless manual labour be assisted in some way in coupling up. If those of our readers who have the opportunity will refer to their waggon-books, and selecting a new 10-ton waggon doing heavy mineral work, will, over 12 months note how many times it is stopped with "coupling broken," "draw-bar snapped," they will find the analysis is very instructive, and will hail the good time coming when "goods traffic" is removed from passenger lines.

We live in exceptionally high-pressure times, and those of us who have to do with constructive work are beginning to look for stronger materials than we possess to meet the heavy demand made upon them. A good brake is certainly a desideratum, and its design affords an open field for any of our readers who may have time and opportunity to experiment in this direction. It is too much to expect owners and railway companies to adopt the automatic continuous system, even were it feasible. But cannot the old side-lever brake be improved upon? I venture to think it can.

Francis M. Rogers, F.C.S.

JOY'S VALVE-GEAR—N.E. LOCOS.

[26713.]—A REPORT has gained considerable ground here in the North that Mr. Wordsell's successor on the Great Eastern has taken Joy's valve-gear out of several engines and put in the ordinary link motion. Can any of your Great Eastern readers give any reliable information regarding this?

I should like to know what other railways have adopted Joy's valve-gear, and with what result, satisfactory or otherwise.

Mr. Wordsell has lately turned out a considerable number of passenger and goods engines, all fitted with this gear; but a great amount of groundless prejudice exists against him, and this is often visited on his work, so that it is extremely difficult to get to know from the men whether they really like them or not, though for style and finish they outshine anything the North-Eastern ever turned out before.

G. S.

APOCRYPHAL LONG RAILWAY RUNS.

[26714.]—I SEE in *Whitaker's Almanack* for 1887 a rather remarkable statement under the heading "Longest Runs of Trains in Great Britain"—viz., that a train runs from Dublin to Cork, 165 miles, without stopping. I can hardly credit this, seeing that the long run from Newcastle to Edinburgh (124 miles) by the North-Eastern night down Scotch express is hardly ever done without stopping for water. Can any reader say under what conditions this remarkable run is performed?

Mr. Rous-Marten's letter on "Speed Myths" is exceedingly interesting; it shows, I think, that for great speed nothing can touch a single wheel engine. He says, "I had the opportunity of testing the swiftest and most powerful engine in the Kingdom." Could he not inform us which engine this was?

There are, I believe, two compounds on trial on the Great Western: A broad-gauge convertible, with four cylinders, and a narrow-gauge with two cylinders, both having 7ft. coupled wheels, and *no* working parts outside the framing, thus making very neat-looking engines. Details as to dimensions and performances are at present kept secret. No. 10 is, I believe, fairly satisfactory, though there is a difficulty in turning sharp corners both with No. 9 and 10.

The L. and N. Western seems to be reaping the results of fitting its stock with the vacuum brake; the number of times this brake has failed them recently ought surely to open their eyes to the folly of their proceedings. We shall see one of Mr. Webb's *splendid* locomotives landed comfortably into Euston-square one of these days; whether the company will then think about altering their brake depends upon the amount of damages they have to pay.

I should be very grateful if some reader would help me in the following difficulty:—I went to pump *hot* water from an open copper to a room upstairs; the pipe runs first about 15ft. horizontally from the boiler, and then 12ft. vertically. I find the pump I have put up (an ordinary suction pump) pumps *cold* water quite well; but when I try to pump the hot water, the steam from the boiler keeps the suction valve open, instead of letting it close, as it should do. At least, this is the only explanation I can think of to account for its inability to pump the hot water.

Zulu.

RAILWAY SPEEDS.

[26715.]—THE amount of repetition that occurs in your columns on railway matters, on account of new subscribers requiring information already given in back numbers, is unfortunately almost a necessity; but it is rather too bad when a correspondent asks the same question twice over, when answered the first time. In letter 26288, p. 86, Mr. Grey asks for details of the 10 a.m. express from London to Grantham. If he will take the trouble to refer to letter 23306, p. 66 of Vol. XL., he will find that the information has been supplied to him before, and that he worked out and published various interesting calculations from it.

The question of maximum speed attained on railways is one concerning which very little really accurate information is available. Mr. Marten fixes it at 75 miles per hour. No doubt his 81·8 record on the G.W.R. was a mistake; but I should like to call his attention to a run given by himself some two years ago in a contemporary (since defunct), in which he states that the distance from Stoke to Tallington, on the G.N.R., 15½ miles, was covered in 12½ minutes. Now, comparing this

with other observations which I have made myself between the same places, I calculate that the maximum speed on that occasion must have just touched 80 miles per hour towards the bottom of the gradient. I believe that between the two points mentioned higher speeds are attained than anywhere else in the world, and I have on one occasion travelled at a speed of 78 miles per hour on that section.

Those who make the matter of railway speed a study will find Kapteyn's chronograph a very convenient instrument for timing, as the speed taken between quarter-mile posts can be read off direct; but when great accuracy is required, if the speed is over 50 miles per hour, it is necessary to take the time for a whole mile and calculate the speed from it, because in timing a quarter of a mile at high speed a very small error in the time introduces a large one in the result. When timing between posts the head should not be moved, otherwise the second post will not be taken in the same relative position to the observer as the first.

Lincoln.

"OURS" FOR HOSPITALS.

[26716.]—I THINK Mr. Bower (letter 26667, page 412) has hit on an excellent way of beginning the Jubilee year, and hope that as many of "ours" as possible will send their mite for such a good purpose. Eleven shillings will provide a copy of the "E.M." post free for a whole year, and each number may afford pleasure and profit during many a weary hour. Might I suggest that, while country subscribers would, no doubt, specify the institutions they wished to benefit, we in London had better leave the choice to you, Sir (if you will consent), as unless we act unitedly, the resulting good might be much diminished. If you, Sir, will notify that you are prepared to receive amounts to be applied in this way, I shall be happy to send a year's subscription for two copies.

D. G.

[We will willingly receive such subscriptions, and distribute them equally, as far as they go, among the London hospitals.—ED. "E.M."]

USEFUL AND SCIENTIFIC NOTES.

Tooth Powders.—Prophylactic medicine is of greater value to the public than curative, although they are slow to give it its due; hence the subject of tooth powders may be of some interest. The necessity of keeping the teeth clean, with a view to the prevention of future trouble, is overlooked by toomany, even in the higher classes, sometimes from carelessness, sometimes from ignorance. Now, cannot the medical attendant do a great deal to combat theis state of things? The dental surgeon is often asked, "How soon should the first tooth brush be used?" "As soon as there are teeth to use it upon" should be the reply. An ideal tooth-powder should be alkaline, since acids dissolve the tooth substance; finely pulverised, that it may not mechanically abrade; antiseptic, to prevent decomposition of food lodged between the teeth, and perhaps to destroy the microbes which are always found choking the tubules of carious dentine; it should contain nothing irritating to the gums; and, lastly, it should be pleasant to the taste, or it will not be used. Fluid dentifrices do not, as a rule, clean the teeth effectually, unless they contain some ingredient which acts upon the enamel itself; and those preparations which are eulogised as making teeth white or preventing deposit of tartar, should be avoided. Charcoal was at one time a very popular form of dentifrice, and is even now largely used, but from the amount of silica it contains it will rapidly wear away teeth that are not of exceptional hardness; and, moreover, the gums in some instances become tattooed in a curious manner from absorption of minute particles. Pumice-powder, again, is too gritty; and camphorated chalk is said to make the gums spongy. Precipitated chalk forms the best basis for a tooth powder, to the base of which may be added pulv. saponis and ol. eucalypt., a drachm of each; and, if there is no objection to the taste, half a drachm of carbolic acid.—*Lancet.*

THE Dudley Chamber of Commerce have just had before them a communication from their secretary on the working of the Boilers Explosions Act, 1882. The communication stated that it was likely that the Government would soon proceed to further legislation in the direction of compulsory supervision of boilers. The workmen were constantly clamouring for an extension of official supervision, forgetting that all increase of working expenses operated vigorously as to wages and trade. It was doubtful if such inspection would prevent many accidents, for the causes which led to explosion developed suddenly. There would be no inspection between the periods of official inspection. The secretary was of opinion that there was no need for further legislation, and the Chamber agreed in these remarks.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60739.]—**Continued Fractions.**—As this query has got into the U.Q. column, I think it well to offer a solution of it. "R. E. F." has asked for a method of computing logarithms by means of continued fractions, and he stated his belief that such a method is given in the second volume of Francœur's "Mathematics." Having that volume (French edition, 1809) in my possession, I may here say that it contains nothing whatever on the subject. The following method of performing the operation I take from a work on "Trigonometry," by T. Luby, T.C.D., 1825:—The problem to be solved in this case is to find the value of x in a continued fraction from the equation $a^x = y$. The two consecutive numbers between which x is comprised can easily be seen by inspection. Let these numbers be n and $n + 1$, and let $x = n + \frac{1}{x'}$; substituting this value in the equation we find $a^{n + \frac{1}{x'}} = y$, and, therefore, $\left(\frac{y}{a^n}\right)^{x'} = a$, or, as we may put it, $c^{x'} = a$. Proceeding again in this manner, we shall see that the value of x' lies between two numbers n' and $n' + 1$, and so assume $x' = n' + \frac{1}{x''}$. Repeating this operation continually, we shall find—

$$x = n + \cfrac{1}{n' + \cfrac{1}{n'' + \cfrac{1}{n''' + \&c.}}}$$

By applying the ordinary process of converting a series into a continued fraction, any one of the logarithmic series may be exhibited in this form.—VLADIMIR.

[60744.]—**Question in Dynamics.**—Perhaps "M.I.C.E., Bath," may like to know—at any rate I owe it to him to tell him—I have come round to his and "Nephesh's" view of this question, and am quite willing to return his compliment by admitting that he was right and I wrong.—W. A. S.

[60881.]—**Pitch Pine Stopping.**—To "NUN. DOR."—What I want is a stopping for shakes, so that when polished or varnished it shall present the same appearance as the wood.—G. H. H.

[60925.]—**Locomotive Engines.**—Your correspondent, "Loco.," p. 415, states as a fact that engines having a small leading-wheel run better than those coupled in front. May I ask if he will be good enough to favour us with any facts or figures upon this important subject? I have ridden many hundreds of miles upon various engines and on different lines; but I may say that I have found several engines coupled in front run quite as steadily as those with bogies or small leading-wheels. Recently, after the Railway Congress at Brighton, through the courtesy of that company, I rode from Brighton to Victoria on one of the Gladstone class, "Northcote, No. 217," and certainly, I have never found an engine to run more steadily at high speed, or to perform its work in a better manner.—CLEMENT E. STRETTON, Consulting Engineer Amalgamated Society of Railway Servants, Leicester, Jan. 8th.

[61049.]—**Electric Lighting.**—This query is addressed to Mr. Striffler; but like many others in which one writer is appealed to, remains up to the present writing unanswered. I write this to point out that if your correspondents would but endeavour to comprehend the principles upon which all schemes of electric lighting are based—as they may by studying carefully Mr. Sprague's work—they could answer all such questions themselves, and save both money and time. The very notion of charging accumulators by means of primary batteries is economically absurd.—NUN. DOR.

[61063.]—**Wheat Straw.**—As the brittleness of wheat straw is due to its silica, anything that would remove the silica would perhaps render the straw permanently flexible. The querist might try the result of soaking in weak hydrochloric acid or in solutions of the alkalis.—NUN. DOR.

[61064.]—**Vertical Engine.**—It appears "J. W. R." is desirous of increasing power with present engine. I should advise, in the first place, to set your valve right—the travel is not equal; that done, you will gain more pressure on your bottom card. Then as to changing your governor. Put on a Fremper cut-off governor, which will increase your initial pressure on your piston, by having the full boiler pressure waiting for the opening of the valve; said governor must be placed as close to the steam-chest as possible, because expansion takes place in the pipe from the governor and steam-chest as well as the cylinder, until the slide-valve cuts-off. By using a good cut-off governor, you could speed up your engine, which is sadly too slow. By doing so, your governor cut-off would be very early, and you would derive more benefit from expansion; your terminal pressure would be lower, consequently, less steam to condense at each stroke, with the higher speed to your air-pump—result would be a better vacuum. I could make many more suggestions; but I presume you wish to make the change as cheaply as possible. There is lots of room for improvement on those cards.—JAS. D. ROSTRON.

[61071.]—**Planing Machine Tools.**—Is it possible that there may be something wrong with the tool-box itself, as it will lift well enough when planing with right-hand tools, but binds hard with left-hand ones? My tools are not cranked, as there is no one here that I can trust to crank them.—A. F. SHAKESPEAR, Lüttichaustrasse 14 III., Dresden.

[61072.]—**Motor for Bottle Brush.**—The water motor will be cheaper than the electric motor, if the querist has a good fall of water. He surely knows how high his cistern is, or can measure with a gauge the pressure at point of delivery. Probably he would find it cheaper to employ a strong lad to turn a flywheel.—NUN. DOR.

[61074.]—**Organ Tremulant.**—The tremulant is a doubtful advantage to a pipe organ, and there are not many illustrations in back volumes. See No. 528, p. 204; No. 348, p. 258; or No. 349, p. 284. A simple tremulant is made by putting a little bellows on the wind trunk with a bit of wire carrying a weight extending from the upper board of the bellows, and a spring to keep the bellows shut, or, rather, to tend to do so. When wind is admitted to the bellows by opening the valve, the bellows opens, but is immediately returned by the spring, a little wind escaping by a small leather-covered hole. This arrangement sets up a sort of vibration in the wind current, which is imparted to all the pipe sounds which the "wind" controls. Perhaps the best tremulant is that which is placed in an enlargement in the wind trunk—a sort of box with a valve or diaphragm, which can be shifted so as to close or open the wind trunk passage as may be desired. The diaphragm carries a valve kept to its seat by a spring which the wind can force; but the spring causes the valve to endeavour to return to its seat, and accordingly the "wind" is put into vibration. A lever lifts the diaphragm out of the way when the "tremulant" is not required. Considering how much we have about organ-building in these columns, it is rather singular that this query has been passed over apparently; but perhaps your correspondents think that a tremulant is of little value in an organ. Be that as it may, the querist will find all he wants at the places cited above.—ORGANON.

[61080.]—**Small Organ.**—"J. C." must settle for himself what reeds he requires. How many tunes does he wish to play? Let him set them all out in the key of C, and see how many accidentals occur, then take a balance and choose reeds accordingly. I explained the system on p. 490, No. 1010, and gave a scale, which may suit "J. C.," on p. 439, No. 1008. It is an easy matter to determine which reeds to use when you know what tunes are to be played: it is difficult and unprofitable to guess at a scale which may or may not suit a querist.—GRAY'S INN.

[61094.]—**Æolian Harp.**—There must be two bridges, one at each end. Use what strings you like, and tune them to anything so long as they are all the same. See No. 1048, p. 163.—ORGANON.

[61094.]—**Æolian Harp.**—There should be two bridges, one at each end, about 1½in. from the pegs; this is not necessarily an exact distance, a little variation does not matter much; the bridges, ⅜in. high, are not fastened, so they can be adjusted at will. The strings are of gut—violin first strings answer best. You can tune the strings to any note; but I find the lower notes C, D, or E of the treble clef very satisfactory. All the strings *must* be tuned to the same note; any departure from this is a mistake—unison is necessary for the best results. It is best to tune with the ordinary tuning-hammer, such as piano-tuners use. In tuning do not be satisfied until all the strings sound exactly alike. When the weather is suitable and there is sufficient wind, which, of course, is a *sine quâ non*, the instrument is put into the window and the sash drawn down close to the strings, but not touching them. The harmonic sounds are then produced in endless variety, but always in the regular order well known to students of acoustics, the combinations at times being extremely weird and beautiful.—D. GRIMSHAW, Burley-in-Wharfedale, near Leeds.

[61101.]—**Stars Visible from Bottom of Well.**—Will "B. A." add to my obligations by fixing a time within which his answer to this question applies. I ask, because the question he has so readily answered has been passed by not a

few professional astronomers, and our own "F.R.A.S." (p. 345) was careful not to make quite so definite an assertion as "B. A." does. Perhaps "B. A." can give a definite answer to the original query: it appeared on page 313.—E. D.

[61103.]—**Bath Chair.**—This is rather a peculiar query. A sketch is to be made and space occupied in order that Mr. Stevens may make a Bath chair to double up. As he understands the principle, why cannot he set the work out on paper to some definite scale, and then see how the parts fit?—J. T. M.

[61104.]—**Steel Band.** — I presume "32in. thick" means a 32nd of an inch thick; but as to the smallest size pulley, that is a matter for experiment with different kinds of steel. All bands of the kind wear longer and work better on pulleys of good size; but 4in. would not be too small if the steel is good.—SAML. RAY.

[61107.]—**Small Coils.**—How can anyone say what is the smallest section-wound coil that can be made? Full directions for making coils have been given many times in back volumes, and it is purely a matter for experiment how small one can be made.—L. P.

[61112.] — **Fletcher's Muffle and Air Furnaces.**—What is the question in this query? All I can find is "Do quartz crystals grow?" although the query occupies 22 lines. I suppose quartz crystals may be said to grow out of the mother liquor.—F. C. S.

[61131.]—**Electric Cautery.**—It is very evident, from A. D. Stewart's reply, Dec. 31st, that he has very little idea as to what his requirements are. Surely, when he could so easily give the R. of his cautery to ·01 ohm, he might have been able to give the diameter of the wire, or at least the weight of same in grains per foot, and from either of these the current could have been found. Having to depend upon others, he says he has, in consequence, suffered much; but I am certain the parties favoured with his orders would suffer in a much larger degree, as it is the exception to find a surgeon who has the least idea what his requirements really are. Happily, there are a few who use electricity every day, and who use it most successfully; but as a rule, surgeons want the (as yet) impossible. They want current to work cauteries, say, 4 to 20 ampères, current to work incandescent lamps, electro-magnets, constant current up to 40 volts, induction currents, &c., &c.; and yet all this should be of such dimensions that they could easily carry it either in their hat or coat-pocket. Mr. Conry appears to have had very little experience in the heating of wires, and his elaborate formulæ I am sure will give "A. D. S." very little assistance. If he had given us the current in the experiment with the No. 30 wire, it would have been of greater service. He does not say anything about the effect of radiation and convection from the surface of heated wires; yet, if he will study this question, he will find that these alone determine the final temperature which a wire carrying a current may attain, specific heat and weight of wire having nothing to do with the question before us. I have made some experiments which may assist the doctor. I find that 14·5 ampères would just raise a platinum wire ·026in. diameter to a white heat, and, using the following formulæ, we can find the current required in Mr. Conry's experiment thus, $c' = c\left(\frac{d'}{d}\right)^{\frac{3}{2}}$ When c = current in a wire with diameter d, then c' gives the current required to heat d' to same temperature, and assuming No. 30 as ·0124in. diameter, then we find the current to heat same = 4·75 ampères. I may add that it would give me much pleasure indeed to see the Leclanché cells which could maintain such a current even a few seconds. If "A. D. S." will get or make three large bichromate cells, he will have no trouble in doing all he wants, and these will also work a 5-volt incandescent lamp of, say, 10 candle-power. The cells should be fitted in a close case, and arranged with rack to raise them immediately you are done using; in fact, if this arrangement is automatic, then all the better. Am-meters are regularly offered in "Sale Column" of "E.M." at 5s. each. I have no knowledge what their value as instruments of precision may be; but their price places them within easy reach. "A. D. S." should have "Sprague's Electricity" on his book-shelf, and a few hours spent in perusing this would be well repaid.—OHM.

[61145.]—**Does it Boil?**—TO "SIGMA."—Thanks; read on after your own on p. 416, and take to yourself all I said to Mr. S. B. Please dwell on this, too. Why is it that water cannot be heated beyond boiling temp. for each selected pressure? It hardly looks as if additional heat was then expended solely in vaporising because nature directly forbade the water to grow hotter, but rather as if the given external pressure were then no longer sufficient to restrain the evolution of (displacing) vapour, and that this process acted as a waste-pipe in preventing further rise of temp. in the liquid. In the nearly-boiling stage, my feeling is that no vapour is formed so as to drive back the atmo. or "displace" it. Surely the vapour then formed only gets between and among the particles of air? And if so, what forbids me to regard such evaporation as a merely passive process by which a liquid is dissolved in a gas, with analogy to solution of sugar in water?—WEALD.

[61145.]—**Does it Boil?**—I meant no offence to "Weald," and am sorry he has taken it, the more so as it hinders his seeing my points. My complaint was that if he had maintained his solution hypothesis at first, no one would have been put to the pains to give him elementary definitions of boiling; and certainly there would have been no opening for purely verbal definitions. The phenomena of vaporisation are exceedingly interesting and important, and numbers of keen-witted men have investigated them and recorded the results of their observations and experiments in books. If "Weald" chooses to despise these records, the loss is his: he simply puts himself at an incalculable disadvantage in his search after physical truth. He does full justice (no more than justice, I must add) to the printed words of Mr. Bottone. Why reject the printed words of other men of science merely because it is bound up into a volume? In this special case he has started an hypothesis which helps to bring home the nature of vaporisation to his mind; but a yes or no answer to his queries will take him but a little way—if he brings mind to a good book, he will assuredly find answering mind therein. The analogy suggested is certainly not complete: the sugar does not dissolve in the absence of the water; the water vapour is given off in the absence of air, to the same amount and with much greater rapidity than when air or other gas is present. Once more, if he wants to understand the subject, why not study it by mastering what the great experimentalists have recorded concerning it? Then he will stand on their shoulders, it may be, to attain further truths. Many thanks to Mr. Fletcher. I ought to have puzzled it out for myself; but somehow missed the explanation.—W. A. S. B.

[61156]—**Battery for Lamps.**—This querist should consult "Sprague's Electricity," new edition, p. 168, Table IV., and Tables V. and VI.; in the latter the cost per unit for various cells is given. —OHM.

[61203.]—**Porous Pots.**—You must burn them over a clear coke fire, as anything else deposits a sort of soot over them and in the pores. If coke is scarce up your way, I shall be pleased to send you some.—W. HOLDEN, Newport, Mon.

[61299.]—**Capricious Dynamo.**—Many thanks for both replies; both, however, are wrong. To "Sigma," I will say no one touched the connections in either case. To "Miller," that the dynamo was specially built for plating, and will not work nicely without the series coils, as the bath is of very low resistance indeed. I have since repaired the dynamo by "soaking" the pole pieces in a forge fire for a couple of hours, and allowing it to cool down gradually; but I am not sure that this remedy will be permanent.—SELIM.

[61234.]—**Bursting Pressure.**—I am much obliged to "T. C., Bristol," for his kind assistance; nevertheless, I think if he will kindly review his calculations, he will find out his error.—NONCONFIDENT.

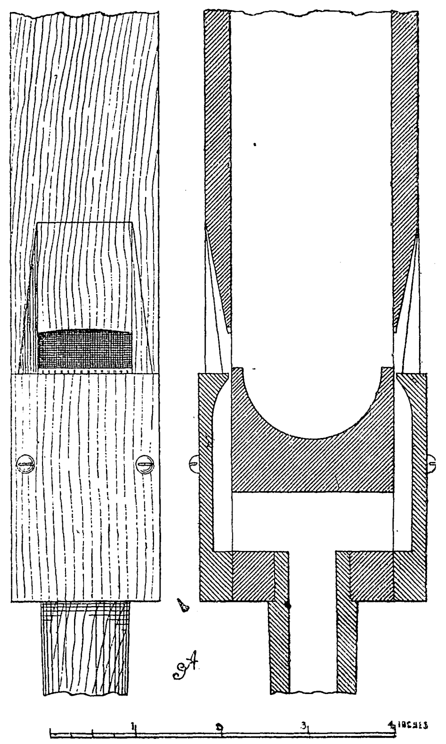
[61257.]—**A New File.**—The file I referred to in my query was not Mr. Kirkwood's, as he seems to imagine, but a German patent, and was for cutting steel, iron, and brass, a special form being made for softer metals and wood. I thought that a reader of the "E. M." might have had some experience with the same or a similar file, and could give his opinion. Cannot "R. S. T." communicate with me, if interested, as out here I have no way of paying for advertisement?—A. F. SHAKESPEAR, Dresden, Lüttichaustrasse 14 III.

[61274.]—**Portable Cell.**—There is no trouble in arranging this. Take an ordinary Leclanché cell, and make up a saturated solution of salammoniac, soak cotton wad thoroughly in this, and then pack the cotton inside the cell. This arrangement works well for testing, especially if used with one of the cells without porous pot.—OHM.

[61290.]—**Mediæval Outlines.**—If "Draughtsman" happens to be friendly with the head of some printing establishment, he might obtain a loan of typefounder's catalogues, which are sure to contain an assortment of interesting and beautiful designs.—ARTHUR MEE.

[61295.]—**Turning Slate.**—Use cast-iron, which is cheap. Some use bits of soft wood which hold grains of emery. Carbonado too dear for such work.—J. K. L.

[61278.]—**Hot-Air Motor for Organ, &c.**—In reply to "C. C.," I may direct his attention to the hot-air engines made by the Britannia Company, Colchester. Personally I have had no opportunity of observing the operation of a hot-air motor as an organ blower; but these engines are good, and will no doubt answer the purpose. They are made up to 2-man power, and heated by gas or ordinary fuel. "C. C." may obtain particulars by writing to the company. I have much pleasure in giving particulars of my Doppel-flöte; and as the stop is practically unknown in England, for there is not another example in any English organ, to my knowledge, I have prepared a scaled drawing of the

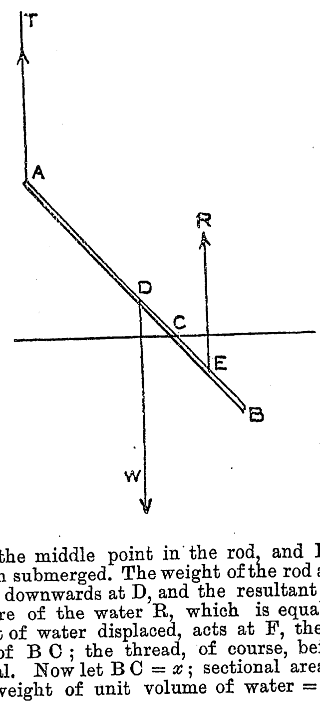


middle C¹ pipe, showing the proportions of mouths, the sunk block, windways, caps, &c. The internal dimensions of the several C pipes are as follows:—

	Ten. C	C^1	C^2	C^3
Width, internally	$1\frac{3}{4}$in.	$1\frac{1}{8}$in.	$\frac{3}{4}$in.	$\frac{1}{2}$in.
Depth, internally	$2\frac{15}{16}$in.	$1\frac{3}{4}$in.	$1\frac{5}{16}$in.	$\frac{7}{8}$in.
Length, from mouth...	$25\frac{1}{2}$in.	$13\frac{1}{4}$in.	$6\frac{1}{2}$in.	3in.

The pipes, of course, are stopped; they are of mahogany on the mouth sides, their caps have plain edges, and the blocks are slightly nicked. The windage required is small, while the tones produced are singularly round, full, and of good mixing quality. The bass octave is added in stopped pipes with single mouths, voiced very full, to carry down, as nearly as possible, the tone of the double-mouthed portion of the stop.—G. A. AUDSLEY.

[61306.]—**Question in Mechanics.**—In subjoined diagram A B is the rod, A T the thread, D



being the middle point in the rod, and B C the portion submerged. The weight of the rod acts vertically downwards at D, and the resultant vertical pressure of the water R, which is equal to the weight of water displaced, acts at F, the middle point of B C; the thread, of course, being also vertical. Now let B C = x; sectional area of rod = a; weight of unit volume of water = ρ; and

weight of rod = W. Taking moments about the point A, we have—

$$W \times AD = R \times AE;$$

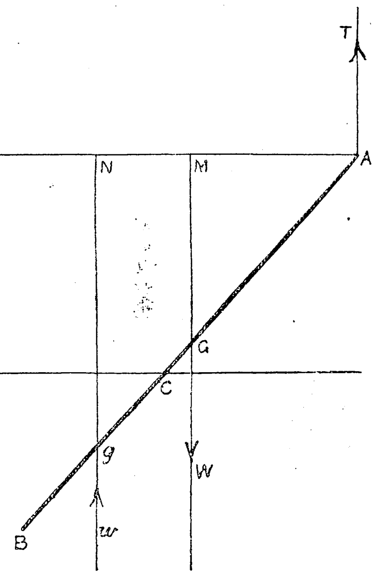
or—

$$(12 \times \cdot 7 \times a \times \rho) 6 = (x \times 1 \times a \times \rho) \times \left\{ 6 + \frac{x}{2} + (6 - x) \right\}$$

$$\therefore \quad 50 \cdot 4 = x\left(12 - \frac{x}{2}\right)$$

On solving the quadratic equation we get $x = 5 \cdot 43$.—A. J. J.

[61306.]—**Question in Mechanics.**—When the rod is at rest, it is kept in equilibrium under the action of three forces—the weight W, the reaction of the fluid on the part immersed, which is equal to the weight w, of the fluid displaced, and the tension of the thread T; but the two forces W and w are vertical forces, therefore their resultant T is also a vertical force. If now in the figure,



G and g be the centres of gravity of the rod and of the fluid displaced, and AMN be a horizontal line through A, meeting the verticals through G and g in M and N; then, taking moments about the point A, we have the equation—

$$W . AM = w . AN,$$

or $$\frac{W}{w} = \frac{AN}{AM} = \frac{Ag}{AG} \quad \text{.........................} \quad (1)$$

If we take BC the length of the part immersed equal to x; then Bg will be equal to $\frac{x}{2}$, and Ag will be $12 - \frac{x}{2}$; also AG = 6.

$$\therefore \frac{Ag}{AG} = \frac{12 - \frac{x}{2}}{6} = \frac{24 - x}{12} \quad \text{.........................} \quad (2)$$

Again, if the weight of the unit of length of the fluid displaced be taken as the unit of weight, we shall have $w = x$ and $W = \cdot 7 \times 12$—

$$\therefore \quad \frac{W}{w} = \frac{8 \cdot 4}{x} \quad \text{.............................} \quad (3)$$

and from (1), (2), and (3) we have—

$$\frac{24 - x}{12} = \frac{8 \cdot 4}{x}$$

or— $$x^2 - 24x + 100 \cdot 8 = 0.$$

A quadratic eqn. from which we have—

$$x - 12 = \pm 6 \cdot 57$$

or— $$x = 5 \cdot 43\text{ft. and } 18 \cdot 57\text{ft.}$$

The second value supposes the point g to be in the line BA produced.—MILVERTON.

[61310.]—**Electricity for Killing Dogs.**—Although I heartily disapprove of cruelty to animals, especially for so-called "sport," yet sometimes I cannot help thinking that some of the energy spent in preventing cruelty might be more usefully applied. We work our signalmen twelve hours a day, we work our tram-men sixteen hours a day, and our engine-drivers often longer; we compel young girls to stand the whole day in shops for the sake of seeming busy, and we tax the resources of science in order to provide a painless death for homeless dogs, and prosecute farmers for not milking their cows at market by Greenwich time! Is not a tram-man better than a dog, and is not an English girl of more account than a cow?—WM. JOHN GREY, F.C.S., Newcastle-on-Tyne.

[61322.]—**Induction Coil.**—TO MESSRS. BOTTONE OR CONRY.—These are all the same in principle. Both medical coils and intensity coils depend on induction for their manifestations. The current given by the former is not required to be very great or of high tension, so no great care is taken in insulation. The latter are made with the greatest care as to insulation, and with an immense quantity of very fine wire, so as to insure very high tension. Yes, a tube regulator can be used with an intensity coil. I should advise you to spend a shilling on "Intensity Coils: How Made," by Dyer.—S. BOTTONE.

[61323.]—**Back Shaft for Sliding and Surfacing.**—I should not attempt to apply a back shaft to a 4in. lathe, such as I described. A 5in. or 6in. lathe is small enough, I think, to put a back shaft to, because it means so much extra work about the slide-rest saddle—too much for one of small size. But if you will give me the sectional dimensions of the bed of the 6in. lathe which you mention, and say on which side the rack is placed, whether back or front, I will draw out the necessary gear.—J. H.

[61325.]—**Fitting Glass Stoppers.**—Wet the stopper, dip it in fine sand, insert it in the neck of the bottle, and grind away. If you are blessed with patience and elbow-grease, you cannot fail to get a good fit.—S. BOTTONE.

[61325.]—**Fitting Glass Stoppers.**—Chuck the stopper in the lathe, put on some fine emery mixed in oil, and while revolving press the bottle on with a gentle hand. The stoppers are roughed off to a near fit with sand and water on a revolving iron plate, and a few touches between bottle and stopper, as described above, make as close a fit as can be desired.—SAML. RAY.

[61325.]—**Cocks.**—I have never taken particular note of the proportions of the various sized plug-cocks, but they should be tight for water or steam to 100lb. at least. I consider lead washers an abomination. Have the thread to fit well, and screw up tight with a little red lead.—T. C., Bristol.

[61328.] — **Electrical Measurement.** — TO "SIGMA."—This question is rather wide, as it involves a good many principles if it is to be answered correctly, and I should have to refer the querist to the information to be found in my "Electricity." It appears he wishes to make experiments similar to those which I made when writing that work, and therefore I can do no better than refer him to the description of the apparatus I devised and used, which will be found p. 229 of the first edition and p. 311 of the second. A tangent galvanometer such as he mentions would answer his purpose; it would be better to make it on the plan I have described, so that each circuit would be a decimal multiple of the others; but to measure the E.M.F., the resistance, including that of the cell, would require to be made 1,000 ohms, much of which would be in the wire itself, with a variable portion to correct for temperature, cells, &c.; then the current in ampères shown by the needle would represent the E.M.F. in volts, as in my own patent instrument, the first by several years in which the actual current in ampères was shown on the dial.—SIGMA.

[61329.]—**Dynamo.**—For such small dynamos it is hardly worth while to have forgings. Nicely annealed malleable iron castings do admirably. Diameter of cores, $2\frac{1}{2}$in. The plate is of brass; to prevent fingers, &c., getting a blow from the rotating armature. The rod is the support of the brushes; but the best way is to support the brushes on a carrier, movable round the shaft and attached to one of the standards. The running resistance of 4lb. of No. 20 on the ring armature is about 4 ohms; hence on the F.M.'s there must be about 16lb. of No. 16.—S. BOTTONE.

[61330.]—**Legal.**—BAD DRY PLATES.—The agent acted as principal in the sale, and is liable.—R. S. T.

[61331.]—**Cable for Electric Light.**—I have changed title to suit index. If your 19 wires, each = ·048in. diameter, are of high conductivity copper, then the resistance of 300 yards out and 300 back will equal ·48 ohm, and the loss in volts in any conductor = C × R. Now, if we take C for your 20 lamps, as = 20 ampères, then the loss in volts = 9·6, which, unless you get your power very cheap, would be costly. Your cable could safely carry twice as much current; but, then, the loss in volts would be twice as great, and if you were not always running the full number of lamps at end of leads, the arrangement would not be good, as turning out lamps would increase the E.M.F. and destroy your lamps. The lamps you mention often break in the manner you state. Perhaps you have overrun them.—OHM.

[61332.]—**Speeding Millstones.**—Inner consciousness seems to say to me that if I want to get up a great speed I should not work off a large wheel direct on to the small one. I want to see what engineers say.—R. S. T.

[61332.] — **Speeding Millstone.** — If not wedded to the particular arrangement you name, why not take the power off the wheel direct by means of segments fixed to wheel? You could then gear up a line shaft, say, 6 to 1, and on this have the bevel gear for driving vertical spindle in a line, at a further increase of, say, 2 to 1—that is, 120 revolutions altogether. Briefly, the quicker the speed is got up, the lighter the shafting and gearing in first motions will be, and consequently less expense in repair and renewal, and less friction. T. C., Bristol.

[61334.]—**Preparation for Mixing Bronze Powder.**—None are so helpless as those who won't help themselves. However, here is the recipe, or the proportions which will answer; but others will do quite as well, and perhaps better, according to the season of the year. Procure some pale copal varnish; add about six times its bulk of turpentine, and about a 30th part of dry air-slaked lime (it won't matter much if it is quicklime). Shake well, and stand aside for several days, then decant or filter. Mix the powder with the varnish—four parts of powder to five of varnish. For the copper or deep-coloured bronzes you need not be particular about getting pale copal, the ordinary stuff will do.—NUN. DOR.

[61339.] — **Steam Boiler.** — If longitudinal seam is well riveted or brazed, and the ends have, say, three screwed stay tubes, it would be safe at 90lb. sq. in. How are you going to fire it? This will have something to do with the power.—T. C., Bristol.

[61342.] — **Problem.**—The plane B may be assumed to lie in the horizontal plane. Then the intersection of A with B will be the trace of A upon the H.P., and the intersection of C with B will be the trace of C upon the H.P. Now the angle between these traces is ω. Draw therefore two lines in the H.P., including an angle ω. Consider these lines as the horizontal traces of two planes A and C, inclined α and β respectively, and draw in the vertical traces. Then find the intersection of A with C, and determine the included angle by the ordinary method.—W. GILBERT.

[61342.]—**Problem.**—As only angles are given in this question, it is properly an example of spherical trigonometry. The three planes will intersect in a point, let this point be assumed as a centre of a sphere, then the planes will intersect the sphere in arcs of circles, forming a spherical triangle, of which one of the sides is ω; the angles adjacent to this will be α and β respectively, and θ, the inclination required, will be the angle opposite to the side ω. Hence, since we have one side of the triangle and the angles adjacent to that side given, the angle opposite that side will be found from the equation,

$$\text{Cos.}\ \theta = \cos.\ \omega \sin.\ \alpha \sin.\ \beta - \cos.\ \alpha \cos.\ \beta.$$

This equation may be adapted to logarithms by making use of an auxiliary angle; thus if we take ϕ such that—

$$\text{Cot.}\ \phi = \cos.\ \omega \tan.\ \beta$$

then— $$\text{Cos.}\ \theta = \frac{\cos.\ \beta \sin.\ (\alpha - \phi)}{\sin.\ \phi}$$

from which two equations, θ may be found by means of logarithms.—MILVERTON.

[61348.]—**Length of Chord.**—If D be the diameter of the circle and A the length of the arc then the length of the chord

$$= \left\{ 1 - \cdot 1666 \left(\frac{A}{D}\right)^2 + \cdot 00833 \left(\frac{A}{D}\right)^4 - \cdot 0002 \left(\frac{A}{D}\right)^6 + \&c. \right\}$$

If $\frac{A}{B}$ be less than unity, three terms would perhaps give a sufficiently near approximation in ordinary cases.—MILVERTON.

[61353.]—**Spiral.**—There is no general rule by which you can obtain the lengths or area of spirals, each particular spiral having a formula of its own. I should advise you to consult some work on the integral calculus, where you will find the solutions of various cases.—G. H. H.

[61353.]—**Spiral.**—As you know how to find circumference of a circle the difficulty is solved. Find the circumference of a circle inclosing the spiral and square this, and add the square of the pitch of spiral. Take the square root of the same, and then you have got the length of outside of spiral.—T. C., Bristol.

[61353.]—**Spiral.**—

h = height of spiral
θ = angle of inclination of spiral with its axis

$$\text{Length} = \sqrt{h^2 + (\pi \text{ diam.} \times \text{No. of turns})^2}$$

or— $$= h \sec.\ \theta.$$

The diam. to be measured horizontally between centres of sections of spiral.—ELAG.

[61353.] — **Spiral.** — Querist does not state whether it is a plain or conical spiral, but below are formula for both:—Let Lp and Lc be the lengths respectively of plain and conical spirals. Let C and c be circumferences of circles equal in

diameter to the diameter of the largest and smallest diameters of the spiral respectively. Let N and P be number and pitch respectively of revolutions of spiral, and let H = height if conical,

then— $\mathrm{L}p = \mathrm{N} \,.\, \frac{\mathrm{C} + c}{2}$,

and— $\mathrm{L}c = \sqrt{\mathrm{L}_p^2 + \mathrm{H}^2}$,

i.e.— $= \frac{1}{2}\sqrt{\mathrm{N}^2 (\mathrm{C} + c)^2 + 4\,\mathrm{H}^2}$.

—SEVERN TUNNEL.

[61354.]—**Photographs.**—This must be due to one of two causes—either the photographs are not sufficiently fixed, or there is something injurious in the mountant. Fix them for a quarter of an hour in hypo. solution, containing 2½oz. of hypo. to one pint of water, and mount them with dextrine. They will not turn yellow if this is done. Perhaps the paper is not good. I can strongly recommend Stanley's or Edwards'.—R. A. R. BENNETT.

[61356.]—**Force-Pump.**—An ordinary deep well pump would do this; but for driving it do not use an eccentric, as you propose, but a crank. The remainder of your proposal will suit. Put an air-vessel on suction and delivery if only one pump is used, and use 1¼in. pipe for, say, 2½in. pump.—T. C., Bristol.

[61357.]—**Shafting.**—Plumb down from the shaft that is parallel to the one to be fixed, and lay down a line on floor by which you may also set new shaft parallel by means of a bob, say a bracket as each end; you can also level along the floor, and then get correct height by means of a lath at each end. Having got the end ones correct, you can easily get a middle one up, and set by a line well strained. The others follow in the same way easily.—T. C., Bristol.

[61358.]—**Dead Point.**—There is one way in which "Another Workman" can get the dead point of his engine effectually. Take off flywheel, and admit steam. Where the piston stops is the dead point.—NOT A WORKMAN.

[61358.]—**Dead Point.**—If you must be very exact you can caliper crank at large and small end, and then scribe a centre line on crank and set it by a level; but if you have a good eye you can set it very nearly correct by sighting when the connecting-rod and crank are in line. Now make a mark on fly-wheel and some fixed part to correspond, and do same for other end; you can now pull round as often as wanted to these marks when setting valves.—T. C., Bristol.

[61362.]—**Faulty Dynamos.**—TO MR. BOTTONE OR MR. CONRY.—Almost impossible to say without examination. The following are among the many possible causes of failure:—1st, the insulation is imperfect; try this by the "sparking test." 2nd, you use too high resistance between the terminals; put on four or five 5c.p. lamps in parallel instead of one or two 10's. 3rd, the F.M. wires are coupled wrongly to the brushes. Rotate the contrary way. 4th, the brushes are too hard, and touch at the wrong points. Use a number of very thin copper strips for brushes, and let them press lightly on the commutator, just about in a line, with the space between the pole pieces. 5th, some of the armature sections are wrongly coupled; the end of one section should be the beginning of the next.—S. BOTTONE.

[61365.]—**Paraffin.**—There is no truth in the statement.—S. BOTTONE.

[61366.]—**Super-Elevation of Outer Rail on Railway Curves.**—I presume "Platelayer" requires the rule stated as plainly as possible, and I will try to do so. Super-elevation of outer rail in inches should be equal to gauge in feet multiplied twice by velocity of train in miles per hour, and divided by one and a quarter times the radius of the curve in feet. As the Irish gauge is 5¼ft., the super-elevation required would be more than on our (English) lines, really about $\frac{3}{26}$ths more. At the pace and radius he mentions, it should be barely $4\frac{5}{16}$in. (Irish gauge). "Platelayer" will find J. W. Barry's "Railway Appliances," 3s. 6d., a very interesting, readable, and valuable work to anybody interested in practical railway work; that is the source of the above rule.—SEVERN TUNNEL.

[61367.]—**Weight of Engine.**—An engine must be the same total weight, no matter if the chimney is towards Dublin or Belfast. There are some other bad faults introduced into Gen. Hutchinson's report on the Portadown accident. Instead of giving the weight in tons, cwts., qrs., he gives tons and decimal parts of tons; and also the distances are all given in miles and decimal parts of miles. It should be in chains, yards, or feet. What I want to know, Sir, is how far was it from where they got off the road to where they came to a stand in the ditch?—that we are not told. Another point is, the Government Inspector measures all his distances from an imaginary "zero" point; why not, as usual, from the first mark on the rail. If we are to get to the bottom of these cases all must be made clear—at least, that is what is required by all railway men.—A PRACTICAL RY. MAN.

[61368.]—**Newcastle and Carlisle Railway.**—The first portion of this line was opened 9th March, 1835. An engine which drew one of the first trains of passengers was named Comet, built by Messrs. R. and W. Hawthorn, and as this firm have presented to me a correct diagram of this engine, I shall be happy to give any further details of it if of interest to your readers.—CLEMENT E. STRETTON, Consulting Engineer Amalgamated Society of Railway Servants.

[61370.]—**Block Tin.**—*Blocked* tin saucepan "R. S. T." should have written; the sheet of tin-plate out of which the saucepan is made or shaped having been planished, hammered, or consolidated by blows with a highly-polished convex-faced hammer on a polished plane, steel anvil, or *block*—hence the name. During this process the tinned iron has lost much of its malleable ductility, has become more dense, and takes a higher polish. *Block* tin is a trade term applied to the pure metal with which the iron plate is coated. Lydney and its surrounding district, the Forest of Dean, is perhaps the very oldest seat of the manufacture of iron and of tin plates in the United Kingdom, the forest having been the great iron-producing centre during the Roman occupation of Great Britain on account of the richness of the easily obtained iron ore, its abundance of oak coppice for charcoal, and of limestone. The geological situation was most favourable, flanking the tidal estuary of the Channel, the ever-narrowing gorge of which concentrates the constant S.W. breezes for supplying the primitive air-blown smelting furnaces placed upon some exposed scarp, while water supplied the motive power for driving the tilt hammer of the forges. All this, alas! has recently become entirely supplanted by the steel ingots imported from the North of England and worked up into steel tinned plates, to be exported for supplying the vast "tin-canning" industry of the American and Australian Continents. In these Botanical Gardens I have often dug up specimens of smelted iron under and around one or two of these ancient hearths, remarkable for its purity and ductility; while specimens of the cinder, scoriæ, or slag, of a bright grass-green colour, high specific gravity, and containing a very large percentage of iron, abound throughout the forest, an observant visitor seeing specimens on the outer edges of the highways; while the names Cinder Hill, Cinder Tump, &c., applied to farm or field, occur in most parishes, where every ploughing turns up specimens thereof. Savants acquainted with the ancient Roman physiognomy and physique may still meet with specimens amongst the forest population (indigenous) identical therewith, and also of the Roman Causeways made by the Roman Legions during their occupation, and still intact.—THE DISPENSER AT THE FREE DISPENSARY, LYDNEY.

[61372.]—**Electro-Magnetism.**—Under the conditions stated in the query, this is an impossibility; but if a separate electro might be used, it could be done, if the electro were made of cast iron, and a strong opposing spring were attached to the armature.—S. BOTTONE.

[61373.]—**Theatre.**—Scenes roll up on the principle of an ordinary blind, only reversed—i.e., the lath end at the top, the roller at the bottom; ropes are wound round either end, which by means of a windlass are caused to unwind, making the roller ascend.—A. F. SHAKESPEAR, Lüttichaustrasse 14, Dresden.

[61374.]—**Vegeto - Alkaloids.**—Most of the treatises on organic chemistry go pretty fully into this matter. If you want a cheap book, get Roscoe's "Elementary Chemistry" (4s. 6d.) If you want to be more thorough, get a peep at Watts.—S. BOTTONE.

[61376.]—**Moss.**—This so-called golden moss is not a moss at all. It is a variety of the stonecrop, which is a Sedum, S. Acre var. It is consequently one of the Crassulaceæ, which are very closely allied to Saxifrageæ. The order is grouped under Calycifloræ. "Discipulus" can easily find out the life-history for himself, knowing the foregoing particulars. I may here point out the confusion which is always arising from the employment of popular names. A moss is at the opposite end of the botanical system to a Sedum, the former being a Cryptogam and the latter a Phanerogam. "Discipulus" should know that the mere fact of the plant bearing yellow flowers was proof positive of its not being a moss.—LEON NOBARD.

[61378.]—**Mechanics.**—You will notice that you do not give actual size of gates, so I cannot answer fully the actual pressure on hinge; but the total thrust forward on one gate is 5 × 6 × 3 × 62½lb. = 5,625lb., which might be replaced by a single force of this amount acting at ⅔ the depth—that is, 2ft. from bottom; and, as the hinges are 1ft. and 3ft. from this, the pressures on hinges will be in inverse proportion, or 4,218¾lb. at bottom and 1,406¼lb. at top. This is not the whole pressure on hinge, as the angle of gate is not here considered, neither is resistance of sill deducted. Weight of contents of globe $= a^3 \frac{\pi}{6} w$; surface of globe $= a^2 \times \pi$; pressure on surface = surface $\times \frac{1}{2} a \times w = a^3 \frac{\pi}{2} w$, which is three times the weight as you state.—T. C., Bristol.

[61378.]—**Mechanics.**—Take the general case, thus: Let b equal breadth of one door, d the total depth, δ that of top hinge, δ_1 that of bottom hinge, n any depth, P shear on top hinge, P_1 shear on bottom hinge, w weight of cubic foot of water. Then, $w\,b\,n\,d\,n$ = pressure on horizontal element of door, and the moment about top hinge is $w\,b\,n\,(n - \delta)\,d\,n$, and the sum of all these moments between $n = d$ and $n = o$ is the shearing moment on bottom hinge; but $-\mathrm{P}_1(\delta_1 - \delta)$ is the shearing moment also. Wherefore, we have—

$$w\,b\int_o^d n\,(n - \delta)\,d\,n = -\,\mathrm{P}_1\,(\delta_1 - \delta)$$

Or—

$$\frac{w\,b}{6}\,d^2\,(2d - 3\delta) = -\,\mathrm{P}_1\,(\delta_1 - \delta)$$

And, writing δ_1 for δ, we get—

$$\frac{w\,b}{6}\,d^2\,(2d - 3\delta_1) = -\,\mathrm{P}\,(\delta - \delta_1)$$

And putting $d = 6$, $\delta = 1$, $\delta_1 = 5$, $w = 62{\cdot}5$, $b = 5$, the results are: $-\mathrm{P}_1 = 4218{\cdot}75$, and $-\mathrm{P} = 1406{\cdot}25$ pounds. If it is required that the hinges shall be of equal strength, the relative position is $\delta + \delta_1 = \frac{4}{3}\,d$.—G. H. H.

[61380.]—**Engine.**—An engine with cylinders 2 by 6in. is quite useless for driving a 12in. saw. It might be possible with cylinders 12 by 8in., but not smaller, and with 30lb. pressure.—SHAKESPEAR, Lüttichaustrasse 14, Dresden.

[61380.]—**Engine Query.**—Oh! yes; it will drive it, but not at 15lb. Try 50lb., and do not force the saw too much, and then, perhaps, the band will keep on all right—that is, if the pulleys are slightly rounding and in line with each other.—T. C., Bristol.

[61381.]—**Opal Plates.**—I have always obtained excellent results by following the directions given by the Charterhouse Company. For rapid printing by contact, the most beautiful results are obtained with various gradations of tone, from very light brown and sepia to black, by a slight modification of exposure and development. Exposure to diffuse daylight 1sec. to 8sec., artificial light two to eight minutes. All subsequent operations in average light until after fixing. Stock solution for developer:—

A	Oxalate of potash	2oz.
	Chloride of ammonium	40gr.
	Water	20oz.
B	Sulphate of iron	½oz.
	Citric acid	¼oz.
	Alum	90gr.
	Water	20oz.

For correct exposure, mix equal portions of A and B. If the development should commence too rapidly, pour off developer, dilute it with water, and re-apply. This will save over-exposed plates. To produce lighter shades, double the exposure, and dilute the developer with its bulk of water. Correct exposure and strong developer for dark tones. Use clean hypo. for fixing, or you will have stains. Protect pressure frame from light entering at back or sides. Clearing solution: alum, 1oz.; sulphuric acid, 1oz.; water, 20oz.—S. BOTTONE.

[61382.]—**Instantaneous Exposures.**—What you have taken for the result of undue exposure, has been most likely caused by over-exposure and a powerful developer. Poor, thin negatives are always the consequences of over-exposure, unless the developer is restrained by means of much bromide. Try again; do not use such a large aperture, and develop with ferrous oxalate, duly restrained with potassium bromide, if needed.—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

QUERIES.

[61383.]—**Inertia of the Reciprocating Parts of Steam Engines.**—In a paper by Mr. Imray, the following formula was given :—

$$i = 1{\cdot}23 \left\{ \cos a\,t + \frac{c^2 (\cos^2 a\,t - \sin^2 a\,t) + \sin^4 a\,t}{(c^2 - \sin^2 a\,t)^{\frac{3}{2}}} \right\}$$

Taking $c = 5$, what will be the values of i for the following values of $a\,t$: 0, 15, 30, 45, 60, 75, 90, 105, 120, 135, 150, 165, 180 degrees? Also if $c = 4$? As a check on the figures, Mr. Imray gives the values when $c = 3$ as 1·640, 1·282, 0·411, −0·435, −0·819, −0·848, −0·820 ; when $a\,t$ = 0, 30, 60, 90, 120, 150, 180. If any reader has the necessary time and knowledge, he will confer a great favour upon me, and in return I shall be very happy to put the results in a form which will be of use to other engineering readers.—O. P. Q.

[61384.]—**Steam.**—A pan, 6ft. diam., used for boiling purposes, is at the base of a building in a room 13ft. sq., the ceiling of which is 4ft. above the top of the pan. There are several holes in the wall of this room, which are used for running belts; and the problem is to draw away the steam from the pan without allowing it to escape through these holes and fill the building. To this end a funnel-shaped covering has been constructed over the pan, as well as the limited space permits, and from this a wooden shaft 10in. by 10in. has been carried to the roof of the building, 25ft. above. Unto this shaft a pipe from a powerful fan sends a strong upward current of air; but this fails to draw up the steam, and although the shaft has been altered in various ways, and the blowpipe has been placed in various positions, still we cannot make any sensible impression upon the volume of steam.—PERPLEXED.

[61385.]—**Shunt Dynamo.**—TO MR. EAVES.—I have a dynamo with cast-iron field magnets of elliptical section, something like a Bürgin machine. F.M.'s wound with about 1,500 turns of conductor, weighing 200 grains per foot; total resistance about 2 ohms. I should like to utilise these F.M.'s for a shunt-wound electro-plating machine. If I made the armature with laminated core, drum-wound with about 30 yards conductor, of resistance between collectors = ·005 ohm, 18 bars on commutator, would that be a right position? How many ampères would it produce, and at what pressure? The machine was originally series wound, eight wires on F.M.'s joined in multiple arc. It worked very well for a short time; but, owing to the low resistance in depositing bath (20 sq. ft. of work in an iron depositing bath), the armature insulation became defective from over-heating. The new machine should do 40 sq. ft., if possible. I may add that I could conquer electrical and mechanical difficulties. Pole opening, 8in. diam. by 8in. length, could be bored out to 9in.—ANGLO-DANE.

[61386.]—**Focus of Lenses.**—Will someone kindly inform me if the "actual" focus of a lens is the distance in quarter inches from the back of the lens to its burning point? Also, what is meant by "back" focus and "equivalent focus?—LENS.

[61387.]—**Ferrule Machine.**—Will some kind reader enlighten me on the following? I have a tool for making them; but it is too slow a process. They are made out of ⅜ single hoop iron, cut off long enough to reach round a piece of ⅜ round steel. I wish to make a machine, to be driven by steam, that will require no attention, only to put the iron strips in position for it to cut them off the required length, and then pass through and come out finished. I suppose there is such a machine. Can any of our readers supply me with drawings or sketch, or any information upon the subject?—E. M.

[61388.]—**Browning Barrels.**—TO "ARMOURER."—I have tried my hand on browning the barrels, first on a singled-barrelled gun, and was quite satisfied with my first try; but having occasion to brown a double one, I found, instead of a clear pattern when finished, a beautiful black polish, with a few brown streaks, about an inch apart. Not wishing to trouble, or take up a lot of valuable space, I tried again and again upon different barrels, with the result of getting a very good pattern towards the ends of the barrels, especially just where the wood plugs were. From there it seems to fade gradually towards the breech ends, where the colour is faint. I have given strict attention to the making-up of the recipe, and think that is all right. Can it be that the wood plug I put in the breech end to keep it off the bench has anything to do with it, or I give them too much scald?—J. W. B.

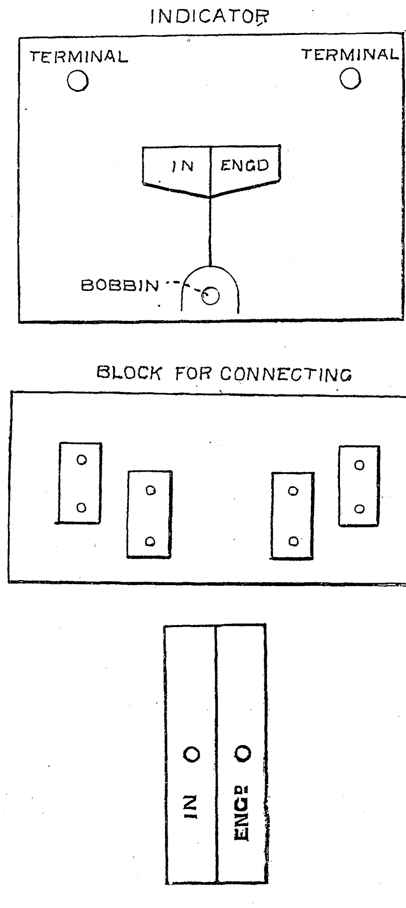
[61389.]—**Wimshurst Machine.**—I have constructed a Wimshurst machine, giving 5in. sparks without condensers; but it is not self-exciting, unless the conductors are removed. Plates are 20in., conductors 1½in. brass tube with mahogany ends. In the dark no leakage is apparent, unless it be manifested by the copious brush discharge from between the plates on one side of machine, this discharge giving a strong odour and affecting the moustaches at 9in. distance from plates. I should be pleased to know how the machine may be made self-exciting with conductors, and also to hear of any interesting experiments that may be made with the machine after one has had the trouble of constructing it. I may mention the conductors are supported by glass tubes of good insulating quality, varnished, instead of rods. I presume this would not affect the working.—HENDON.

[61390.]—**Engine Query.**—I have a small horizontal slide-valve engine, with cylinder 1⅝in. bore and 4in. stroke. What size and shape of boiler would be most suitable to drive it, and what strength should the plates be?—J. B., Leeds.

[61391.]—**Soldering.**—I notice on page 391, letter No. 26640, Dec. 31st, "Regel" kindly gives some information as to how to tin a soldering iron, and mentions chloride of zinc as the soldering fluid; but he doesn't say how the fluid should be applied, for if the copper is required to be hot, I presume the soldering fluid would cool it too much for it to melt the tin required to tin it with. I also wish to ask your readers if this soldering fluid would be a suitable flux to use when it is required to coat iron with lead, and, if so, which is the cheapest mode of obtaining or making the soldering fluid in quantities, and how it should be applied, and whether it could be used in the same way as galvanisers dip their iron sheets through their flux when passing through the spelter?—GALEN.

[61392.]—**Electric Motor.**—Would any of our readers kindly give a little information for the construction of a motor? I have a brass flywheel, weighing 1¼lb. and 4⅝in. in diam. What I should like would be an illustration showing dimensions and connections, also length and diam. of cores of magnet. What size wire, distance of armature from magnet, and the working of the contact-breaker? Also what battery-power required?—A. C. CHAMBERS.

[61393.]—**Electric Indicator.**—TO MR. CONRY, OR MR. BOTTONE.—I have got an indicator to repair, which had not been connected or working for some time. It is for telling when a person in an office is in or engaged. One tablet is placed beside the desk at which the party sits,



with a two-way push from it, with the words in and engaged, so that by pressing either it indicates on another outside the door. It is Sakes' patent, as used for electric bells, set in a small square frame, with two terminals to each. When I went to it, I found eight wires hanging derelict, and a small block with four pieces of brass screwed to it with eight screws. If you could tell me how to connect it, and wires, it would greatly assist me. I inclose sketch to explain.—J. B.

[61394.]—**Dynamo.**—TO MR. BOTTONE.—I am making a dynamo of double the dimensions given in your valuable book, and I wish to ask you a few questions respecting it: Would it be detrimental to the working of the machine to fix the field magnets and bearings on cast-iron bed instead of wood base-board? Would the dynamo do for an arc light, and what candle-power? What quantity of wire shall I require? What is a safe speed to run it?—A YOUTH.

[61395.]—**Legal.**—A. dies, leaving to his only son, B., the interest of a certain amount, which principal, after B.'s day, has to be divided between B.'s children, C., D., and E. The amount is left to be invested in Gov. stocks, or freehold mortgages. C. is desirous of drawing part of his share, and has the consent and hand of B., D., and E., but is refused by the trustees, one of whom is an attorney. Can this be done? Also, if C., D., or E. dies before B., have they not the power to make a will?—W.

[61396.]—**Stains on Horses' Coats.**—I have a horse that lies in the wet and muck every night, and I wish to show it at the horse show this summer. Could anyone recommend anything that would take out the stains without affecting the skin?—UNDER STRAPPER.

[61397.]—**Disposal of House Sewage.**—Can any reader state the best mode of disposing of this where there is water in the house but no drainage?—A. B.

[61398.]—**Electric Battery.**—I am anxious to construct a battery that will light, say, two 10-candle lamps for two or three hours occasionally, and that will at other times run a small motor, say, sufficiently powerful to drive a sewing machine for, say, two hours at a run. It must give off absolutely no fumes, be made up with one liquid only, and require as little attention as possible. I have thought of the bichromate form, with two zincs and three carbons, each 5in. by 2in., in each cell, and, say, six cells. Will anyone kindly give me their practical experience in this matter, and tell me what is the best exciting liquid and its proportions to use in such a battery, and if the one described above would meet my requirements? I may say that I have searched the ENGLISH MECHANIC through, but there are so many and varied ideas and opinions that I am absolutely confused, and therefore desire the opinion of someone who, from experience, is in a position to give practical advice, and such advice would, I am sure, be very welcome to others than—BEWILDERED.

[61399.]—**Leclanche Batteries.**—Will any of "ours" kindly say whether the bursting of the jar (inner cell) is injurious to the working of the above battery? I have several electric bells working with the above batteries, and am often troubled through the inaction or feebleness of the ringing, which is not remedied by adding fresh salammoniac to outer jar, &c. Should be much obliged for answer as to cause and remedy.—COLLIERY MANAGER.

[61400.]—**Electric Light.**—There is available within half a mile from our works about 1,500 tons of water daily, falling down an incline about 300 yards in length, giving a head of about 40ft. Will any of "ours" kindly suggest the best and most economical plan of utilising the above power for generating electricity for lighting purposes at our works, stating the necessary material and machinery, &c., required, and probable cost of same, and what would be the probable result in candle-power, and continued cost of maintenance?—COLLIERY MANAGER.

[61401.]—**Oval Chuck.**—I have just completed an oval chuck, which I made according to a sketch of one I saw in "E. M." a good while ago. I have tried to turn oval bradawl handles and handles for screw-drivers, but find it a very tough job to get them level and smooth without rings and marks of tool. I have also tried to turn flat oval pieces, such as small frames suitable for photos., &c.; but I find there is a curious twist in the work, which I cannot account for. I think keeping the tool on a certain level with the work may have something to do with the mischief. I should be glad if any of your obliging readers would give me a reliable hint as to what is wrong, and the remedy.—CHURCHILL.

[61402.]—**Electric Bath.**—Having an order to supply and fix complete an electric bath in private house, I should feel greatly obliged if some of your kind readers would assist me by giving full illustrated particulars, and best mode of fitting, and all appliances necessary to give full satisfaction.—ELECTRODE.

[61403.]—**Renovation of Violin.**—I have a violin been badly used. I am going to have it scraped and polished. Which will be most likely to improve it—French polish or linseed-oil polish?—A. C. CHAMBERS.

[61404.]—**Medallions.**—I have a number of medallions, cast by a friend many years ago, in what seems to be plaster or clay. These having been laid aside for a great many years have become very dirty, some of them a dark brown colour and others nearly black. Would anyone kindly oblige by tell me an effective way of restoring their colour? I have tried scrubbing in water with a brush; but the water seems to effect them, as they fizz and splutter, and look speckly after immersion.—P. A. S.

[61405.]—**Liquid Fuels.**—I wish a simple formula for calculating the theoretical evaporative power of petroleum and creosote oils from their constituents of carbon, hydrogen, &c., and also should be glad of an authoritative opinion as to whether petroleum or creosote gives the best results as liquid fuel?—LESS SMOKE.

[61406.]—**Glow Lamp.**—Would anyone kindly tell me how many pint bichromates are required to light a 5c.p. lamp for a couple of hours? How can I know which is the negative and which is the positive pole of a battery? How are bichromate batteries connected?—JUVENILE IGNORAMUS.

[61407.]—**Glass Spinning.**—In the old days I have seen this operation performed in the Polytechnic, and I still have in my possession some of the result. I have endeavoured to imitate what I saw done as far as my memory allows, but without success. Can any reader inform me (1) whether the wheel on which the glass is spun should revolve with a high velocity (as that which I have made is able to do), or slowly? (2) whether any particular sort of glass should be used? (3) to what sort of blowpipe flame should the glass be exposed? (4) whether the operation can be seen anywhere in London?—S. B. B.

[61408.]—**Violin Query.**—I have a valuable old violin, the tone of which has always been perfect up to a few weeks ago, when there commenced a buzzing kind of noise, similar to what would be produced by the strings being close to finger-board. I have tried all I can think of—altered the position of soundpost and bridge, and changed strings, &c., without effect. But what makes it more puzzling to me is that about a fortnight ago, after some alteration, the defect seemed to have disappeared; but was present again next day; and two days ago, after fixing the soundpost further back than usual, the tone was all that could be desired immediately on tuning up; but on trying it next day the nuisance had returned. It is a mystery to me, and I shall be glad if any reader of the "E. M.," who is able to tell me the cause, will oblige me by doing so.—A. W.

[61409.]—**Coating Springs with Copper.**—I want to coat some hardened springs with copper. Can any of "ours" help me with some suggestion? Coating must be of sufficient thickness to stand handling. I do not want to employ electricity if I can find any simpler process.—TONGE.

[61410.]—**Medicinal Action of Dynamos.**—A paper on "Insomnia," read before the British Homœopathic Society on Dec. 2nd, and reported in the monthly *Homœopathic Review* of January 1st, contains the following, and as it is a matter upon which many readers of the "E. M." have opportunities for making observations and taking notes, attention is hereby drawn to the subject:—"Dr. M. (a visitor), in reference to the action of magnetism, said that he had occasion to examine the dynamos which supplied the electric lighting to a large building. The engineer in charge of the dynamo stated that in the first week of his employment he noticed his health affected, and he felt very irritable. In the second week he found himself very sleepy, and since then he had experienced an increasing sense of this irritability. The engineer further said that all the employés experienced the same effects." Communications thereon will, no doubt, be esteemed in "Ours" generally, and especially by—THE DISPENSER AT THE FREE DISPENSARY, LYDNEY.

[61411.]—**Drilling.**—I have several hundred small irregular castings to drill. There are five holes in line,

some deeper than others. Wanted to know best method of drilling them. Each one must be counter-part of its fellow with ordinary vertical drilling machine. Twist drills will be best, I suppose.—DRILL.

[61412.]—**Twin Screw and Paddle Engines.**—To "NUN. DOR."—Many thanks for your kind attention to my query on above. Would you kindly furnish as much additional information as possible respecting the reason of the increased celerity of working a ship with twin screw or paddle engine? Also give as full a description as possible of the "disconnecting" engines—a speciality with some North of England makers. The reason my query appeared secondly was that, having failed to observe its first insertion, I thought it had become mislaid, and repeated it. I hope I am not troubling you too much.—TWIN SCREW.

[61413.]—**Irish Locos.**—Would any engineer kindly give a drawing of the new express engines on the G.S. and W.R., Ireland, and some account of the dimensions of same?—VIATOR.

[61414.]—**Electro-Motor.**—To MR. BOTTONE AND E. CONRY.—I want to make an electro-motor with H armature, 2in. by ½in. in height. Please tell me size and quantity of wire for armature and field magnets, and battery required, and will it drive sewing machine? Also, is there a book published on electro-motors?—A NEW SUBSCRIBER.

[61415.]—**Photographs by Pellet's Process.**—Can any reader kindly give me drawings and exact measurements whereby I can make a frame for the above, large enough to take paper 52in. by 31in.? Also the approximate cost?—PHOTOGRAPHER.

[61416.]—**Early Railroad History.**—I have been reading several books on railways, and they do not agree. Some say that tram roads were introduced 1602, others 1630, and one 1680. With regard to iron rails, were they used 1738 or 1767, as books do not agree upon this?—HISTORIAN.

[61417.]—**Midland Engines.**—I see the *Engineer* states that the new Midland 1738-1757 class have 250ft. more heating surface. Will any reader say if the cylinders are 18in. or 19in. diam., and if the boilers carry 160lb. of steam pressure?—ANTI-VAC.

[61418.]—**Great-Western Engines.** — Will any correspondent kindly say the size of the largest driving wheel on the Great-Western system? Are the 9ft. Bristol and Exeter engines reduced to 8ft., and also what class does No. 10 belong to, and has it an 8ft. 6in. wheel?—LOCO.

[61419.]—**Loco. Wheels.**—What is the largest driving wheel in use in England at the present day?—LOCO.

[61420.]—**Loco Firegrates.** — What is the usual size in square feet for the firegrate of a modern loco., and how much coal per hour per foot of grate can be burnt to give the best result or get the greatest heat from it? How many cubic feet of air are required to consume a pound of coal, and how much water will be turned into steam by 1lb. of coal?—LOCO.

[61421.]—**Case-Hardening.**—Could anyone inform me how to case-harden small set screws made of Bessemer steel? I have a portable forge.—W. E. GENT.

[61422.]—**To Mr. C. E. Stretton.**—Will Mr. Stretton, if he has drawings of Mr. Kirtley's 700 and Mr. Johnson's 1145 classes of engines, please give same in "E. M." at an early date?—ROVER.

[61423.]—**Strength of Materials.**—Will someone please give me the method of working questions, such as the following? A 10in. shaft has a 4in. hole run through it. What fraction of its weight is removed? To what extent is its strength in resisting torsion affected? What is the weight of a cubic inch of cast iron?—DARENTH.

[61424.]—**Model Steam Engine.**—Will some kind friend favour an amateur with the sizes for a model vertical steam engine with cylinders from about 1in. to 2in.? The sizes of crank throw, connecting-rods, length of piston, &c.?—ANGOSTURA.

[61425.]—**Oak Cantilever.** — What must be the breadth in inches of an oak cantilever, 6ft. long, 9in. deep, in order to carry a load of half a ton at its extremity? The actual stress is not to exceed quarter of the breaking stress. The breaking weight of an oak cantilever 6in. long, 1in. deep, 1in. broad, is 280lb.—DARENTH.

[61426.]—**Charcoal for Small Forge.**—Not being able to procure same in these parts, should be glad to know of some simple method of making a small quantity.—AMATEUR BLACKSMITH.

[61427.]—**Energy in Coal Gas.**—I have seen it stated that one cubic foot of South Metropolitan gas gives 622 thermal units of heat. This would mean, I suppose, 622lb. of water raised 1° Fahr., or one gallon raised 62·2° Fahr., and therefore 2·42cb.ft. of this gas should be required to raise one gallon of water from 62° Fahr. to 212° Fahr. As 1 unit = 772 foot-pounds, 1cb.ft. of this gas should give 622 × 772 = 480,184 foot-pounds = 214·3 foot-tons—that is, ten tons raised 21·43ft. Can any reader say how nearly these values have been realised in actual practice in water heaters and in gas engines, stating, if possible, the percentage efficiency obtained?—SEPHIROTH.

[61428.] — **Legal.** — A tenant, A., wished to leave the house and garden, which he rented half-yearly. The landlord permitted him to do so, on A.'s finding a suitable tenant, B. B. was found, and accepted by the landlord's agent in writing. After A. had let B. the house, A. mentioned for the first time a "small garden valuation," which proved, on examination, to consist of articles B. did not require. When the time came for A. to deliver the key, he refused to do so until B. took over the articles and paid the money. As B.'s own notice was nearly expired, and his goods packed for removal, he was forced to do so. (1) Could A. legally refuse the key on such grounds? (2) Could he let the premises to another person after B. was accepted by the landlord? (3) Could B. recover the money so obtained from him, or so much of it as was exorbitant? (4) Could B. recover any loss he incurred by reason of A. refusing him the key?—SEPHIROTH.

[61429.]—**Calculation of Chemical Analyses.** In an analysis of gas liquor published some years ago, the following particulars were given:—Specific gravity, 4½° Twaddell; free NH_3 0·9; total NH_3 1·16, equal to 5·5 per cent. Am_2SO_4, CO_2 1·33, SH_2 0·154. Equivalents of NH_3 to CO_2 and SH_2 1·45. I have been much puzzled as to how this last particular is obtained—viz., 1·45. Can Mr. Grey, or some other reader, tell me, and state a general rule for getting the number of equivalents of each constituent in any given analysis?—SEPHIROTH.

[61430.]—**Colouring Statues.**—I should be glad to know how best to go about colouring a small size "Venus Milo," made of plaster-of-Paris, in imitation of red terra-cotta. The proper pigments and proportions, and full particulars to make a successful imitation desired.—E. X. P.

[61431.]—**Dynamo.**—To MR. BOTTONE.—I wish to wind a 10c.p. Siemens dynamo for plating purposes, H armature. Would you kindly state what number and weight of wire I ought to wind on F.M.'s and armature.—R. H. H.

[61432.]—**Voyage to Australia.**—Am sending a delicate lad this month viâ Cape, and back by China route. Shall be grateful for any hints as to clothing and other requirements for the voyage.—P. C. M.

[61433.]—**Impurities in Gas.**—Please state simple test for impurities in coal gas, and what is the remedy (if any) when a company deliver gas not properly purified?—G.

[61434.]—**Snow Plough for Highways.**—Will some practical mechanic kindly give full particulars and drawing of the best form of snow plough for parish highways in the country? One that can be drawn by two horses and clear a width of about 12ft. in an average fall of from 6in. to 10in. will be desirable.—T. CHAPLIN.

[61435.]—**Storage Cell.**—To MR. CONRY.—What is the lightest form of secondary battery I could use to light a 500c.p. Swan lamp for two hours at one time, lamp to be specially made of low resistance? What would be the smallest number and weight of the cells? I have a charging current of 45 volts and 15 ampères. I should like it portable, if possible.—LIGHT.

[61436.]—**Petroleum Tank.**—What causes a 100gal. petroleum oil tank to smoke at a temperature of about 50 or 55 deg.? There is a yellow scum accumulates on the galvanised iron tanks. Would it be phosphorus? Can is not painted. Friends will greatly oblige, as it is of much importance to know.—T. WOOD.

[61437.]—**Influence Machine.**—I have two plates of vulcanite, 17in. in diam. and ¼in. thick, which I wish to make into an influence machine. Will the thickness be an objection to the construction of an effective machine?—IGNORAMUS.

[61438.]—**Measuring Cloth.**—I want a simple rule for finding the length of cloth on a roller, the circumference of which is 12in. When I have 100yds. of cloth on roller it measures 48in. circumference. How am I to find the number of yards for a larger or lesser circumference without taking off the cloth to measure? — FACTORY WORKER.

[61439.]—**Faulty Musical Box.**—I have a musical box, which, during playing, occasionally whistles. It is thoroughly cleaned and oiled, and appears free of action everywhere. Will any reader kindly inform me of probable cause?—BOX.

[61440.]—**Emery Wheel.**—I want to make a grinding and polishing machine to be driven by a 5ft. hand-wheel, and suitable for finishing and polishing rough forgings used in bicycles and sewing machines. Could any reader of the "E. M." give me any information respecting diam. and thickness of emery wheels suitable for taking off rough surface, and what speed they ought to be driven at? Also, what wheels are best for finishing, and if any kind of emery or polishing powder is used? Any other information would be exceedingly acceptable.—M. I. P.

[61441.]—**Notes on the Church Organ.**—To MR. G. A. AUDSLEY, F.R.I.B.A. — As one of the many admirers of Mr. Audsley for the masterly, comprehensive, and convincing manner in which he has dealt with the subject of chamber organ requisites, I trust he will pardon my putting a question respecting a quotation from Helmholtz, which appears at p. 402 of "Ours" of last week. It is some years now since I read Helmholtz's magnificent work on acoustics, and I have not at present the book by me for reference; but assuming that Mr. Audsley has quoted correctly, I am somewhat puzzled by the ninth and tenth upper partial tones being described as d‴ and e‴ respectively. Surely the ninth partial must lie somewhere between d‴ and d‴ flat, and the tenth partial a trifle sharper than d‴ sharp. Kindly put me right on this point.—C. R. O., Devon.

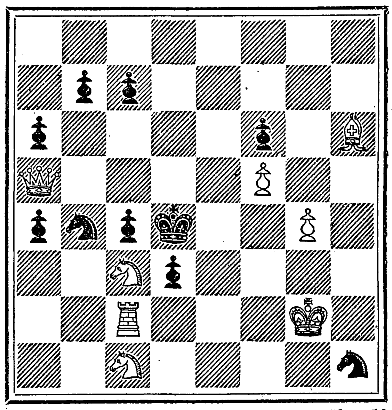
AT a recent meeting of the Chemical Society, a preliminary note was read on "The Electrolysis of Ammonic Sulphate," by Herbert McLeod, F.R.S. When a neutral solution of ammonic sulphate is electrolysed in a U-tube provided with platinum plates as electrodes, nearly pure oxygen is evolved at the positive pole and hydrogen at the negative. For one volume of gas from the positive pole, a quantity varying between 4·7 and 5·4 volumes is evolved from the negative pole. A small amount of ozone is produced. On mixing together the electrolysed liquid at the poles a strongly alkaline liquid is obtained, containing a considerable quantity of "active" oxygen. When the liquid is first neutralised with sulphuric acid, then treated with excess of baric chloride, and the baric sulphate filtered off, the liquid deposits baric sulphate on boiling, an indication of the presence of persulphuric acid in the solution. When sulphuric acid that has been electrolysed is exactly neutralised with baric hydrate, the precipitate filtered off and the liquid boiled, baric sulphate is precipitated; at the same time the liquid becomes acid and a further quantity of baric sulphate is thrown down on the addition of baric chloride.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXVI.—BY C. PLANCK.

Black.



White. [8 + 10

White to play and mate in three moves.

The receipt of solutions to the above will not be acknowledged before a fortnight. Solutions must be received before 28th Jan.

SOLUTION TO 1,024.

White.	*Black.*
1. Q-Kt 8.	1. Anything.
2. Q, R, B, or Kt mates, or P takes R, becoming Kt, mate.	

(Seven variations.)

In 1,025, the B Pawn at K R 7 should be a B Bishop.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,024, by J. J. Spence, W. J. Carpenter, H. Turner (variations should be given), V. S. Pochin, T. H. Billington, W. Hewson-Kilbee (see notice above to H. Turner), A. Bolus, Major, Link (but second solution wrong, as Kt-Q 4 discs. ch.), and Country Boy.

A BEGINNER.—If 1. $\frac{\text{R-Q Kt 2}}{\text{Q takes R}}$, 2. $\frac{\text{R-Q R 6}}{\text{K takes Kt}}$.

J. MACKENZIE.—If 1. R takes Q, how do you proceed if Black play Q Kt-Q 3? Respecting 1,023, see notice in last number.

F. KRASSER.—See notice above to Link.

T. H. BILLINGTON.—Thanks for your suggestion, which we intend to adopt.

GAMES received with thanks from H. Balson and C. J. Lambert; also *The Wanderer* for December.

J. MACKENZIE.—In 1,023, if 1. $\frac{\quad}{\text{Q takes Kt}}$, 2. P takes Q, becoming a Kt, and discovering (ch.) mate.

W. HEWSON-KILBEE.—We found afterwards that you were right respecting 1,023. The defect is easily remedied, but the second solution is quite as good as the author's.

USEFUL AND SCIENTIFIC NOTES.

THE needle industry of Redditch has been largely revolutionised during the last twenty years by the introduction of machinery, and the stupendous proportions which the trade has assumed—the present weekly make being not less than fifty millions—necessitates an increased employment of the most improved machinery. The latest move has been the introduction of a machine for the grooving of sewing-machine needles, which bids fair to entirely supersede the old stamping process. At the present time there are about 8,000 persons engaged at Redditch in the manufacture of needles alone.

Locomotives.—A rough average of dimensions and weights derived from the corresponding engines of those respective types as in use on the London and North-Western, the Midland, the Great Northern, the Great Western, the North-Eastern, the London and Brighton, the Caledonian and the Lancashire and Yorkshire Railways, presents the following figures, given by Mr. Ed. Woods, as fairly representative of modern practice:—Express passenger engines: Weight of engine in working order, say 42 tons; greatest weight on a single axle, 15 tons; area of fire-grate, 19 square feet: heating surface, 1,300 square feet; pressure of steam in boilers, 140lb. per square inch. Tractive power, assuming an average effective pressure of steam in the cylinders of 90lb., per square inch, 8,900lb.:—Merchandise or mineral engines not being tank engines: Weight in working order, 38¼ tons; greatest weight on an axle—N.B. axles coupled—14 tons; area of fire-grate, 18 square feet; heating surface, 1,300 square feet; pressure of steam in boiler, 140lb. per square inch; tractive power, assuming an average effective pressure of steam in the cylinders of 90lb., per square inch 12,690lb.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 12, and unacknowledged elsewhere :—

J. H. PRENTICE.—V. Buhot.—J. A. Maclean.—Prof. Thompson.—F. Hazeldine.—C. L. L.—Architectus.—J. B.—J. Brown, Belfast.—G. Edwinson.—Broscenius.—Cautery.—Electrical Student, No. 2.—Alex. Fraser.—One in a Fix.—D. Evans.—Young Beginner.—A. Baines.—J. C. Kelly.—M.I.C.E., Bath.—Milverton.

BELA BUCKEN. (When we refer correspondents to back numbers, we do not insert the query unless there is some special reason. We can form no idea of what particulars you require; but we are quite certain that all the particulars necessary to enable anyone to construct a Schanschieff cell have been given in our columns, in the pages to which you were referred. The special solution forming the subject of a patent was described on p. 78 of this volume.)—E. W. (The earth forms the return in submarine telegraphy: as a rule, it is the metallic sheath of the cable itself which forms the "earth-plate.")—H. YOUNG, JUN. (Most of the questions are against the rules. See Hints No. 4. The other questions have been answered recently. You should make a Wimshurst machine, and for that you will find full directions by the inventor in No. 1127, p. 192, this volume. Instructions for making the two-plate machine were given by Mr. Wimshurst in No. 1073, p. 142, Vol. XLII. If you must have the other, see No. 969.)—SEEKER. (You will find full information in our columns, by reading up the volumes from Vol. XXIII. (There is not a complete treatise giving the history of the telephone; but there is much information in Prof. S. P. Thompson's biographical sketch of Reis, published by E. and F. N. Spon, 125, Strand, W.C. For Prof. Hughes's experiments with the microphone, see No. 686, and the indices of Vol. XXVII. and subsequent volumes.)—JOHN LIVINGSTONE. (Answered several times in last volume. Some are made of glue 12, treacle 3 parts; others of gelatine (purified glue) itself; but all have the addition of a little tannic acid or of bichromate of potash to render them insoluble, and some for use with much undercut work contain also a little glycerine. Almost any oil will do, provided it is clean.)—DARENTH. (Encastrer is a French verb, meaning to fit into a groove or frame.)—WILKINSON AND DAVIS, Keokuk, Iowa. (We do not think they have any agent here. The address we gave will find them.)—WM. BOWN. (You will find in back volumes many preparations recommended; but it is absolutely necessary to know the character of the water before offering an opinion as to which is the best remedy. For instance, is the lime sulphate or carbonate, and is it impossible to take the greater portion out of the water before the latter is fed into the boiler. The simplest "composition," and perhaps the most effective, is common washing soda; but there should be frequent and regular blowing out.)—H. HALL. (There are obvious reasons why such a query would remain unanswered; but perhaps any of the locksmiths would give you the requisite information privately. In a simple form you will easily understand that locks might be so fitted with wards that each would require a key with special clefts; then a master key would be one of the same size, but without clefts at all, so as to pass round the wards in the lock case, and shoot the bolt.)—GREATLY BORED. (Answered recently. Line the wall with canvas stretched on battens.)—A. J. G. (We have not heard of it. Perhaps you mean the method described on p. 66, No. 445, in which the leaves are immersed in a solution of caustic soda. We believe the slower process is preferred by the professionals.)—J. K. (As to Woolwich Arsenal, you must apply there, to the superintendent of the factory you think you could be useful in; but we imagine they employ only those men who have been regularly apprenticed to their trades.)—TRANSFER. (Perhaps those you mean are like the so-called Swiss transfer pictures, and are varnished over.)—W. J. DIXON. (The matter is of too much personal importance for a query. Surely you would not accept advice except from a medical man who has had an opportunity of examining you. Teeth can be extracted painlessly by means of a local anæsthetic.)—H. W. POSGATE. (Heat it carefully in a flame until soft enough in all parts, and then bend round a former. Plug one end and be prepared to blow into the other should any sign of collapse be detected. It is work requiring much practice.)—JOE. (You can get a set of tools at almost any tool shop, and you will find full directions in back volumes. See Nos. 922, 935, 936.)—ENTERPRISE. (Only by application at Lloyds, or in the case of the Board of Trade, by examination when surveyors are advertised for. Full particulars of such examinations from the Civil Service Commission, Cannon-row, Westminster.)—C. W. TRANTER. (The Wimshurst machine has been described in our pages by its inventor. See p. 192, this volume, and the indices. A little book on it by Mr. T. Gray is published by Pewtress and Co., Little Queen-street, High Holborn.)—W. C. ROBERTS. (All Government reports can be obtained from the Queen's printers, East Harding-street, E.C. Such a report would, no doubt, be on sale at the Government publishers in Dublin.)—AN AMATEUR, Aberdeen. (You will find plenty of information about electric motors, lamps, and dynamos in back volumes, and lately scarcely a number has been issued without something about them.)—LAMP TRIMMER. (How can anyone say why you do not get a maximum light from your duplex lamps without examining them? Perhaps you expect too much. 2. The snow that falls in the gauge is melted and measured as rain. Roughly, 1in. of snow represents 1-12th of an inch of rain.)—VULCAN. (Mount cutting described many times. See Nos. 891, 892, 954. Usually they are cut by a knife guided by a former; the edges dressed with glair or gold size, and the gilding applied in the usual way.)—C. KEMP. (With a preparation of isinglass dissolved in acetic acid. The bottle containing it is immersed in warm water, and the letters are made warm. Hold in position until cool.)—PERCY. (Any book of games will explain. There is no special object in the game.)—M. N. (We do not suppose you will find a better negative varnish than you can make by dissolving picked shellac in pure methylated spirit. 2. Nothing better than starch for mounting prints.)—NEGATIVE. (The most transparent paper is probably that prepared by the patent process described on p. 475, No. 1114.)—WILLIAM TELL. (Prints can be purchased of any print-seller; the price varies with the value or assumed value. 2. The question was answered the other week. They are made up of several thicknesses of pine with grain reversed, and faced with pear, boxwood, or sycamore.)—T. R. S. (According to the patent law of the United States, "every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent.")—OLD POT. (Can be mended with solder, or brazed.)—J. TUN WELLS. (Vulcanite is made by heating a mixture of rubber and sulphur under pressure. Steam is generally used, as it gives both heat and pressure.)—J. W. D. (If you mean an electrical telephone, see p. 233, Vol. XXXVI.)—JANUARY. (You will find a variety of diagrams for connecting up telephones in back volumes. Perhaps one in No. 1006 will suit you. 2. The amount of light given depends on the size of wick and the quantity of oil consumed. The circular wick, with the button over it, as in the Doty, gives the best light for a given consumption of oil.)—T. WOOD. (Probably a seidlitz powder with the two packets mixed in one, or perhaps some Lamplough's pyretic saline. 2. The directions issued by the Metropolitan Board of Works for preventing lamp accidents contain all that is requisite.)—AMERICUS. (You will find methods of setting out tunes on barrels for organs in several back volumes. Try Nos. 330, 473, 490.)—A. C. (There are full directions with diagrams for making pedals and pedal action for organ in No. 594; but you should look through the back volumes for much information on the subject, which may probably give an idea for your special purpose.)—E. B. (Where water is soft, the boilers always get rusty. In No. 1104 a correspondent said he had been successful in cleaning the surface with sandstone and painting with two or three coats of boiled linseed oil.)—A TO F. (Yes, it can be had post free for 2½d. Your newsagent must be very lazy or neglectful, and we should recommend you to change him.)—G. EDWINSON. (Quite outside our sphere.)—CHAS. NORTH. (We really do not care to invite more details of G.N.R. fast runs, or those of other lines. They have appeared in back volumes *ad nauseam*, and we have good reason to know that the great majority of our readers, with ourselves, are tired of the repetition in which many correspondents on railway matters indulge.)

How to use Gas-Lime.—This substance should be freely exposed to the air for two or three months before applying to any soil on which is a growing crop, because, besides many sulphides, it contains a compound of sulphur and cyanogen that is very deadly to plants. In anticipation of a turnip crop, it may be applied to the fallow up till, say, February, which would allow sufficient time for oxidation to alter the poisonous qualities of the cyanogen. It is, perhaps, best to slightly harrow it into the stubbles after they have been ploughed, because in this case the ammonia—or a portion of it—resulting on the conversion of the cyanogen will be retained in the soil if there is in it lime, salt, kainit, or substances containing bases on which the ammonia can form as nitrates. This simple view of it may be borne in mind in making it into composts, for unless there are substances on which the ammonia can form, it will combine with carbonic acid and escape into the air. The compost should therefore contain a little superphosphate, salt, or kainit, or even a small portion of old lime. But in making a compost heap it must be kept well away from a growing fence or the roots of valuable trees, or it will kill them. I may add, that in my experience it is the most effective substance that is to be had for the destruction of fungoid and insect pests in the soils, and applied to the fallow as above, at the rate of about five tons per acre, there need be little fear of finger-and-toe.—("Farmer," in the *North British Agriculturist.*)

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What offers for 52in. **Bicycle**, in good condition, with lamp, bell, spanner, &c., strong, and suitable for a beginner. Can be seen by appointment. Wanted good air-gun, and part cash. For value see Sale Col. advt.—C. E. K., Lady Cross, Gayton-road Harrow.

Medicines (Homœopathic), strong tinctures, powders, exchanged for Belladonna Seeds by the DISPENSER, at the Medico-Botanical Gardens and Free Dispensary Company Lydney.

Wanted, 7 or 8-horse nominal compound **Launch** ENGINE. Brotherhood 3-cylinder, 6in. by 7in., as part exchange.—S. S., 63, Palmerston-road, Southsea.

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Organ, 8 stops, 312 pipes, pedals, bourdon, composition pedals, interior new, noble mahogany case. Take Harmonium or American Organ, and cash.—J. HOLT, Ormskirk.

Exchange magnificent 12-bore, double, modern, London made Breechloader, value 6 guineas, for Dog Cart. What offers?—C. E. HILLSDON, Woodman's-cottage, Sandgate, Kent.

Wanted, good **Box of Mathematical Instruments**, in exchange for Crown postage stamp album, containing 386 stamps, first-class condition.—FOOTE, 15, Fraser-street, Bedminster, Bristol.

6 perfect vols. of "**English Mechanic**," unbound. What offers in exchange for one or all?—J. BRYAN, Photo., Bridlington, Yorks.

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Medical Coil.—Large handsome ten-guinea coil, 12 powers, good as new, in polished mahogany case.

Cornet.—Besson's best eleven-guinea plated cornet, perfect, good as new, accessories and case.

Saloon Pistol, in thorough order. Wanted, large opera-glasses by known maker, good microscope, modern tricycle, or offers.—BARNETT, 40, Poland-street, London, W.

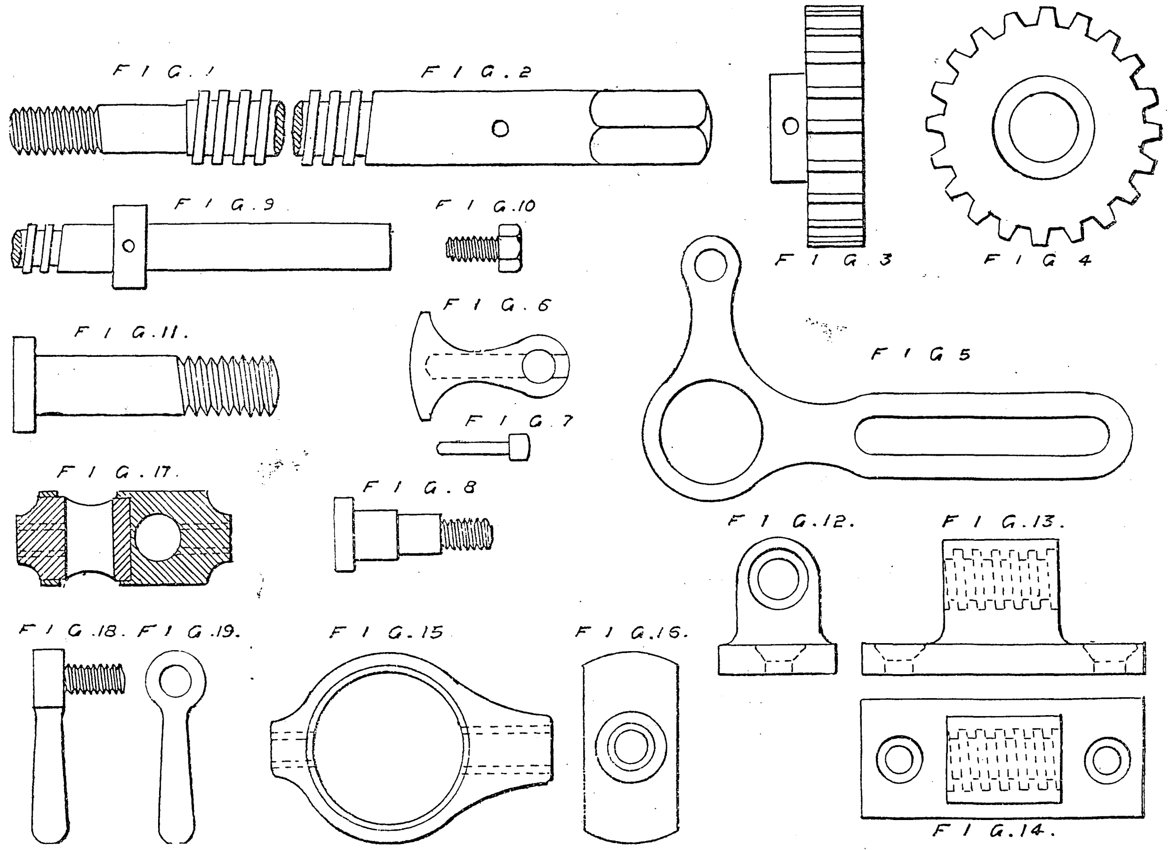
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 21, 1887.

HAND-PLANING MACHINE CONSTRUCTION.—III.

CONTINUING the description from p. 316: the four square threaded screws for the several slides may be next proceeded with. The largest of these screws is the one for the main cross slide seen in the front view on page 273. It is ¾in. diam. and 26in. long over all. The square threaded part being about 20½in. long, either a right or left-handed thread will serve equally well. Mild steel or good iron is the material best suited for screws of this kind. A rod fully ¾in. diam. carefully straightened and metal has been cut from the groove. Generally the time taken in making a rough but effective solid die will be saved over and over through not having to fit, by the usual method, with a single tooth-cutter on the screw-cutting lathe. The subject of screw-cutting does not, however, claim more than a brief mention under the heading of these papers; moreover, there are cheap treatises devoted entirely to the subject.

The small end of the screw has a ½in. Whitworth thread upon it about 1in. long. This is to take the pair of lock-nuts, shown in the drawing of the complete machine. The large end is squared to take the handle used for turning the screw when moving the saddle across the machine. The toothed wheel, which is moved by the self-acting feed, is fixed on this screw just beyond the square by a round steel pin put through diametrically. This pin may be 3-16in. diameter. It is a mistaken idea with many people that a hole such as this causes the which the pin is put, is turned to 1⅛in. diam., and takes the arm of the self-acting feed shown at Fig. 5, and to be referred to later on. The wheel may be turned when in its place on the screw, and if this is made just a trifle tapering, and the wheel made a tight fit, so that it will only drive on when made hot, they will fit as firmly as though solid. After the wheel has been once secured on its place, it need never be removed.

The screw for the vertical tool slide is ½in. diam. left handed, and its plain end is shown at Fig. 9. The collar shown secured by a transverse pin is made of the same metal as the screw, and should be made hot before driving on. A steel pin ⅛in. diam. will suit very well. This collar confines the end motion of the screw in both directions, the lower side bearing against the casting, and the upper side against a plate fixed to the casting by two bolts, as shown in the illustrations on pp. 273 and 274. The screwed part is simply a plain thread, and



centred will be large enough. Take one fine cut all along, using the back steady, and reducing the rough rod to exact diameter Next turn down a length of about 1½in. at one end to the exact diameter of the bottom of the square thread: this will be 9-16in. bare for the usual square thread ¾in. diameter. The rule being—the pitch of square threads is double that of V-threads, and the depth is equal to 19-20th of the pitch. Whitworth's ¾in. V-thread has ten threads per inch, so the square should have five, and the depth of thread on both sides the screw will equal 19-20th of 1-5in., so that 9-16in. bare diameter for the core of the screw is as near as can be without going into dimensions too minute to caliper. This 9-16in. part will serve to show the depth for advancing the tool when cutting the threads. Square threaded screws necessitate more care in cutting than do V threads, and the fact that the pitch of this particular thread is a prime so far as ½in. and ¼in. pitch guide-screws are concerned, will cause additional trouble to an inexperinced screw-cutter. It is certainly a good plan to tap a piece of bar steel and make a solid die with which to regulate the size of the thread after the screw to be very weak at that part. The strength of the threaded part of the screw is much less.

Reference to the accompanying illustrations show several parts of the planing machine drawn to a large scale, and measurements may be taken from them. The diameter of the toothed wheel (Figs. 3 and 4) is 2½in., and by measuring the size (it is reduced in the engraving) a scale can be made for measuring other objects shown on the block.

Fig. 1 shows the small end of the cross-slide screw just spoken of. The extreme end has a ½in. thread to take the lock nuts, and for a distance of about 2in. the diameter is ½in., to fit the hole in the casting. Fig. 2 shows the large end of the screw. The square has rounded shoulders, instead of having them filed into a sharp angle, which latter plan has no recommendations. The hole for the transverse pin is shown.

Fig. 3 is an edge view of the wheel to be pinned on the screw; the side of the wheel is shown at Fig. 4. It has 20 teeth, and these may be of the usual shape, though the form shown may be used if the wheel is cut specially. The boss of the wheel, through the end is left perfectly free. The hand-wheel is fitted on the plain end slightly tapering, and has a key to prevent its turning without the screw. A ¼in. bolt, Fig. 10, tapped into the end of the screw, fixes the hand-wheel.

The two vertical elevating screws for the cross slides are made from plain rods of ⅝in. metal. One is right-handed, the other is left. The mitre wheels on their top ends serve as collars, and are secured by cross pins. It is most essential that these two screws be cut precisely alike in pitch, or the cross-slide will not travel up and down level. The pin holes for the mitre wheels should not be drilled till the screws are put in their places, and are adjusted to nearly a uniform height. The position of the pin holes may be marked through the holes drilled in the bosses of the mitre wheels. The nuts for these screws, which are fixed on the back at the ends of the cross-slide, must be made before the mitre wheels are fixed. Three views of one of these nuts are shown in Figs. 12, 13, and 14, which are respectively end, side, and top views. These nuts are best made of cast-iron; but brass or gun-metal is often used in its place. The hole for

the screw is drilled and tapped, also the two holes for countersunk screws which fix these nuts. The base of the nut is then surfaced to bring the screw in line with the hole in the standard. This process need not be a very long one. One screw hole is then marked, drilled, and tapped, and the nut fixed by the one screw. The position of the square threaded screw is then carefully verified before drilling the hole for the second holding screw. The cross slide must be carefully leveled and fixed securely against the standards before the nuts can be fitted.

The bolts used to fix the cross slide are ⅝in. diameter, and one is shown at Fig. 11. The whole bolt is shown round, head and all. A small pin may be put through both head and casting to prevent the bolt turning when the nut is screwed up, or the shank of the bolt may be squared just below the head, and fit a square hole in the casting. The former plan is, perhaps, preferable. The thickness of the cross-slide casting at the part where these bolt-heads go is not sufficient to allow a thick head, but the dimensions shown give ample strength. Hexagon nuts and good washers are wanted to complete these bolts.

The self-acting cross-feed may next be taken in hand. The piece shown in Fig. 5 is made of the shape shown, and is ⅜in. thick, though ¼in. would amply suffice. A piece of bar iron can soon be worked out to shape if the precise form is carefully marked, and a series of holes drilled all round. The large hole is 1⅛in. diam., and fits on the boss of the wheel shown at Figs. 3 and 4. The hole in the vertical arm takes a ⅝in. stud, on which the pawl works. The slot, 2¾in. long, is to take the bolt (Fig. 8), which forms the hinged fulcrum of the long, vertical rod of the feed motion. This bolt, Fig. 8, has a round head and a parallel shank, ½in. in diameter and ½in. long, to take the eye of the vertical rod; the remainder of the ½in. part is flattened on two opposite sides to allow it to pass in the slot. A 5-16in. thread is cut upon the remainer to take the nut which secures the bolt at any desired position. This nut is much best in a form similar to that shown at Fig. 19, that it may be tightened by the fingers alone. These "permanent tommys" are a great convenience when nuts require to be altered often. The time and trouble wasted in looking for wrenches, &c., would be well spent in fitting such nuts as these.

The pawl itself is designed to be self-acting in both directions. The shape is shown at Fig. 6. A ¼in. hole is drilled down the centre of the pawl from the end where the hole is, as shown by the dotted lines. The hole takes the plunger shown at Fig. 7. An open spiral spring is made to go freely inside the hole and around the tail of the plunger. The effect of this spring is to keep the plunger pressed outwards. The stud fixed in the vertical arm of Fig. 5 has three flat places filed upon it, about equidistant, one being at top. By pressing the plunger in, the pawl may be placed on its stud. If the pawl is now placed vertically the plunger will bear upon one of the flats of the stud, and if moved through a small arc either way will resume its vertical position through the action of the spiral spring. Similarly, the spring will act when the pawl is turned over sufficiently for the plunger to bear on either of the other two flats. Thus the pawl has a spring that may be used to keep it entirely out of gear, or to make it engage in the wheel teeth either way round.

Fig. 15 shows side view, and Fig. 16 an end view, of the wrought-iron strap which fixes on the cannon that rides upon the main spindle; this strap is clamped where required by the screw shown at Fig. 18. The dotted lines show where this is screwed, also where a ½in. bar is screwed; this bar forms the horizontal rod of the self-acting feed. The method of connecting these two rods of the self-acting feed is shown by Fig. 17; this consists of two distinct pieces, one fitting inside the other. Each piece is drilled to fit one of the rods, and has a screw like Fig. 18 to fix it. The outer piece in which the other is fitted has a large segmental slot to allow free motion to the rod. This connecting piece is capable of being shifted along each rod, and so the length of either or both may be altered without trouble. The sectional drawing will probably suffice to explain the construction of this joint coupling.

The horizontal rod, which forms the shaft carrying mitre wheels which turn the vertical screws, is 21in. long and ¾in. diam. One end is squared to take the same handle that is used for the cross-slide screw, and which is shown in position on page 273. The mitre wheels are fixed on the rod by pins put through their bosses. The pairs of mitre wheels require to be fitted so as to gear together properly. The teeth and the spaces between them must be smoothed if cast wheels are used. Then the depth of the gearing is regulated by turning metal from the back of the boss. This should be done before the wheels are finally pinned in their respective positions.

The handle which fits on the main spindle is made by screwing four rods of 1⅛ iron into the cross piece shown on p. 274. This cross is a casting, and it must be carefully centred so that each arm will stand out at right angles to its two neighbours. Also all the arms must be in flat. The main spindle itself does not require much labour spent upon it. The rod is turned true and the key ways sunk in it. The pinion used to drive the rack has shrouds on both sides, so these confine the end motion of the main spindle.

In the next article the slide which is attached to the cross slide, and its belongings, will be taken in hand, and the construction concluded.

DURNFORD'S IMPROVEMENTS IN CAMERAS.

THE improvements in photographic cameras patented by Major C. D. Durnford, of the Ordnance Store Department, Edinburgh, consist in making the base of the camera in two parts, hinged together, on the edge of one of which he erects the front of the camera. The front part of the base is of sufficient size to enable the hinder part to be turned up to inclose the back and other parts of the camera when desired, and a rod is fitted which may slide in one or more sockets, and enter a bracket on the front part or edge of the base to make the whole base very rigid; and, to assist in producing this effect, the end of the rod, and the aperture in the bracket into which the same enters, are preferably bevelled, whereby the rod is wedged in position. To the rear of the base on each side are fitted extension pieces which are so hinged as to be capable of folding in alongside the rear edge of the base, and of being opened out in continuation of the lines of the sides of the base in all positions, being on the same plane therewith, and on these two extension pieces may be the usual racks for the extensions of the camera. When these two pieces are closed alongside the rear edge of the base, the same may be held in position by a T piece on the end of the sliding-rod or otherwise, and when these two pieces are opened out the same may be held in position by blocks or chocks on the bottom of the back of the camera, or otherwise. The back of the camera is made, as is usual, of a frame divided into two complete frames or parts, which are extensible; but the two parts are not connected together by the ordinary transverse bar and other appliances, but by two L-shaped levers, one on each side. One end of each lever is pivoted on a bracket projecting from one part of the back, while the other end is jointed in the proper position to the other part of the back, and a tail-piece may be fitted on the rear side or elsewhere of the lever, which can work in a socket, and can act as a stiffener, and, if required, as a stop. A sliding stop also is preferably fitted to clamp the lever when the two parts of the back have been duly separated, or are in other desired positions in respect of each other, and the parts of the stop and lever so in conjunction are preferably bevelled, whereby the stop and the lever are wedged in position. On the top of the back may be fitted a suitable slotted bracket projecting from one part of the back, in which slot travels a pin fixed in the other part of the back, and a sliding stop can also be fitted to clamp this bracket on. The bellows of the camera is formed in the usual manner, but to render unnecessary the usual size and depth of the back frame of the camera required by reason of the very deep folds of the bellows, all the rear or back part of the bellows is formed with extremely shallow folds for such a distance as may be deemed necessary, and these extremely shallow folds may be either very gradually or suddenly increased in depth, with the object of not intercepting the rays of light from the lens, thus permitting the use of a smaller back than is usual. The dark slide may be fitted to, and used with, the back of the camera in any usual manner, or may conveniently be supported in position by an extension of the bottom of the back, being retained thereon by studs and sockets, while the upper edge of the slide could be held by a catch or otherwise, and the sensitive plates can be held in the slide in any usual or convenient manner. The camera can be hinged on one edge of the top of table of the tripod or other support; or, still more conveniently, the camera can be secured as usual to this top or table, which top or table can be hinged to the tripod or support at and on one side, and in either case the camera could be maintained in position by a hinged stay passing through a socket on the opposite side of the top, and clamped by a screw.

INCREASING THE ILLUMINATING POWER OF GAS.

OF the various methods of increasing the illuminating power of gas at the point of consumption, two only seem to have achieved any degree of popularity—viz., the method of carburetting the gas as it nears the burner, and that of heating the air, and sometimes the gas too. Of the former the albo-carbon light is a well known and successful device; of the latter, the Wenham and the Bower "regenerative" burners are coming into use. Of the so-called incandescent methods, in which the gas is made to raise some substance to a dazzling whiteness, on the principle of the well-known limelight, little has been heard since the exhibition at the Crystal Palace, which we described in No. 930. Lewis's system is a sort of Herapath blowpipe, with a cap of platinum gauze, while Clamond's consists in the use of a little basket or cone, made of threads of magnesia, supported by platinum netting. The latter seemed at the time to give the most promising results, and it is not surprising that the lead of Clamond has been followed by other inventors. Not long ago it was stated that Dr. Auer, of Vienna, had succeeded in discovering a material which could be rendered incandescent on an ordinary Bunsen burner, and which would last for a reasonable time without requiring replacement. Dr. Auer caps the Bunsen burner with a cowl of specially-prepared cotton or woollen material about 2½in. high, and of a diameter suited to that of the burner. This cowl is supported by a platinum wire or ring held by iron rods, but any arrangement which will keep the cowl up will answer. The preparation of the cowl has not been fully described, but it is stated that a solution of zirconia and nitrate or acetate of lanthane or of yttrium is used for impregnating the woollen or cotton material; this material is then carbonised and leaves a kind of network which seems more favourable to the production of the light than the solid cylinders of zirconia tried in 1868 by Tessié in oxyhydrogen burners. The cost of manufacture of each cowl is about a farthing, and its durability is said to be 1,000 hours, at the end of which time it has become so incrusted as to diminish its illuminating power. Another method of increasing the lighting power of gas has been recently patented in this country by Mr. J. Mactear, of Victoria Mansions, S.W., who employs strontia, baryta, and thoria separately, or in combination with zirconia. He prepares a wick as a vehicle for supporting the incandescent material,

making the same of cotton fibre or of other suitable fibrous material and of any desired form. He prefers to wind the fibrous material around a thin platinum wire, which is subsequently bent into a spiral, helical, or grid-like form for suspension in or over the gas flame (preferably in a glass chimney to avoid cross air currents), as such a construction and form of wick has several advantages and affords a good support to the earthy matter after the fibre has been burned away, and renders the same capable of continued use for a considerable time. To prepare the wick for use, it may be saturated with a solution of hydrate (or other suitable compound) of strontia, and then dried; this on ignition leaves oxide of strontium. Or the wick may be coated after saturation with the strontia solution, and after being dried, or before such saturation, with hydrate of zirconium, which on ignition, leaves a film of oxide of zirconium or a zirconiate of strontia—a compound which is intensely incandescent when applied and used in the manner referred to. The hydrate of zirconium may be prepared from a soluble salt of the earth in the usual manner by precipitating it with an alkali—e.g., ammonia. Or to obtain the coating of zirconiate a sulphate of that earth or such of its organic salts as will leave on calcination the oxide of the metal zirconium. Baryta may also be similarly used as the incandescent material to be applied to the fibrous wick alone, or in combination with the strontia, or in combination with the strontia and zirconia. Or the wick may be coated with oxide of thorium alone, or with this in combination with oxide of zirconium or in combination with the strontia or baryta. In the use of such improved means the organic matter is destroyed upon ignition by the gas flame, but the earthy matter incorporated in the wick retains the form and disposition of the fibre which has been saturated or impregnated with it, and becomes highly incandescent, causing the luminosity of the gas flame to be very considerably increased.

THE HAMMER-BLOW IN LOCOMOTIVES.*

AN ordinary locomotive, when balanced for the horizontal action of the moving parts by means of counter-weights disposed within the rim of the driving wheel, cannot possibly be balanced in a vertical direction, excepting so far as the moving-gear has a vertical component of motion. Thus, the coupled-wheel of an ordinary four-coupled engine may be counter-weighted to balance the half-weight of the coupling-rod, for this revolves, in a sense, wholly about its crank-pin; but the driver, which is counter-weighted for the piston, cross-head, &c., is evidently out of balance vertically, owing to the fact that the pistons and all parts having a rectilinear motion only have no vertical component of motion, and so do not counteract the vertical action of the balance-weight in the rim. It is thus easily seen that the action of these parts would be best balanced by an equal and opposite force generated by similar moving parts. Theory and experiment alike show that a pair of engines working on to the same crank-pin with their cylinder-axes inclined at right angles to each other are arranged most advantageously. It is difficult to see how such an arrangement could be applied to a locomotive, and even if applied, there would be set up so many other disturbing actions, due to inclined cylinders, as to more than neutralise any benefit obtained. It is, indeed, difficult at first sight to see in what way the vertically-unbalanced force in the wheel-rim can be eliminated in a practical manner.

Dismissing the first suggestion of inclined cylinders at right angles, as unsuited to the question of locomotive balancing, let us proceed to inquire whether the ordinary engine can be made to exert an even pressure on the rails at every period of the wheel revolution. The so-called "hammer-blow" in locomotives is the irregularity of the pressure exerted between the wheel and rail, which arises from the vertically-unbalanced action of the counter-weights placed in the wheel to neutralise the horizontal action of the piston and other moving parts. This vertical action of the balance-weights, as stated above, is not counteracted by any corresponding action in the moving parts, for of these the connecting-rod alone has any vertical movement due to the rotation of that end which is attached to the crank-pin. The big end, then, directly, and the remainder of the rod to a lesser degree, has some influence in a vertical direction; but there still remains a large unbalanced action corresponding with the weights of piston, rod, and cross-head, and part of the connecting-rod. Hence, when the balance-weight is at its nearest position to the rail, the vertical action adds to the pressure on the rail, whilst when at the opposite, or upper side of the wheel, a relief of pressure occurs, and it is this alternate addition and relief which constitutes the supposed hammer-blow. At high speeds, this action certainly partakes of the nature of a blow, but may be represented by a wave-line diagram, where the mean weight on a wheel is represented by the ordinates between two parallel lines (say ten tons). The alternate variation of pressure is shown by a curved line, the space from crest to crest of wave being one circumference of a driving-wheel, or 22ft. in the case of a 7ft. wheel.

In order to fix the mind, let us assume the case of a 7ft. diameter single engine, with an unbalanced vertical action, resulting from 43lb. of a counter-weight acting at a radius of 32in., this weight being the excess left unbalanced by the vertical action of the connecting-rod, the total balance-weight, perhaps, being 86lb. The centrifugal force due to 43lb. at 60 miles an hour, may be found by the well-known formula, $F = \cdot 00034\ w r N^2$, when N, in this case, is 240. Then $F = 2{,}240$lb. fully, say one ton, which acts alternately upwards and downwards, with a difference of two tons.

Now, an investigation into the deflection due to one ton load upon a spring 24in. span, composed of twelve plates 5in. by $\frac{3}{8}$in., and a top plate 5in. by $\frac{1}{2}$in., will show such deflection to be about $\frac{1}{16}$in. The downward action of the balance is resisted by the rail, and cannot affect the steadiness of the engine. The upward action is resisted by the weight of the engine, acting through the springs. It must serve, then, to support the weight of the engine, and by so doing it relieves the weight upon the rail; but as it now exceeds the weight of the engine, it cannot affect the steadiness in any way. The net result is simply a constantly-varying pressure on the rail on either side of the mean.

We have just seen that one ton represents a spring deflection of $\frac{1}{16}$in. It thus appears that an arrangement whereby the spring could be caused to vibrate one-sixteenth on each side of its mean deflection would serve to equalise the rail pressure at the speed of 60 miles per hour. This spring action might be brought about by placing the wheel upon the axle eccentrically to the amount of $\frac{1}{16}$in., the eccentricity being so arranged that at the counter-weight side of the wheel the radius from the axle centre to the wheel tread would be 3ft. $5\frac{15}{16}$in., whilst on the side opposite the radius is 3ft. $6\frac{1}{16}$in. Then as the wheel revolved, or rolled along the rail surface, the axle centre would be raised and lowered through $\frac{1}{8}$in., and with it, of course, the axle-box and spring-pin, so causing a constant action of $\frac{1}{8}$in., representing the alternate addition and subtraction of one ton of load. This, of course, rests on the assumption that the engine remains fixed in a vertical direction, and does not partake of the action of the springs. The practical action, however, would not altogether conform to the assumption, and there would be to some extent a transference of the "hammer-blow" action to the other wheels of the machine, though to a very reduced amount, and also, to some extent, an absorption of the spring action by the inertia of the general mass of the locomotive. It has been stated above that the excess of action on the rail cannot affect steadiness of running.

The relief action, however, of one ton, when in excess of the weight of the wheel and half-axle, &c., with centrally-fixed wheel, is resisted by the spring. A little thought will show that this can have no action in deflecting the spring, its action being merely to support the weight of the engine, relieving the rail-load to that amount. With an eccentrically-fixed wheel, however, the speed at which the centrifugal action was calculated would require to be constant. It may, however, be taken for granted that at low speeds, such as four or five miles per hour and upwards, the irregularity of action due to the radius difference of one-eighth would not be more severe than the present pressure variation existing in a normal engine. In the example of this paper, with 7ft. wheels the "blow" occurs every quarter second in each wheel, at sixty miles velocity. The two wheels together give blows following each other in one-sixteenth and three-sixteenths of a second respectively, the cranks, however, being at right-angle. With 6ft. wheels, the action is more severe and oftener repeated (F varying with r and N^2). Here we see one advantage attendant on the use of large wheels which may perhaps explain why in America the question of the hammer-blow has received far greater consideration than in England, where wheels of 7ft. and 8ft. are employed to run at speeds which in America are run with wheels of 5ft. and 5ft. 6in. Hence the hammer-blow is at least of double the intensity in America, compared with England, and varies inversely as the square of the wheel diameter.

Assuming our reasoning to be correct in principle, it is clear that for every speed there is a certain eccentricity which will render nugatory the present unbalanced counter-weight action. It by no means uncommon to find the eccentrics of steam-engines made compound, the main eccentric driving the valve being seated upon an inner and smaller eccentric on the shaft. By this device, the throw of the combination may be varied between limits by any desired amount, depending upon the angular displacement of the eccentrics relative to each other.

The application of this principle to the axle-seat of a locomotive wheel would, if it could be safely and practically effected, supply a means of giving to such driving-wheel any desired eccentricity between nil and a maximum of, say, the above calculated $\frac{1}{8}$in. A suitably designed governor, revolving at a speed proportionate to the forward velocity of the engine, could be so arranged as to vary the eccentricity to suit the speed, exactly as in the case of the steam-engine.

The writer, however, does not propose this as a practical solution of the question, so much as an indication of the principles involved. It does, however, appear that a certain speed might be calculated for, and a fixed eccentricity given to suit the speed at which the engine will run. So arranged, an engine would run its calculated 30, 40, 60, or 70 miles per hour with perfectly even rail pressure, and at no speed would this vary so much as in a normal engine.

Fast express engines would be best ex-centred at, say, a mean speed of 60, local trains for 40 miles, whilst freight engines would count for, say, 20. We have seen that in a large wheel there is a total action of two tons; this seems severe, but it does not appear probable that such action can be very dangerous to bridge structures. The real action of the hammer-blow is gradually imposed; excess and deficiency of rail-pressure and the mean culminations of the two wheels may be taken as the true vibratory cause. Should these culminations synchronise at the train speed with the period of oscillation of the bridge, the effect might be serious, especially if the culminations also at the same time coincided with floor-beams. Any want of coincidence between these three might entirely nullify vibration by their mutual interferences. Such a concomitancy of vibration, panel length, and culminations as above described, is not likely to occur, and in considering the question of bridge vibration, it would appear that if anything be done, it should be in the direction of so arranging panel lengths as not to correspond, at average speeds of train, with the period of vibration of the bridge, or with wheel circumferences—this latter possibly the better safeguard of the two.

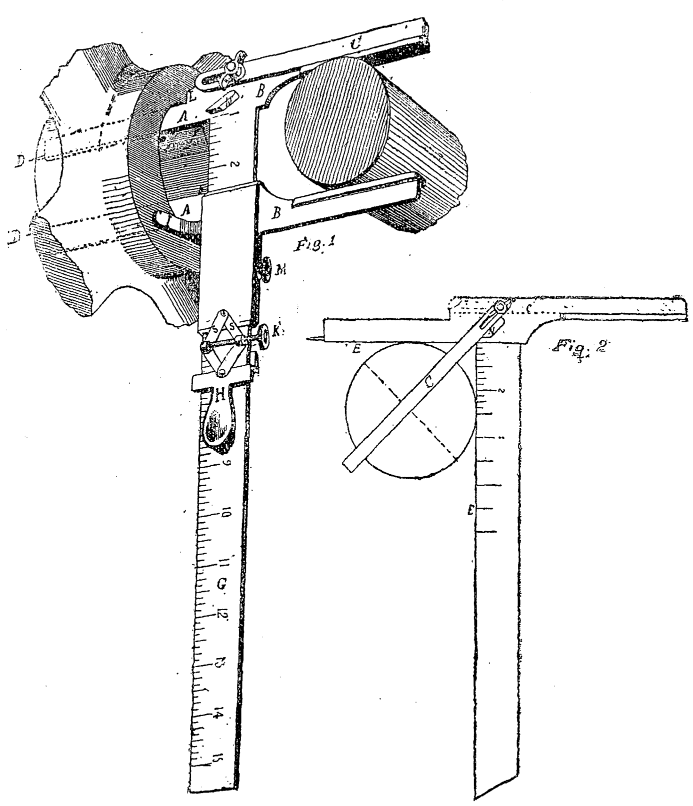
In conclusion, the writer would state that there appears every reason to believe that the vertically unbalanced action of locomotives is very severe. The writer's house is only 40 yards from the centre of a double-track railroad, on which some trains pass daily at a speed of 60 miles, or upwards.

The vibration set up apparently coincides with the wheel revolutions, and is very severe, and of a vertical nature in the ground; but great differences are observable in different engines. Heavy four-coupled engines set up greater vibrations than single engines. The four-coupled wheels are from 5ft. 6in. to 6ft. 6in. diameter. The single engines have 7ft. wheels, and also inclined cylinders. Now, whatever may be the faults of inclined cylinders, it is easy to see that the vertical action of the steam against the cylinder-covers and through the connecting-rod, upon the rail, will serve to counteract the "hammer-blow," which must also be less severe than in the smaller wheels. These appear to be the chief reasons why the vibratory actions of the small wheels are greater, apart from their greater frequency.

* From a paper by W. H. BOOTH, in *Journal* of the Franklin Institute.

A COMBINATION TOOL FOR MACHINISTS.

THE machinist's tool herewith illustrated, the invention of Mr. John C. Eckert, of Dayton, Ohio, is a combination of seven distinct tools, but, unlike most combined tools, it is so constructed that in the use of any one it does not conflict with the others. Fig. 1 shows the tool complete. It consists of an internal and external caliper; a centre square attachment C (an indispensable tool which is expensive individually, but costing only a trifle in this connection); a pair of compasses or dividers, D D; a square, E E; a gauge, F F, and rule, G. The small arms A A are inserted in the bore of a pulley until coming in contact with cross-bar I on movable arm, and corresponding shoulder L, when the movable arm is adjusted to the caliper of the bore and secured by set-screw M. The large or shaft arms B B are represented as embracing a section of corresponding shafting, by which it will be seen that it is only necessary to caliper one or the other to obtain the positive gauge of both at one operation, and at the same time read the exact dimensions on graduated beam



thus insuring accuracy. Fig. 2 illustrates the centre square attachment with movable arms removed, and with the slotted bar G thrown into position at an angle of 45 degrees for making centre lines on a shaft, and which bar is securely held in that position by the thumb screw J and lug N, and when not in use is thrown at rest as at C, Fig. 1, and entirely out of the way. The bar C has at pivot end a longitudinal slot extending about one-fourth its length, which permits of lengthening or shortening to that extent. An improved adjuster connected with this tool has a central bearing on sleeve of movable arms, thus avoiding any lateral friction on sleeve or side of beam, and preventing any undue wear on the most essential and delicate parts. The clamp H is held by the thumb, thus dispensing with an extra set-screw, the sleeve is finely adjusted by screw K up or down, and the operation is greatly facilitated. The adjuster can be instantly removed from the beam if desired, as the plates S S are simply hooked on the sleeve, and by slipping it off the beam, it may be unhooked. —*American Machinist*.

ORTHOCHROMATIC PHOTOGRAPHY.*

ORTHOCHROMATIC photography, although not new, is at the present time receiving a large amount of attention both by dry-plate makers and photographers. It is a curious fact that a discovery to render the yellows lighter than the blues was not taken up with more zeal at the time of its discovery, and that it should have laid semi-dormant for some years until a commercial firm takes to supplying the public, which starts it into life again. I am referring only to England, as on the Continent they have employed it for some years; but we English are always somewhat behindhand in taking up a new discovery.

I am not going to discuss who is the legitimate claimant of producing orthochromatic effect in photography; but it is my intention this evening to give you the results of my experiments as far as I have gone (there is nothing original in the chemical I employ, it being erythrosin, and that was discovered years back), and to place in your hands a really good orthochromatic formula, but with one drawback—they will not keep many days.

The formulæ which have been published, compounded with eosine and ammonia, into which dry plates are to be dipped, have in my hands proved useless, and I believe others have found the same. One of my experiments shows me that chloride of silver, dissolved in ammonia with eosine and used as a bath, gives orthochromatic effect, and I should imagine that if a plate is made containing chloride of silver, and then bathed in a solution of ammonia and eosine, it ought to answer: probably this may account for the failures of those using the ammonia eosine bath with ordinary plates. After various experiments with different compounds with eosine or erythrosin, I found that carbonate of silver, dissolved in excess of carbonate of ammonia and mixed with the erythrosin, gave me the best effect.

The orthochromatic effect in a plate is due not to eosine or any other stain being an optical sensitiser, as some state, because you may stain the film as much as you please, still the yellows will refuse to impress themselves upon the film; but I believe it is due more to a chemical change, which is produced by having free silver present as well as a compound formed with the erythrosin.

Although I discovered the above (*i.e.*, the use of silver carbonate with eosine) quite independent of anything that had been published, I see that I have been somewhat forestalled in the publication of the formula, as last week in the *News* appeared a formula with ammonia, silver, and eosine, by Vogel, and, I think, the week previous another formula containing fluoride of silver, carbonate of ammonia, and eosine, which practically amounts to the same as I have given above. Mr. Hastings will bear me out in what I say, as I confided my formula to him some four or five weeks ago. However, I need hardly trouble you with all this.

After trying various proportions, I find the following to work fairly well:—

Silver nitrate	20 grains
Ammonium carbonate	90 „
Water, distilled	16 ounces
Erythrosin (2·100)	10 drachms

The plates are placed in this for two minutes. A rinse in distilled water gives less chance of stains, and then placed in a rack to dry. Let me here state that if they are used in the moist condition the orthochromatic effect is practically *nil*; they must be used quite dry. By this treatment the plate is rendered three times more sensitive. I must insist upon the necessity of using only ruby light, the plates having now become so sensitive to yellow that the greatest precaution must be taken in handling them. My chief reason in not giving you this formula before was the great difficulty of developing the plates free from fog; this I am glad to say I have now overcome. I pass round a plate half of which is quite free from fog. This was got rid of by soaking the exposed plate before developing in the following:—

Potassium bromide	120 grains
Ammonia	½ ounce
Water	12 ounces

Do not allow to remain more than thirty seconds, well rinse under the tap, and proceed to develop with any of the usual developers—ammonia, potash, or ferrous oxalate. If there is much blue in the object to be copied, a yellow screen must be used if exposure is to be made by daylight, although by gas or lamplight it is quite unnecessary. The best effect is always secured by gaslight exposure.

A very good substitute for coloured glass is to colour a collodion film and strip it from the glass. The glass should be rubbed over with talc or a solution of wax in ether, and well polished off, and coated with collodion containing methyl orange. The dried film should appear decidedly orange. The stripped film can then be gummed to the cap of lens, having cut out the centre first, and used preferably behind the lens. The carbonate of silver and erythrosin may be mixed with an emulsion, but requires great care. It should be mixed at as low a temperature as possible, and the plates used as soon as they are dry, as their life is very short. The orthochromatic effect is very marked, and the speed increased about ten times. If any one is desirous of trying this, I give the following:—

Emulsion (containing, say, 200 grains silver)	10 ounces
Silver nitrate	10 grains
Ammonium carbonate	45 „
Erythrosin (2·1000)	5 drachms

Before development they must be treated with the ammonia and bromide.

Very fine results can be obtained from collodion emulsion—in fact, the results far surpass gelatine, and can be used by daylight without the necessity of employing a yellow screen at all, but, alas! like gelatine, do not appear to keep any better. The bath for a collodion emulsion plate is best made as follows:—

Silver nitrate	10 grains
Ammonium carbonate	45 „
Water	2 drachms
Spirit, methylated	8 ounces
Erythrosin (2·1000)	5 drachms

Dissolve the silver in a test-tube by heat in two drachms water, and add the carbonate of ammonia bit by bit till all dissolved. Add the spirit gradually to the hot solution, and finally the erythrosin. Place the dried collodion plate in this solution for two minutes, and dry; the plate, before development, to be treated with the ammonia and bromide, and developed by ferrous oxalate, three to one, to each ounce of which add three grains of bromide. If mixed with the emulsion, it begins to fog at the end of three days, so it is better to dip the plates as required. The exposure is only four times more than a fairly ordinary rapid gelatine plate by daylight, and by gaslight they are about equal. The action of the erythrosin silver compound renders the collodion film exceedingly tough, very much like an alumed gelatine film, and is very difficult to scrub off the glass afterwards.

* By J. B. B. WELLINGTON. A communication to the London and Provincial Photographic Association.

USEFUL AND SCIENTIFIC NOTES.

Speed of Atlantic Liners.—The following statements of the average speed of Atlantic Liners are given by the U. S. Superintendent of Foreign Mails; the figures being reckoned from actual times, which include all delays in getting under way and to berths:—

From New York to Queenstown, 2,820 nautical miles: Cunarders (each three trips).—The Aurania 15·6 nautical miles per hour; the Bothnia, 13·4; the Umbria, 16·8; the Etruria, 17; the Servia, Guion liners (three trips).—The Alaska, 16·4; the Arizona, 15; (one trip) the Wisconsin, 11. White Star Liners (three trips).—The Germanic, 14·9; the Celtic, 13·4; (two trips) the Britannic, 14·5; the Republic, 13·8. The National Liner America (five trips), 15·7. Inman liners (two trips).—The Baltic, 13·2; (one trip) the City of Berlin, 13·7; the City of Chicago, 13·3; the City of Richmond, 12·8. The Anchor liner City of Rome (two trips), 16·3.

New York to Southampton, 3,192 miles: North German Lloyd's (three trips).—The Trave, 16·6; Saale, 16·3; the Eider, 15·2; the Aller, 15·8; the Ems, 16·4; the Fulda, 16; the Elbe, 15·7; (one trip) the Werra, 16·2.

New York to Plymouth, 3,062 miles: Hamburg American liners (three trips).—The Hammonia, 13·9; the Wieland, 13·7; the Lessing, 13·8; the Gellert, 13.

New York to Glasgow, 2,926 miles: Anchor liners (three trips).—The Furnessia, 12·2; the Ethiopia, 11; the Devonia, 11·2; the Anchoria 9.5.

New York to Havre, 3,200 miles: French liners (five trips).—The Bourgogne, 16.4; (four trips) the Normandie, 15·5; (three trips) the Champagne, 16·8; (two trips) the Gascogne, 16·2; the Bretagne 15·9.

New York to Antwerp, 3,444 miles: Red Star liners (four trips).—The Noordland, 11; the Rhynland, 12·2; (three trips) the Westernland, 13·3.

Boston to Queenstown, 2,682 miles: Cunarders (three trips).—The Cephalonia, 12·8; the Scythia, 12·8; (two trips) the Gallia, 13·9.

Tempering Springs.—The following method is recommended for large springs:—Make a bath of 6 gallons lard or fish oil, 1¼lb. gum arabic, and ¼lb. rock salt. Mix well and it is ready for use. Heat the steel to a dark cherry-red; cool and do not draw the temper.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE January meeting was held on the 14th inst., J. W. L. Glaisher, Esq., President, in the chair. The following gentlemen were balloted for and duly elected Fellows of the Society:—The Rev. W. Birks, Wanstead Villa, Villiers-road, Southsea; Capt. Thos. Exham, Officer's Club, Canute-road, Southampton; Mr. Shelley Fisher, The Priory, Larkhall-rise, S.W.; Mr. Cuthbert Hutchinson, Rock Lodge, Roker, Sunderland; Mr. W. E. Jackson, Constantinople; Capt. Thos. Mackenzie, R.M.S.S. *Moselle*, Southampton; Mr. Horace Pearce, The Limes, Stourbridge; Mr. Jas. Cruikshank Roger, The Grange, Walthamstow.

The names for suspension were read by Col. Tupman; amongst them was the name of Miss Pogson, a daughter of Mr. N. R. Pogson, Director of the Madras Observatory, who had been proposed for the fellowship of the Society by three Fellows in the usual manner.

The President said: There can be no question that at the foundation of the Society the admission of women was not contemplated; but it seems doubtful, as a matter of law, whether the Council, either by their charter or under the by-laws of the Society, can exclude women if they are proposed. The Council has had several legal opinions before them, and the majority of the Council were of opinion that they were not justified in refusing to let this certificate go forward to the general body of the Fellows, to be dealt with by them as they think fit. It was not so *primâ facie* invalid that the Council felt it their duty to keep the nomination from the Fellows. On the part of the Council, he expressed no opinion whatever upon the general question. Those who felt that the admission of women was undesirable had only to record their votes accordingly at the balloting in March. One black ball in four excluded. In voting adversely there could be nothing personal, as those who brought forward the candidate knew that it was a new departure, and that her eligibility was questionable.

Mr. Knobel read a paper by Dr. Copeland on "The Variability of the Spectrum of γ Cassiopeiæ." The paper stated that Miss Clarke, in her "History of Astronomy during the 19th Century," made the assertion that the bright lines indicative of hydrogen in this star died out during the nine years from 1874 to 1883. There were two records of these bright lines having been seen at Dun Echt about the middle of this period. At present C is extremely bright, but it was not visible in June, 1872. There could not be the slightest doubt as to the variability of the spectrum, as pointed out by Mr. Von Gothard several years ago. It was remarkable that the C line was more variable than the F line, and there is certainly a colour change in the whole light of the star which accompanies these changes in the spectrum.

Mr. Maunder agreed with Dr. Copeland that he had observed the F and C lines two or three times during the interval named. Indeed, he had never looked at the spectrum of γ Cassiopeiæ without having seen the F line, though it was variable in brightness.

Mr. Knobel read a letter from Mr. Penrose on the occultation of γ Virginis, observed at Athens on the 18th of December. At the reappearance there were clouds which prevented the dark body of the moon being seen, and the power used was not sufficient to separate the two components of the double star. A bright flash showed the reappearance of γ_1, and five seconds later another flash, which seemed to double the brightness of the star, showed that the other component had appeared.

Mr. Knobel said the older Fellows of the society will remember the great interest that attached to an observation of an occultation of this star observed by Admiral Smythe in 1832. On that occasion neither he nor Mr. Dawes were able to see any second flash; both components seem to have reappeared at the same moment.

Mr. Downing said: This occultation was observed at Greenwich, but the observer was unable to see any second flash like that described by Mr. Penrose. I do not know the distance between the two components.

Mr. Sadler: The distance is now about $5\frac{1}{2}$ seconds I think.

Mr. Ranyard: It does not follow that because the phenomenon was not observed at Greenwich, that it could not have been seen at Athens, for the distance between Greenwich and Athens is so great that the reappearance would take place at quite a different part of the moon's limb. The one star may have appeared over a valley, and the other above a mountain, as seen from Greenwich, while the reverse may have been observed from Athens.

Mr. Knobel read a paper by Prof. Pritchard on the "Application of Photography to the Determination of Stellar Parallax." Since last May a series of photographs had been taken of the components of 61 Cygni and the neighbouring stars, with which its place was compared by Bessel in 1840. About 200 plates had been taken, and the distances of the four nearest stars made use of by Bessel had been measured upon them. Some doubt had been expressed as to whether there was any dislocation or unequal stretching of the photographic film, due to the unequal way in which water flows upon the plate while it is being washed. In order to check this, four photographs had been taken every evening; but out of the 200 plates taken only seven showed any evidence of such unequal stretching, and these had, of course, been rejected. The provisional parallax obtained for the centre of the binary system was 0·438 second of arc, the parallax obtained by Bessel was 0·348s., that obtained by Struve 0·564s., Ball 0·4756s., and Asaph Hall 0·270s. The research will be continued till the end of the cycle.

Mr. Ranyard said: It is a matter of very great interest whether the parallax of stars can be determined from the measurement of such photographs as these. For undoubtedly this photographic method offers some great advantages: it permits of opposite phases being directly compared side by side and measured over and over again. These photographs were taken, I conclude, with the reflector of the Oxford Observatory, which has a focal length of 10ft., and I conclude that the original negatives have been measured. With a focus of 10ft. they would be on a scale of about $2\frac{1}{4}$in. to the degree, or about one 1600th of an inch to the second of arc—or less than one 3,000th of an inch to half a second of arc—that is a very small quantity, much smaller than could be distinguished by the naked eye. I once made some experiments as to what length could be measured with the naked eye, and concluded that the 400th of an inch was about the minimum I could attain to for sharp lines. But let us assume that the centre of a small point could be fixed to one 500th of an inch, we should need a power of six to enable us to make readings to the 3,000th part of an inch. A photographic negative, when examined under the microscope, does not show an even shading; but it breaks up into a number of definite dots or granules, which, in the case of the dry plates now used, are larger than in the old wet plates. Some years ago, when measuring some prominences on eclipse photographs taken with the old wet collodion process, I came to the conclusion that I could not with advantage make use of a magnification higher than five diameters. With a higher power you see too distinctly the granulation, and the problem of measuring the distance between two small dots on a photograph would be like measuring the distance between two heaps of shingle, and not from the edge of one heap to the edge of the other, but from a point which you select as the centre of one heap to a point which you select as the centre of the other; and then systematic errors would come in, which would prevent your combining different readings and deducing a probable error according to the ordinary method. I think, therefore, that with such photographs as these one ought not to rely on the results of measurements to less than half a second, a quantity which does not differ much from the difference between the estimates of the parallax made by different observers. When we get telescopes with 100ft. focus the problem will be changed; but we shall then not get within the limits of probable error which some of these observers have thought that they have attained to.

Mr. Common said: I should like to point out that all the disadvantages which Mr. Ranyard has mentioned apply equally to the image as seen in the telescope. The focal image needs to be magnified, and no better measure can be got by the eye than can be obtained by the photograph, measuring at your leisure, with the opportunity of repeating it as often as you like.

Mr. Ranyard: There is this difference—you can magnify the image in the principal focus of the telescope 200 or 300 diameters, or as much as you like, without seeing any lumpiness of the image which would tend to give rise to systematic errors.

Mr. Common: Mr. Ranyard must not forget that the image is already magnified in the focal image, by reason of the focal length. The eyepiece does not do all the actual magnification.

The Astronomer-Royal: I think that a pretty good answer is given to Mr. Ranyard's criticisms by the fact that Prof. Pritchard's measures agree with one another to much less than half a second of arc. I have had an opportunity of looking them over, and can say that the agreement is fairly good. One cannot from *à priori* reasoning get at such accurate numerical estimates. The results show that the readings are much closer together. I am inclined to think that Prof. Pritchard's results are more accurate than Bessel's made with the heliometer, and the photographic measures can be made with much less labour. By this method stars at much greater distances may be utilised for parallax measures than was possible before.

Mr. Knobel read a paper by Mr. Isaac Roberts, on "Photographs of Nebulæ in Orion and in the Pleiades." An enlargement from an over-exposed photograph of the Orion Nebula, showing an extension of the nebulosity over an area about seven times as great as that covered in Mr. Common's photographs, was exhibited. The detail of the central portions was, however, quite blotted out. This photograph was exposed for one hour and twenty minutes. An enlargement from a photograph of the Pleiades Nebula, exposed for three hours and six minutes, was also shown. This confirmed the photographs shown by Mr. Roberts at a former meeting, and proved that the nebula extended over the whole group.

Mr. E. J. Stone read a paper entitled "Observations of the Moon made at the Radcliffe Observatory, Oxford, during the Year 1886, and a Comparison of the Results with the Tabular Places from Hansen's Lunar Tables." He said that these observations showed that the moon was still running away from Hansen's places. He could not believe in such a change taking place per saltum without some theoretical explanation which ought to be forthcoming. If the one he had offered with regard to the change of the solar year was not correct. Hansen's tables agreed with the observed places pretty accurately, from 1754 to 1864, and since that time, the moon has run away more, some $15\frac{3}{10}$ seconds, which is a quantity larger than can be accounted for by anything like personality in the observations.

Capt. Noble made some remarks on the present condition of the *Nautical Almanac*, pointing out that no change had been made in the tables of Jupiter's Satellites used. They were founded on observations made more than 50 years ago. And no change had been made in the dimensions of the Saturnian system published, though those used obviously did not agree with any modern drawings of the planet.

The meeting adjourned at ten o'clock.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE fourth meeting of the session was held on Monday, the 10th inst. Mr. C. A. Defieux occupied the chair. In presenting a list of thirty-eight candidates, the secretary pointed out that eight were from Scotland. He thought this was important, as Scotland had hitherto taken but little interest in astronomy; indeed, of the 1,000 odd Fellows who formed the Royal and Liverpool Societies, only 20 were from Scotland. He attributed this better feeling to a correspondence which had lately appeared in the Edinburgh papers, where, amongst other reasons given for this apathy, was a supposed reluctance to accept their astronomy "from across the Border." This expression, however, only proved how little was understood of the constitution of the L. A. S., for of the communications before them that night one was from Glasgow and others from Vienna, France, and Dublin. If, therefore, there did exist a "borderland of science," it certainly would not be determined geographically. Mr. W. D. H. Deane, M.A., thought the indifference was rather caused by the system of education. Technical astronomy formed part of the curriculum at the Edinburgh and Glasgow Universities, and at most of the public schools, but this was dry work, and little calculated to arouse an interest in the science.

The president contributed a list of 33 red stars which had been detected by the late Prebendary Webb, but had not hitherto been published. They had been identified in Argelander, and, in some cases, re-observed with his, Mr. Espin's, $17\frac{1}{4}$in. Calver reflector; though ill-health has, unfortunately, compelled him to relinquish the hope of re-observing them all. The stars had been brought approximately to their places up to 1885, and the list was accompanied with remarks and notes by Mr. Webb, so that the whole formed a valuable appendix to "Celestial Objects."

Comparing occultations past and present, the Rev. S. J. Johnson, F.R.A.S., remarked that the occulation of γ Virginis, which took place on the 19th of last December, was observed under very different circumstances to what would have been the case half a century ago, for it was just 50 years since Smyth observed γ Virginis as a single star. So few conspicuous double stars lay in the moon's path, that when the occultation of one happened it was attended with great interest. β Scorpii was occulted in September, 1871, but this did not seem to have been observed. The immersion of γ Virginis took place when the moon was low down, so that it was impossible to see the star separate, but at the re-appearance things were more favourable, though, unfortunately, he just missed the emergence of the companion by turning his head to note the exact time. From an observation in 1756, Mayer found the position angle = 54° 21′, and inferred a revolution in 700 years; but in 1781 Herschel found it = 40° 44′; whilst in 1830 it had altered to 30° 20′, so that it seemed pretty certain that the period could not much exceed 180 years. It was from an observation of this occultation that Ferguson endeavoured to prove the moon devoid of an atmosphere.

Mr. W. H. S. Monck, F.R.A.S., reviewed the

different theories as to the origin of meteorites. The one which accounted for their existence by projection from terrestrial volcanoes was open to many objections, but principally on account of the enormous velocities which had at times been observed. The great detonating fire-ball of 23rd Nov., 1877, had, for example, been estimated by Col. Tupman to have moved with at least parabolic velocity, and many other instances of a like speed had been observed. No such velocity could be imparted by volcanoes; therefore, if the theory were defensible, it must be in connection with Mr. Proctor's hypothesis of planetary, or even stellar, origin.

Mr. S. M. Baird Gemmill had observed a star which he suspected of variability. The position was *p.* the fine orange star which formed a triangle with 119 and 120 Tauri. In October, 1884, he had estimated it at 8 mag., but in the following October he had found it quite half a magnitude brighter. In a note on the recent maxima of U Geminorum, Mr. J. Baxendell, jun., referred to a former paper on the subject by Mr. George Knott, which he thought should form a standard for future estimates. The star was well worthy of careful observation, both on account of the varied phenomena it presented, and from the fact that it seemed to form a kind of connecting link between the so-called new or temporary stars and those of more regular period.

M. C. M. Gaudibert described the crater and neighbourhood of Condamine (Webb 237), which he had observed on the 6th of December, when the libration was very favourable. The air would not permit of a higher power than 100 on his 8½in. reflector, but he had distinguished several markings which were not included in Neison. There was also a wide opening on the N. W., and a much smaller break at the opposite wall. Besides these two ruptures, the whole ring was very uneven, particularly on the S. W. side, where there where four craters—the smallest on the wall itself.

In a continuation of his papers on telescopes, Mr. W. F. Denning, F.R.A.S., dealt with the influence of wind on definition. The east wind was rarely favourable, though the rule was far from absolute. They should remember that several distinct currents sometimes prevailed, with the air strata in different degrees of humidity. A mere surface breeze from the east might therefore underlie an extensive and moist current from the south-west, when the definition would be very fair. Calm nights, with a little haze, were often the best of all; whilst, with sparkling and brilliant stars, there was generally wretched definition. In the course of a night the definition would sometimes fluctuate in a most remarkable manner, so that an observer who found it impossible to obtain satisfactory images might an hour or two later have no reason to complain. It frequently happened that a morning following a turbulent night became so fine that it might be included in the 100 hours which had been assigned by Sir W. Herschel as the annual limit.

Mr. W. S. Franks, F.R.A.S., described Saturn as a beginner might expect to view it with a 3in. telescope, and Mr. T. G. Elger, F.R.A.S., continued his illustrated papers on "The Moon Surveyed in Common Telescopes."

The meeting concluded with an exhibition of photographs of Nebulæ star clusters, Saturn and Jupiter, by MM. Henry and Herr Gothard. An examination of the Nebulæ in Andromeda disclosed the remarkable fact that the 4½in. stellar camera photographed considerably more detail than the 17in. refractor of the Brothers Henry, or even the 3ft. telescope of Mr. Common. This was accounted for by the shortness of its focus, which would concentrate the more delicate rays into a smaller compass, although the larger instruments photographed from six to eight times the number of faint stars.

Mr. R. S. Newall, F.R.S., F.R.A.S., was elected on the Council in place of Mr. John Stead, deceased. The meeting adjourned at 9.45 p.m.

Gasholders.—The famous South Metropolitan gasholder, 214ft. diameter, over 150ft. high, and 5,500,000 cubic feet in capacity, long held its position as the largest in the world. It is now exceeded, however, by a pair of holders which have been erected at the Birmingham Corporation Gasworks, the dimensions of which are indeed prodigious; each of these is contained in a tank measuring some 240ft. in diameter, is 150ft. high, and holds 6,400,000 cubic feet.

Welding Steel.—The following is said to be an excellent compound for welding steel. High-class steel can be welded by the use of this better than with borax, because it is not necessary to heat so high. The pieces should be held together when heating:—Copperas, 2oz.; saltpetre, 1oz.; common salt, 9oz.; black oxide of maganese, 1oz.; prussiate of potash 1oz. These should be pulverised and mixed with 3lb. of good welding sand, the mixture being used the same as sand.

SCIENTIFIC NEWS.

A TELEGRAM from Cambridge, Mass., forms the subject of Dun Echt Circular No. 131. Dr. B. A. Gould finds the star D.M. + 34°, 4184, to be a variable of the Algol type. The latest minimum occurred on Jan. 17 at 10h. 19m. G.M.T., the star changing from 7·1 mag. to 7·9 mag. with a period of three days. Dr. Gould asks observers to watch the star, as it cannot be seen after January on account of twilight. Dr. Copeland adds that the new variable is identical with 40373 Lalande, and is situated 4m. 52s. *f.* and some 16′ N. of T Cygni. According to the new Armagh Catalogue, its place is 1887·0 R.A. 20h. 47m. 32·5s., N. Dec. 34° 13′ 59·5″.

Circular No. 62 of the Liverpool Astronomical Society, issued by Mr. T. E. Espin, states that the star announced in Circular 10 as invisible has reappeared, and was observed on Jan. 16 at Wolsingham, Darlington, by Mr. W. H. St. Q. Gage with the 17¼in. eq., as a red 9-mag. star. It is therefore a star with a long period probably, and a variation from 9 ± to below 12. The star's place for 1885 is R.A. 4h. 21m. 25s.; N. Dec. 15° 50·7′ preceding Theta Tauri by 0m. 35s., and 0° 8′ N. of it.

The report of the superintendent of the United States Naval Observatory for the year ending June 30, 1886, has been received, and we learn from it that the plans for the new observatory provide a place for, and contemplate the eventual mounting of, a suitable photographic telescope. With regard to the 26in. refractor, it has been used mainly in observations of double stars, of satellites, and of Saturn, but stellar parallax has also been attended to. No deterioration of the objective has been noticed since it was repolished 10 years ago; but the report refers to the lack of sufficiently good atmospheric conditions to bring out the full powers of the instrument. During the year there have been 1,853 visitors, and 1,553 permits were issued for night visitors.

Major-General De Lisle, R.E., of Ipplepen, Newton Abbot, has sent us some copies of "Tables for the Reduction of Latitude and Log. radius of the Earth for Spheroid Ⓔ," a few misprints having been discovered in those issued last year. The fresh copies have been forwarded to all purchasers with one exception —the address having been lost; but those who have not received them will know where to apply.

The Lalande prize of the Paris Academy of Sciences has been awarded to Dr. O. Backlund, of Pulkowa, for his work on the motions of Encke's comet, in which he shows that the acceleration of the mean motion is subject to a progressive diminution, and amounted between 1871 and 1881 to scarcely half what it was between 1819 and 1865. The Valz prize was awarded to M. Bigourdan for his investigations into the effect of personality in the observation of double stars. The Damoiseau prize was awarded to M. Souillart, of Lille, for his revision of the theory of the motions of Jupiter's satellites. M. Obrecht was awarded an "encouragement" of 1,000 francs for his "Etude des Satellites de Jupiter"—a thesis written for his doctor's degree. The subject of the prize for 1888 is "Perfectionner la théorie des inégalités à longues périodes causées par les planètes dans le movement de la Lune." The memoirs must be sent in before June 1, 1888.

Prof. A. W. Rücker is delivering a course of five lectures on "Molecular Forces" at the Royal Institution. They are delivered on Thursdays, and extend to Feb. 17.

Amongst the papers promised for the meetings of the Society of Arts, we note Jan. 26, "Photographic Lenses," by J. T. Taylor; Feb. 2, "Electric Locomotion," by A. Reckenzaun; Jan. 16, "Handicraft Training," by H. H. Cunynghame; Feb. 23, "Recent Advances in Sewing Machinery," by J. W. Urquhart. Papers for which dates have not been fixed, include "Miners' Safety-Lamps," by E. H. Liveing; "Development of the Mercurial Air-Pump," by Prof. S. P. Thompson; "Progress in Telegraphy," by W. H. Preece; "Railway Brakes," by W. P. Marshall; "Living Organisms of the Air," by Dr. Percy Frankland; and "Cultivation of Tobacco in England," by E. J. Beale.

The fortieth annual general meeting of the Institution of Mechanical Engineers will be held on Thursday and Friday, February 3rd and 4th, at the Institution of Civil Engineers. The president, Mr. Jeremiah Head, having been in office for two years, will retire, and will induct the president-elect, Mr. E. H. Carbutt. The following papers will be read and discussed, as far as time permits: "Notes on the Pumping Engines at the Lincoln Waterworks," by Mr. Henry Teague, of Lincoln; "Description of a Portable Hydraulic Drilling Machine," by M. Marc Berrier-Fontain, of Toulon; "On Copper Mining in the Lake Superior District," by Mr. Edgar P. Rathbone, of London.

Sir Charles Bright, president of the Society of Telegraph Engineers and Electricians, delivered the opening address of the session last week, and took advantage of the fact that this is the jubilee year of the electric telegraph, to give its history at some length. He also showed that the postal telegraph promises to develop into a profitable Government department.

Several suggestions have been made to celebrate the jubilee of the electric telegraph, Cooke and Wheatstone's patent having been taken out a week before the Queen's accession. There is some little rivalry, but it is expected that it will be determined by the Society of Electricians, and that it will take the form of an exhibition showing the development of the several branches of telegraphy and telephony.

The number of applications for admission to the Normal School of Science and Royal School of Mines being greater than the accommodation the school affords, it has been determined to make a sort of selection of candidates for admission. Applications must be sent to the Registrar before the end of May, accompanied by a statement of the studies pursued and examinations passed, with a reference to a teacher or teachers. A knowledge of elementary mathematics will be held to be of the first importance, while in the case of "occasional students," some preliminary knowledge of the branches of science they wish to take up will be expected.

The total number of applications for patents during 1885 was 16,101, of which no fewer than 7,237 were abandoned at the preliminary stage. That is about 45 per cent., a higher percentage than prevailed under the old law. It must be remembered, however, that the first ten years of such a reform as the new Patents Acts will scarcely show the true effect on the progress of invention; for many utterly useless devices, such as perpetual motion, &c., have found their way to the Patent Office since the reduction in the cost of stamps.

The Upper Table Rock at the Niagara Falls fell into the river on the night of the 13th inst. The mass of rock is estimated to have measured 150ft. long, 60ft. wide, and 170ft. deep. The mean rate of regression of the Falls has been variously estimated, some putting it at a yard per annum, while a more moderate computation considers 12in. sufficient, taking one year with another. Table Rock was the favourite spot for viewing the Horseshoe Fall, and its displacement leaves a perpendicular wall, where one can stand and look behind the cataract into the dark chasm through which the spiral stairway goes down to the path behind the Falls.

After a residence of nearly three years at Torrens Observatory, near Adelaide, Mr. Clement L. Wragge has accepted the appointment of Government Meteorologist of Queensland, and, according to the papers received, would leave Adelaide for his new post about Dec. 19 last. His work will consist of daily reports and weather charts showing the meteorological conditions prevailing throughout Australasia, but especially Queensland, and he intends to publish quarterly *The Queensland Meteorological Record*, similar to the publication of the Royal Meteorological Society. He also intends to introduce the Royal Meteorological Society's system at all stations.

The new Orient liner *Ormuz* is designed to make the trip from London to Australia in 28 days. Within less than ten months from the signing of the contract the vessel steamed

out of the Clyde, although she is of 6,500 tons measurement, and was fitted and embellished complete. The *Ormuz* has the largest triple expansion engines yet made, the cylinders being respectively 46in., 73in., and 112in. in diameter. Her dimensions are 465ft. long, 37ft. deep, and 52ft. greatest beam. The pitch of the screw propeller is 29ft.

At the meeting of the San Francisco Microscopical Society on Dec. 8, Dr. Ferrer described the new Zeiss photo-micrographic camera and stand. The camera itself is of very large size, permitting a range of nearly 8ft. from the object, when fully extended. Its front bears a metal sleeve or nose-piece which racks out to the body tube of the microscope, forming a light-tight connection with it. In addition to the ordinary ground-glass focussing plate, one of clear plate-glass is provided, furnished with a focussing glass sliding vertically between brass guides. By this means an exceedingly delicate adjustment can be obtained. The fine adjustment is regulated by a milled head attached to a long brass rod, which latter translates the movement to the fine adjustment micrometer screw by means of two very ingenious universal joints. The illumination used on this occasion was a very large oil lamp, with a bull's-eye condenser interposed between it and the Abbe condenser in the sub-stage, and for work with low powers, Dr. Ferrer stated that he had found the light fairly satisfactory, but he hoped to improve upon it by using the electric light in some way, and several patterns of incandescent lamps were now being tested by him. He also stated that he had ordered the best obtainable heliostat, for photographing with sunlight, and he, therefore, hoped soon to be in a position to do excellent work with high amplification. Hitherto he had dispensed with the oculars, using only the objectives and specially-constructed amplifier; but he intended very soon to make a thorough test of the new "projection" oculars of Zeiss, in combination with the apochromatic objectives of the same maker.

At the meeting on Dec. 22nd Prof. Runyon, who was present as a visitor, exhibited a number of photo-micrographs made by him with the Walmsley apparatus, and only a common oil-lamp as a source of illumination. The subjects chosen comprised sponge spicules, single and arranged diatoms, insects, and anatomical specimens. William Norris stated that several series of interesting slides had been received by him, which he would turn over to the Society. The first set was composed of diatoms collected and mounted in Australia, by Dr. Thomas Porter, and comprised many rare and beautiful forms. The second lot was from William H. Pratt, Taunton, Mass.; and the third from Gerald Stuart, F.R.M.S., London. The last-named set consisted of diatoms from New Zealand and the East Indies, and was of special interest from the fact that it contained *Navicula Durandii*, a form recently discovered and named in honour of Mr. Durand.

At the annual meeting of the Society of Public Analysts, held in the rooms of the Chemical Society, Burlington House, on the evening of the 12th inst., Mr. A. H. Allen, of Sheffield, analyst for the West Riding of Yorkshire, &c., and author of the well-known work on "Commercial Organic Analysis," was elected President of the Society for the ensuing year.

Mr. Sydney T. Klein, F.R.A.S., has reprinted his paper read before the County of Middlesex Natural History and Science Society last November entitled, "Thirty-six Hours' Hunting among the Lepidoptera and Hymenoptera of Middlesex, with Notes on the Methods adopted for their Capture." It will be found interesting and useful by all entomologists. It is published by C. Seers, Argyle-street, Bath.

A SWEDISH mechanic at McKeesport, Pennsylvania, has invented three nail machines to work together that will turn out 250 nails per minute, any size from the smallest to 7in. One of the machines makes the common nail from the plate. The wire nail is cut and headed by the second machine. The third cuts a fluted nail with guttered sides, which the inventor claims will cling to wood better than any made.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

OCCULTATION OF ALDEBARAN.

[26717.]—WELL observed on Jan. 6th with $12\frac{1}{2}$ Linscott, lat. 54° 44′ 23″ N., long. 1° 48′ 43″ W. Disappearance at 12h. 9m. 24s., and reappearance at 12h. 58m. 47s. by my watch. Slow $6\frac{1}{2}$ minutes on G.M.T. By Shadwell's tables for facilitating the approximate prediction of occultations, I obtain the following results:—Disappearance G.M.T., 12h. 16m. 2s.; reappearance G.M.T. 13h. 5m. 17s.; angles from north point respectively, 140° and 235°.

Would some kind reader work out this occultation for me by the most approved and reliable method; say, at same time, what dependence can be put upon this class of observation for the obtaining of Greenwich Mean Time? **H. P. Slade.**

66 CETI (Σ 231: 6, 7·8).

[26718.]—I HAVE lately been observing this interesting pair, and I find the *comes* of almost equal magnitude with its primary.

Would Mr. Sadler kindly tell me whether the *comes* has brightened of late, or the primary dwindled?

"Celestial Objects" gives it thus: 7 (Gore 6, 1874) 8·5; and the "Star Guide" has it 5·9, 7·5.

Unless I am very much mistaken, there is nothing like the difference of a magnitude and a half between the stars. I am much indebted to Mr. Sadler for former courtesies. Would he, at his convenience, kindly give a note on 66 Ceti?

Jan. 17. **H. Dowsett.**

CONCERNING THE LUMINIFEROUS ETHER.

[26719.]—WE must assume ideal pictures as the advanced mind delineates them, although a "mental reservation" is nearly always necessary.

If we delegated all hypothetical computations from the domain of science, and worked more upon evident truth, we should have far greater respect for the One who said, "Let there be light, and there was light, and He *saw* the light, that it was good." Light is invisible "to us." Its effect upon matter makes us cognisant of its existence; but again, the omnispective power is even able to scrutinise everything that is, and therefore, if we banish all theoretical deductions, we must then look upon those deep gaps in wonder and awe. We should not think of or respect Him as we do if He had not made some things preternatural and beyond the ken of us "worms."

The true man of science must not fly shy of the gaps and enigmas that present themselves. Certainly, this is not the way to advance research. If we had shunned every phenomenon we should assuredly have remained in our primeval state, instead of elevating our mind with those beautiful theories in speculative science.

It is not mere idle talk to advance postulates when we consider their *primum mobile.*

It is upon experimental data that our "all space-pervading medium" has been founded; in short, by its analogy to the other undulating force—viz., sound. By analogy the scientist classifies and arranges all natural objects, and the behaviour of those objects in his category of specific genera, species, and other sub-families, and is it not perfectly logical to admit "that sound and light being alike in their many dogmata, that they are analogous in their wave-like motions? How else can it be conceived? Can we explain the abstruse theory of the beautiful prismatic colours of the soap-bubble, or the bending of light round corners which so annihilated the corpuscular theory of Newton, without the assumption of that *hypothetical luminiferous ether.*

"Are we to wait," with our hands in our pockets until someone discovers the real translation or wave-motion, whichever it may be, of light? Surely this does not tend to advance our knowledge? One great objection have I against the undulatory theory, and that is the peculiar formation of the (photographic) invisible image by the catalytic impact of the waves or undulations of the elastic etherial medium. We are taught by physicists to assume that the luminiferous ether pervades the interstices of the ultimate particles of matter, and that we may look upon these microcosms as analogous to the planetary bodies of visible magnitude.

Assuming that indestructible atoms of matter have a spheroidal figure, then a heap of such spheroids (whether held together by cohesion or chemical attraction), must necessarily have *spaces between;* as in a vessel full of marbles we can "pack away" sand, or even shot, to a certain limit without making any rise in the neck of the containing vessel. The sand or shot filling the interstices, of course, represents that "subtler fluid than air, the luminiferous ether." Then if a set of wave-motions were set up in the interstices of a sensitive body, such as a dried emulsion of gelatine and silver haloid, these waves, owing to their non-synchronisation with the oscillations of the ultimate atoms of the haloid salt, would undoubtedly produce some effect; but it is not so. The action of light is superficial, and does not insinuate itself between the ultimate particles of matter.

Newport, Mon. **A. Treyer Evans.**

[26720.]—I QUITE sympathise with "Sigma" in his vigorously-worded attack on the above "precious jelly"; but at the same time I do not believe that Mr. Grey or any other really scientific man looks upon the idea of an "ether" as anything else than a "working hypothesis," and a convenient mode of representing the actions and phenomena of light to our gross material imaginations.

Nevertheless it is, as Sir David Brewster once called it, a "clumsy contrivance"; which will, we may hope, soon go the way of heat fluids, electrical fluids, and magnetic fluids, about which precisely the same kind of controversy was carried on until it was recognised that the molecules of ordinary matter were quite capable of taking up and transmitting energy in its various forms without the help of any "go-between" medium.

To take one point mentioned by Mr. Grey—the enormous velocity of light. The absolute velocity of transmission of electricity is almost certainly the same as that of light. Electrical changes are transmitted to the earth from the sun at the same rate as the variations of his light; witness Mr. Carrington's remarkable observation of an outburst of a facula on Sept. 1, 1859, simultaneously with a disturbance of the magnetic instruments at Kew. Yet no one thinks it necessary to assume the existence of an electriferous ether, but acquiesces in the view that the molecules of bodies can and do take up the peculiar movement, whether of vibration or revolution, which presents to our senses the phenomena called electrical.

Those who have not done so already, should read the remarks made by one of the clearest and most profound of modern scientific thinkers, Sir W. R. Grove, at the end of the chapter on Light in his "Correlation of Physical Forces."

A. X.

[26721.]—IN my schoolboy days our atmosphe was said to extend five miles above the earth's surface; then it suddenly jumped to ten miles, next fifteen, twenty, and twenty-five. Where will the limit be placed a few decades hence? At the moon, or our nearest planetary neighbour, or the sun, or the uttermost star? For my own part, I had "fifty years ago" seen enough of air-pump experiments, and learnt enough about the "diffusion of gases," to prevent my putting any limit to the extent of our atmosphere, but rather to feel assured that it existed throughout the universe. Undoubtedly, the further you go away from the earth's attraction, until you reach another attraction, the more rarefied it becomes; but it must be just as impossible to obtain a perfect vacuum in space by going away from the earth, as it is to obtain one by relieving a vessel of the influence of that attraction by the action of the air-pump.

I have seen some very great changes in the ideas of scientific men, and I may yet live to hear the "wonderful jelly" and the "luminiferous ether" as much laughed at as the "windows of heaven" are in the present day. I think I am much more likely to do that than to hear Mr. Grey, by "scientific reasoning *from experiment*," prove that this wonderful and incomprehensible substance has any existence except in the imagination.

If I suspend several balls by separate strings in a line, so that they touch each other, and then drawing back one of the end ones, I swing it against number two, none of the balls seem to move, except the one at the other end, which immediately bounds away from its neighbour. Is not this a third kind of "motion known to us" that may be designated transmitted motion?

During the nearly threescore years and ten of my existence the daily production of carbonic acid

gas has immensely increased in England and throughout the world, while the area of vegetation has been constantly diminishing, yet we have no evidence that the proportion of it has at all increased in the atmosphere. How is this? Where does it go to? Does it pass through the "luminiferous ether?" May not its corpuscles be subject to this third kind of motion? I have my ideas on this question, but fear I am too old, and that my time is too much occupied to permit me to test those ideas by "scientific reasoning from experiments."

January 4th. **Abergwili.**

THE COST OF LOCOMOTIVE WORKING.

[26722.]—AN interesting work, entitled "Railway Problems," is about to issue from the pen of Mr. Jeans, the secretary of the Iron and Steel Institute, and the following preliminary remarks by the *Engineer* refer to a problem which will interest some of your readers. There are a good many problems in railway working, and not the least puzzling is the cost of loco. mileage.

It is, for example, says the *Engineer*, well known that the cost of locomotive power is a large percentage of the whole cost of working a railway. Mr. Jeans gives a table dealing with ten first-rate British railways, from which it appears that the difference in total cost per train-mile is comparatively small. At the one end of the list is the North British Railway, with an expenditure of 2s. 2d. per train-mile; at the other end is the South-Western, with 3s. But we find that, while the cost of working the London and Brighton line, for example, is 2s. 4d., the cost of engine power per train-mile being 10·1d., the total for the Midland is the same as for the Brighton, but the cost of engine power is only 7·7d. Here we have a curious unexplained compensating action, which is not confined to the cases named. The figures refer to 1884. Mr. Jeans hardly attempts to supply any explanation of the apparent discrepancies, yet it may be possible to cast a little light on the matter, and so your contemporary proceeds to point out that, although the work done by all the railways named varies, the total expenditure is remarkably constant. If we reject the London and South-Western line, with its exceptional 3s. per train mile, we find that the difference between the North British with 2s. 2d., and the North-Eastern, with 2s. 7d., is only 5d., or, say, one-sixth. The relations between the cost of the locomotive power and the total cost are so obscure that they appear to have no relation to each other. Thus, although the cost of locomotive power on the London, Brighton, and South-Coast system is 10·1d., while on the Midland it is 7·7d., the total cost per train mile is the same. Again, on the North British the cost of locomotive power is 6.5d., while the total expenses are 2s. 2d. On the London and North-Western the total cost is 2s. 7d., while locomotive charges amount to 7·9d. It appears, then, that the causes which determine the cost of locomotive power are largely distinct from those which determine the whole cost; and it will be found, further, that there are really no grounds for drawing any deductions as to the relative economy and efficiency of locomotive engines on British railways from such figures as those we have quoted. For example, let us take the cost of coal; we shall not be far wrong if we say that on the North-Eastern it costs about 7s. per ton, while on the London, Brighton, and South Coast it costs on the engine £1. If we reduce the total consumption to a dead level of 30lb. per mile per engine, we shall have the cost of coal per mile on the first-mentioned railway in round numbers 1d., and on the latter 3d. Here, then, we have at one swoop 2d. a mile against the Brighton engine. But this comparison is not fair, because the coal used on the Southern line is better than that burned on the Northern line, although, of course, nothing like 2d. a mile better; probably we shall be correct if we say that it is about ½d. a mile better. The London and Brighton Company has a very large metropolitan traffic, which seriously affects the engine expenses; but of this Mr. Jeans takes no cognisance. Its goods traffic involves a great deal of shunting and standing about at stations, which means waste of fuel. Again we have to bear in mind that the total annual mileage of an engine has a very important effect. Now, on the Brighton Railway the mileage is 19,848, while on the North-Eastern it is 16,240. But the average annual expenditure on a Brighton engine is £742, while that on a North-Eastern is £728. The wages paid in the Brighton locomotive shops are higher than those paid in the North; and the cost of coal is, as we have said, nearly three times as much. It follows, therefore, that Mr. Stroudley's engines are, by comparison, kept up for less money by a good deal than are the North-Eastern engines, although the actual cost is considerably more. But further, the work done by the engines on the North-Eastern is very different from that done on the London and Brighton lines, so different that there is hardly any room for comparison.

The *Engineer* proceeds in quite a long article to notice some of these minor problems, which really have considerable interest on the balance-sheet; but they are worth some attention by those who write in your columns about locomotives. How, for instance, do Mr. Webb's compounds compare with other engines of the older type; and how do the coupled engines compare with the single when the mileage worked by each is compared with its total expense for a year? Mr. Jeans' book will evidently contain some matter about which to talk and write. **N. B. R.**

GOODS TRAINS AND PARTING COUPLINGS.

[26723.]—I SEE that "W. F." (p. 436) admits the cord suggestion "to be very good, so far as it goes, but it does not go nearly far enough." It does not go "far enough," it is true; but I demur to it being considered "very good." It was put forward as a simple device to which the most cheeseparing manager could not object on the score of expense; and it would serve a useful purpose, although "W. F." "repeats" that it would not enable the driver of a parted train to prevent the hindmost portion running back. Perhaps he will point out where it has been asserted that it would. However, it is usually—in these columns at all events—considered that a critic of a suggestion should be provided with a better. What is "W. F.'s"? At present it is not discoverable. I do not want to quote Latin, so I will give a free translation of a hint which an old Roman writer penned years ago—I am not sure about his "penning" it, but done into English it reads, "If a better system's thine, impart it freely, or make use of mine." Will "W. F." give us his "better system," for I presume he has one? I should be sorry to regard him as merely a "destructive critic." **Nun. Dor.**

EXPRESS TRAINS.—II.

[26724.]—

GREAT WESTERN RAILWAY.

3 p.m. ex Paddington to Swindon. The best run. October 10, 1886.

Miles.	Stations.	Booked Time.	Actual Time.	Speed.
		p.m.	h. m. s.	
	Paddington	3.0	3 0 0	
$5\frac{3}{4}$	Ealing		3 10 30	$32\frac{6}{7}$
$12\frac{3}{4}$	Slough		3 23 0	$61\frac{1}{5}$
$6\frac{1}{4}$	Maidenhead		3 29 0	$62\frac{1}{2}$
$10\frac{3}{4}$	Reading (A)......		3 41 0	$53\frac{3}{4}$
$17\frac{3}{4}$	Didcot		3 58 0	$62\frac{10}{17}$
24	Swindon	4.27	4 23 0	$57\frac{3}{5}$

REMARKS.—Bad slack through Reading and a quarter of a mile beyond. Lost half a minute.

Load equal to 6½. Loco., Hirondelle. Chief dimensions of loco.:—Cylinders, 18 by 24; carrying wheels, 4½ft.; drivers, 8ft.; heating surface, 1,952 sq. ft. Water in tender, 2,700 gals. Coal, 2¾ tons. Consumption of coal per mile, 26lb.

GREAT WESTERN RAILWAY.

Swindon dep. 1.18 up. The worst run. December 16, 1886.

Miles.	Stations.	Booked Time.	Actual Time.	Speed.
		p.m.	h. m. s.	
	Swindon (A) ...	1.18	1 46 30	
24	Didcot		2 12 0	$56\frac{8}{17}$
$17\frac{3}{4}$	Reading............		2 30 0	$59\frac{1}{6}$
$10\frac{3}{4}$	Maidenhead		2 42 0	$53\frac{3}{4}$
$6\frac{1}{4}$	Slough		2 48 0	$62\frac{1}{2}$
$12\frac{3}{4}$	Ealing		3 2 0	$54\frac{9}{14}$
$5\frac{3}{4}$	Paddington	2.45	3 9 30	46

REMARKS.—Arrived at Swindon 1.20 p.m. Delay owing to luggage being in wrong van.

Load, 7. Loco., 2,009. Chief dimensions:—Cylinders, 17 by 24; carrying wheels, 4½ft.; drivers, 8ft.; heating surface, 1,952 sq. ft. Water in tender, 2,560 gals. Coal, 2½ tons. Consumption of coal per mile, 25¾lb. **French Loco.**

[26725.]—I QUITE concur in Mr. Rous Marten's views as expressed in letter 26659, especially the concluding portion. When timing trains I usually take both mile-posts and stations, if possible; but at night it is, of course, impossible to take posts. For station distances Bradshaw is worse than useless, as the distance is only given to quarter miles, and not always accurately then. One requires the distance to chains, and this, I believe, can only be obtained from Airey's railway maps.

In reply to "Practical Man" (26661) the driver told me that the night Scotchman runs the 124 miles from Newcastle to Edinburgh without stop, provided the load does not exceed ten coaches, and the weather is moderate; but otherwise, he said, he would require to stop for water.

"French Loco" (26663) quotes as his best run on the Midland one which is decidedly below the average. He takes the booked time from Bradshaw, which gives arrival time at Kentish Town and departure at Kettering, so that 3.6—4.27 should be read for 3.4—4.30.

The following run shows a speed as high as is likely to be found in ordinary practice:—

Miles.		H. M. S.	Speed.
$105\frac{1}{4}$	Grantham.	4 17 20	—
100	mile post.	4 26 19	—
97	"	4 29 26	57·7
94	"	4 32 3	68·7
92	"	4 33 42	72·7
90	"	4 35 18	75·0
87	"	4 37 48	72·0
80	"	4 44 11	65·7
—	Peterbro'.	4 48 23	47·8
72	mile post.	4 54 13	
67	"	4 58 58	63·1
61	"	5 5 48	52·6
54	"	5 12 21	64·1
45	"	5 21 45	57·4
—	Hitchin.	5 36 25	51·3
22	mile post.	5 48 36	
15	"	5 55 36	60·0
4	"	6 7 10	57·0
—	King's Cross.	6 13 20	—

REMARKS.—8ft. single No. 773 and 6 coaches Usual slack to 10 miles an hour through Peterbro', and slacked by signals at mile-post 7, speed being reduced to about 20 miles an hour. Due to leave Grantham 4.17 and arrive King's Cross 6.15.

On the occasion of the above run we left Manchester at 2h. 0m. 13s., M.S. and L., No. 500, and 5 coaches, and arrived Sheffield 2h. 58m. 41s. (due 2h. 59m.), although delayed over two minutes by signals outside Sheffield. A coach was added at Sheffield, which was left at 3h. 3m. 46s. (due 3h. 3m.) and Grantham was reached 4h. 11m. 38s. (due 4h. 13m.), with a signal slack at Newark and a stop outside Grantham station waiting signals. The highest speed attained by the M.S. and L. engine was 72 miles an hour between posts 129 and 128 (from London).

It should be known that the 9.12 a.m. from Peterbro' to London (Mondays only) is due Finsbury Park 10.32, being 73¾ miles in 80 minutes, or over 55 miles an hour, decidedly the fastest timing in this country. **Kappa.**

ELECTRIC LOCKING FOR RAILWAY SIGNALS.

[26726.]—YOUR correspondents "Electric" (61171), and Mr. Stretton (26710) describe Spagnoletti's system of electric locking for railway signals. That the system is imperfect in its present aspect is evident, so without repeating what has been urged against it by Mr. Stretton, with whom I entirely agree, I ask What is electric locking for —to prevent mistakes? Well, but if it has to trust to the very men who make mistakes, what good is it? It fails in its object. If signalmen always did right, and worked their levers and instruments properly, why wish for electric locking?

The action of the men must be mechanically controlled so as to make mistakes impossible.

Rover.

ELECTRIC LOCKING FOR RAILWAY SIGNALS.

[26727.]—IN your issue of the 14th inst. you publish a letter from Mr. C. E. Stretton, dated the 7th January, pointing out imaginary defects in my system of electric locking of railway signals. Now, when a man makes a statement in error, doing another an injustice, and his misconceptions are pointed out to him, and he admits his mistake, it is pardonable; but when he is told of his errors by the best authority to correct him, and persists in publishing his erroneous ideas, I consider, as I believe every other reasonable man would do, that such conduct is unpardonable.

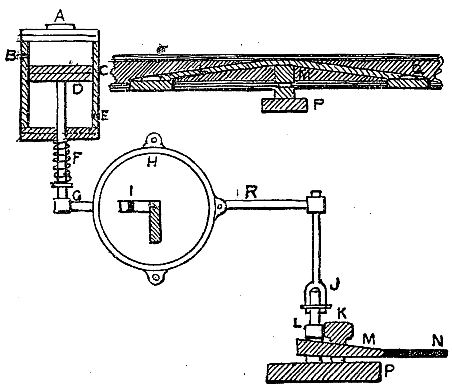
Mr. Stretton wrote a similar letter to *Iron*, which appeared in the issue of that journal of Dec. 3rd, finding the same imaginary faults, and wrongly describing the principle and working of my system, as he does in his letter which appeared in your journal of the 7th instant. I replied to this letter, and my answer appeared in *Iron* issued Dec. 10, informing him of his errors. Still, in spite of this, he perpetuates his mistakes by writing to your journal as above referred to, and this nearly a month after his mistakes were pointed out to him. He states he has examined the system and finds such and such things to exist, which I most distinctly say do not, and

never did exist. He has certainly misunderstood both the principle and working of the system, and I think, as a representative man and an adviser to a society, it would not only have been more prudent, but have shown better judgment on his part if he had properly understood the system, and obtained a correct knowledge of its working, before venturing to give an opinion upon it, or attempt to describe it, as it is evident from his own showing that he is ignorant of its working and capabilities. I ask you to be good enough to allow me to reply to this letter, as such statements are not only misleading to your readers and the members of the society to which he belongs, but unfair to the inventor. He, in this letter, also states that I admit that such "defects" exist; here, again, he has misunderstood my letter, by which I endeavoured to correct the wrong conclusion he had arrived at in his first letter to *Iron*. I admitted the point he raised was an important one, and said it was provided for; but I never admitted the defect existed, and no doubt if he reads my letter again he will see that he is wrong. I can only say the system does exactly what he says it ought to do; that he has wrongly described it, and that provision is made to effectually and surely prevent any chance of accidents arising from the cause he states. It is satisfactory for me to be able to state that my experience has not been with such unreliable and careless signalmen as it appears to have been his lot to have worked with. I have always found them a steady and careful class of men, and most anxious to do their best for the safe working of the traffic.

C. E. Spagnoletti, M.I.C.E., &c.

SIGNAL RECORDER.

[26728.]—I SUBMIT to the readers of this paper a device for recording the signal about 100 yards before the train reaches it, and I think it would be of great advantage for the safe working of the line, as on a foggy night, for instance, it would show the driver of the train if the signal was at danger or not, and I think the drawing will explain itself. A is piston for working signal in the gauge, B a



very small hole to let in the air after signal is recorded, C cylinder, D piston, E small hole to let in and out any air that would stop the free play of the piston; F spiral spring to pull piston down after train has run over plane; G a slotted joint to raise piston, H gauge to show signal, I signal arm, J small wheel to be hung from engine, to run over plane which lifts up signal in the gauge; K rail, L plane, M wedge to lift up plane at the same time as signal on post; N rod to signal-box, O foundation for wedge to run on.

D. Evans.

MIDLAND GOODS ENGINES.

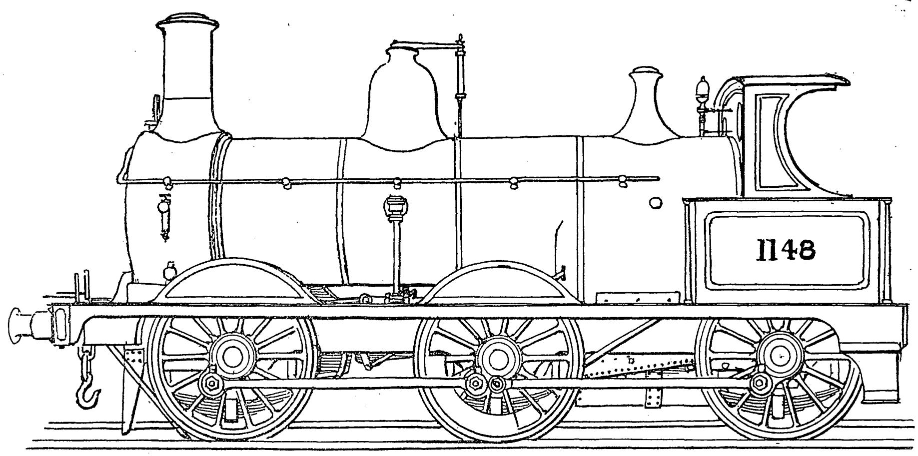
[26729.]—IN your issue of this date I notice a correspondent, who signs his letter "Rover," p. 442, (61422), asks me to furnish a diagram of a Midland engine of the 1142 type. I therefore beg to inclose diagram of No. 1148, which is one of those designed by Mr. S. W. Johnson, and constructed by Kitson and Co., Leeds, 1875. These engines are required for heavy mineral traffic, and have cylinders $17\frac{1}{2}$ by 26, and six coupled wheels of 4ft. 10in. diameter; the tractive force for each pound of effective pressure on the pistons being therefore—

$$\frac{17\frac{1}{2} \times 17\frac{1}{2} \times 26}{58} = 137{\cdot}284.$$

The engine illustrated has done very good work on the Midland Railway, and the following numbers are of the same dimensions:—

381 to 385
400 to 404
1142 to 1251

It will be observed that there is no brake upon the engine wheels. Some of these engines have,



however, been since fitted with brakes, and it is to be hoped all soon will be, as at present they are capable of conveying trains which they are unable to stop or properly control on inclines.

Clement E. Stretton.
Consulting Engineer Amalgamated Society of Railway Servants.

306, City-road, Jan. 14.

COAL ECONOMY—GOODS TRAINS AND PARTING COUPLINGS.

[26730.]—I AGREE with "Nun. Dor." (26692) that we are using a deal more coal than is necessary, and I have given this subject my special consideration, and the result is that I have found out how to use one quantity of steam over and over again in a steam-engine. (One writer quoting a former letter of mine called it "regenerating the steam.") I want to guard against this. I would not regenerate it, for I would not allow it to die, but keep it alive from the starting of the engine until it stops, no matter how long it worked. I also have to say that an engine on the plan suggested would do more than double the work that the engines are doing at the present time, reducing the first cost one-half.

"Nun. Dor." says: "There are plenty of firms who will make engines so that a ton of coal would yield 700H.P. an hour." I calculate that 8,960H.P. can be obtained from one ton of coal per hour. Our coal is being literally thrown away, and it is no exaggeration to say that one-tenth would suffice for the steam-engines, and less than one-half for many other purposes, and at the same time the smoke nuisance entirely done away with.

I am sure that it is as necessary that goods trains should have as good continuous brakes as passenger trains. I have seen a deal of runaway trains in my time, and the relating of them would make my letter too long; but I will just give one. A goods train got to the top of Checkerbent bank, and had to stop, so that the men could pin some brakes down; it was very slippery, and if they stopped a yard or two too soon they could not start again after the brakes were put on, and besides, from the slippery state of the rails, the brakes would not hold the train after they turned the head of the bank. Although they were moving very slowly, the train got on too great a speed before the brakes were put on: result, they knocked Bolton station down, and the fireman met a terrible death! The question is, How is this to be remedied? I would suggest an inquiry into the matter by the companies appointing a few earnest, good, and qualified men to see if some plan could be devised to cure the evil. I believe it could be done. I never see a mishap on the line but I set my wits to work to find a cure, and I believe I can do it. I am willing to work with any others in this matter. I have no faith in electricity: it has failed so often in signalling that I distrust it. I invented a mechanical communication that was automatic, and had it before the Board of Trade and the L. and N.W. Company, so that if the train parted it would have warned both driver and guard, and communication could have been kept up whilst shunting operations were going on.

I have by an accident been rendered unable to work as a driver, so no one need be afraid of me taking his job. I believe railway work can be made more safe, efficient, and a deal more economical, and I have no doubt but the plan that I have recommended will be the best to effect the object in view. Let every one do his duty, and assist in this difficult task. I hope to see the work of my life accomplished—namely, improving railway work, so that higher wages, safer work, and greater dividends may be paid. Ten per cent. per annum could easily be made on every railway in England is the opinion of

Benjamin Bagshaw.

10, Brook-street, Crewe, Jan. 17.

THE DUPLICATION OF THE CUBE.

[26731.]—IN your last issue is a letter (26698) on this subject, in which a solution is put forward as being exact. I will show in the first place that it is only a near approximation, and then show why it must necessarily fail to be exact.

Referring to the figure given in the letter, we have, by similar triangles, A G : A I : : A E : A H; and, therefore—

$$AG = \frac{AE^2}{AH} = \frac{36}{\sqrt{45}} = \frac{12}{\sqrt{5}}.$$

Again, since K L = A L, we have at once that—

$$KL = \frac{AK}{\sqrt{2}} = \frac{12}{\sqrt{10}}.$$

Consequently—

$$KL^3 = \frac{1728}{10\sqrt{10}} = 54{\cdot}644.$$

This is evidently approximately double of 27, which is the volume of the 3in. cube, but not exactly so.

Now, suppose x and a to be the sides of two cubes, such that the first is double the second one in volume; then $x^3 = 2a^3$, and hence $x = \sqrt[3]{2} \, . \, a$. Consequently, to find the value of x when a is known, we must be able to find the cube root of 2 geometrically. But no lines that can be drawn on a plane surface, by the help of Euclid's postulates only, are so related that the length of one is the cube root of the length of the other; hence any attempt at the duplication of the cube by means of Euclidean lines on a plane surface must inevitably be a failure.

Inverness College. **C. W. Bourne.**

[26732.]—THE following will dispose of Mr. Williams's plan (letter 26628) for duplicating the cube. Taking the diagram as given:—Let A D = 1. A G = 2 the sides of their respective squares, D H must = 2, and E H = 1; A D H forms a right-angled triangle; $\therefore$ $(AH)^2 = (DH)^2 + (AD)^2$; therefore $AH = \sqrt{5}$; the diagonal of the square on $AG = AF = \sqrt{8}$; now, A E = A I radii of the same circle. Now, the triangles A E H, A J I are similar and proportional; $\therefore$ A H : A I : : A E : A J, that is, $\sqrt{5} : 2 :: 2 : \frac{4}{\sqrt{5}} = AJ$. Again, A J = A K radii of the same circle, and the triangles A E F and A L K are similar and proportional; $\therefore$ A F : A K : : E F : L K—that is, $\sqrt{8} : \frac{4}{\sqrt{5}} :: 2 : \sqrt{\frac{8}{5}} = LK$. Now, $\sqrt{\frac{8}{5}}$ is not $\sqrt[3]{2}$; therefore, L K is not the base-line of the double cube.

Helix.

LATHE MATTERS.

[26733.]—I AM about setting up a lathe at home, and, thanks to the writings of some of our contributors and the advice of a friendly mechanic, I have little doubt of being able to secure a serviceable tool. Now, except for the occasional making of some little piece of scientific apparatus, my tastes do not lie in the direction of mechanical engineering, neither do I look forward to spending my leisure in perfecting the tool itself, and adding ingenious adjuncts thereto; but I find, now and then, that in making various things for use and ornament about the house I want round forms, and, it may be, a screwed fitting of some sort, and I expect to find a lathe, equipped with a few necessary appliances, helpful from time to time.

But surely it must be possible, and would be very pleasant, to do much more than this with a lathe; and yet nothing is more remarkable to me, in looking over the columns of the "E. M.," than the almost total absence of any reference to the results of lathe work, apart, as aforesaid, from mechanical engineering. *Engineering*, a few months since, recommended "ornamental" turning for its value in hand-education, and illustrated specimens of geometrical ornament. Well, no

artist would for a moment allow such things to be classed as ornament: they and all their kind go to enforce the truth that geometry, without feeling, cannot produce ornament. In our museums there are plenty of pretty pieces of turned work, plain turning all of them, often pole lathe or bow lathe, and mostly things that we either don't want or can't afford to produce now, such as spinning-wheels and Cairo window-lattices.

In these pages we have had, in the last year or so, one capitally lucid article by "O. J. L." on a turned photograph frame, and as a handicraft lesson nothing could be better; but if a pretty frame were the result desired, a hint was given that a fret-saw and a penknife would be more useful than the lathe. Now, surely this is not making the best of the tool; there must be things about the house that would be better made between the centres of the lathe than at the bench. It is not credible that all the lighter sort of lathes are—like the Duke of Marlborough's now going a-begging—toys, costly in money or in time and brains, and I cannot but believe that some who may have read this could recount experiences of lathe produce, as distinct from lathe production, which would interest others besides

W. A. S. B.

LATHE MATTERS.

[26734.]—I THINK "F. A. M." is somewhat of a "thirsty soul" where the lathe is concerned. Perhaps a number of contributors are mentally solidifying the late discussions and ideas advanced —perhaps some are materially embodying some of the notions. Can anyone tell us the fate of Mr. Hartley's apparatus? I intended going to the sale, but was prevented by other matters. I was much interested in the article on Mr. Evans's book, and intend getting a copy; but do not as yet know the price and quarter to apply.

The radial index is quite new to me, though an index that traverses all the circles without altering its length, and is able to return to its starting point, was published in the ENGLISH MECHANIC last "season," together with my first letter on the "Division Plate." It is not so simple as radiation, but has the advantage of being always tangential; and again, it was not specially designed to allow intermittent use of the various circles, but to maintain the tangent. It appears to me, however, that with an arc to start with, it would be only at No. 1 hole in each circle that they would be all on the arc, and capable of usage by the one index. I should prefer a second index, lifting the first to clear plate, as the second index could be set and used anywhere in the circle, and the first would remain quite free from disturbance. As some of those who have plates with the holes starting from a radius may wish to have the advantage of the arc —which, perhaps, I do not quite understand—I will again briefly describe my arrangement. A stem, parallel to radius and surface of plate, stands fixed over the circles; on this stem the index slides, being formed with a suitable socket to fit thereon, and being provided with a pinching screw. The index has also provision for lengthening or shortening. The stem can carry any number of pawls; for constant use I should use one to each circle for my plate. I am scheming to make the last named device give any number; if I discover a suitable way, I will endeavour to explain it.

Vulcan.

THE EDMUNDS MANDREL.

[26735.]—TWO years ago there was a discussion in the "E. M." about the "standard interchangeable lathe mandrel" proposed by Dr. Edmunds, a subject of wide practical interest to our readers.

I have been looking through the back numbers of the "E. M.," but cannot find that any final decision as to the dimensions of the standard mandrel and the pitch of its screw was arrived at. It seems to me that the advantages of such a standard lathe mandrel are so great as to insure its general adoption if the interests of the user only were consulted.

Dr. Edmunds has been frequently asked by other readers to recur to this subject, and as it is of such general interest alike to amateurs and the trade, many of us would, I am sure, be glad if Dr. Edmunds would give us any final conclusions at which he may have arrived.

If "F. A. M.," "Vulcan," "O. J. L.," and other readers would then favour us by discussing the subject with a view to determining the best form to adopt, we may perhaps bring the question to an intelligible conclusion. A. Gray.

THE WIMSHURST MACHINE.

[26736.]—IN all ordinary forms of the Wimshurst machine, the collection of the electricity produced is effected, as far as I am aware, by means of wire combs. But whether this is the best method or not, appears to me to be open to question. Of course, in the ordinary glass frictional machines, the use of such collecting points is imperative, because, the excited surface being non-conducting, the action of a conductor opposed to it is merely local, and therefore a sufficient number of such conductors, or discharging points, have to be opposed to the glass to cover the whole extent of excited surface.

But in the Wimshurst machine the conditions are wholly altered. Here the electricity (or at least the effective portion of it, for I suppose the glass between the sectors behaves in the same manner, only much more feebly, as the sectors themselves) has to be collected from metal surfaces, and a conductor in contact with the smallest portion of those surfaces, serves to reduce their whole area in the same electrical condition.

I therefore substituted for the combs on each side, two guttapercha covered wires, bent so that the ends pointed towards the glass, each terminating in a short brush, similar to those on the neutralising rods, which nearly touched the surface of the glass. The results obtained from the machine so fitted appear to be fully as good as those obtained with the combs, while the collecting wires are much more readily made and attached. I should imagine that compound machines especially would be more conveniently put together in this manner.

One advantage is, that the wires exposed much less surface than the combs usually do, and therefore afford less facilities for escape of electricity.

No doubt Mr. Wimshurst, or perhaps other of your correspondents, have already tried this method, and if so, I should be glad to know what their experience has been. Crispin.

SACCHARINE.

[26737.]—"R. S. T." asks what is meant by attributing "antifermentive" and "antiseptic" properties to saccharine.

In the *Gaz. Chim.* Turin, 1886, experiments are quoted to show that saccharine acts as an antiseptic in retarding the fermentation of sugar, wine, and milk. Further, it has been found that peptonisation and diastasis are stopped, and it is stated that it is also useful for certain disinfecting processes in the intestines.

Few experiments have been made with saccharine in England owing to the extreme difficulty of obtaining supplies. Orders which have been given over six months ago to the wholesale German houses have failed to be executed up to date.

E. J. Millard.

SUGAR ANALYSIS.

[26738.]—IN reply to Mr. A. H. Allen, letter 26695, I regret that I should have mistaken his meaning in the statement he made in letter 26549, that Pavy's solution cannot be employed for the detection of small quantities of sugar. I took the statement to mean that Pavy's process would not quantitatively estimate small proportions of sugar. I am pleased to find that he agrees with me that it will.

I had no desire to keep any "special knowledge to myself": the method was I supposed well known to analysts, and has been detailed and illustrated in the *Lancet* so long ago as 1879.

Alf. W. Stokes.

TRICYCLES.

[26739.]—IN reply to "Gamma Sigma" (26708, page 435), I have long ceased to experiment with tricycles that seat the rider on the driving-wheel axle. I think they will go out of use in time for reasons too long to state here.

I am only speaking of tricycles that carry part weight on the steering wheel. Years of riding and observation have convinced me that the axles of the driving wheel and steering wheel should work nearly in the same parallel line. This would, of course, bring the three wheels to about the same size. This brings us to the question, How large ought wheels to be? I say for a 6ft. man the wheel diameter should not be more than his own height, 72in. This would bring us to three 36in. wheels for the tricycle. Of course, the two driving wheels turn as one double wheel, and only value as one wheel. The next point to consider is how to get a 36in. steering wheel in a tricycle. In a bicycle it is easy to do it with a vertical fork, as the machine balances perpendicularly; but a tricycle, with its double driving wheel, follows the contortions of the road, and is best steered by a horizontal fork, I think.

I prefer 30in. or 32in. wheels, double or single, for driving, always keeping the steering wheel a little larger than the driver. One of my favourite machines is called an "Emperor." It drives on one 30in. wheel geared to 48in., and steers on two 42in. wheels. This is an extreme size for steering wheels; but I expect the "Rover" pattern bicycle will be much used next season. This machine has the steering wheel the same size or a little larger than the drivers.

My tricycle pedals I allow to reach about 3in. or 4in. off the ground; safety bicycle pedals about 6in. from road, lowest point. A tricycle follows the slant of the road, and the pedals are kept the same distance off; but the safety bicycle is vertical to the road, so that if the pedals are too low the inside one might strike a stone on the rising ground.

Jan. 17. R. G. Bennett.

PUMPING HOT WATER.

[26740.]—IF you want to pump hot water, you must bear in mind that the pump will not act by suction, owing to the steam spoiling the vacuum created by rise of plunger. You must have the whole of pump *below* the supply of hot water, so that it lifts valve and runs into barrel on rise of plunger; once in, you will have no difficulty in forcing it as high as you please. You will have to have a pipe in or near bottom of the open copper—it will not lift (if above 150°) even to top of vessel.

T. C., Bristol.

[26741.]—THE vapour (see letter 26714) fills the space under piston and prevents the formation of a vacuum.

Put pump so low down that the piston, when at top of its stroke, is below the level of the hot water in copper: make the valves of metal or of some substance not affected by hot water, and you will have no trouble. Glatton.

[26742.]—THE failure of "Zulu's" pump (letter 26714) is due to the high vapour tension of hot water as compared with cold. As "Zulu" is no doubt aware, the water rises in an ordinary cold-water pump because the action of the buckets removes the atmospheric pressure from the water in the barrel, which is then forced up by the atmospheric pressure on the water outside it. Suppose, however, we generate vapour from the water in the barrel by heating it, we shall force it back against the outer atmospheric pressure.

In an ordinary pump water will rise, say, 26ft.; but to depress it down to 12ft. we have only to heat it sufficiently. I calculate from a table of vapour tensions that a temperature of about 76° Centigrade (169° Fahrenheit) will do this. Therefore it will not rise to 12ft. in "Zulu's" pump unless the temperature be below 76° C., perhaps several degrees lower. The water could, of course, be raised by a force pump placed at or near the level of the water in the copper. J. Brown.

Belfast.

[26743.]—"ZULU" (letter 26714, page 436) is not quite correct in his supposition, because it is not the steam from the boiler that acts upon his pumps, as he surely has the supply-pipe near the bottom of his boiler; but the real cause of his failure is, that the moment the pressure is lowered upon the surface of the hot water by the action of the lifting bucket, steam or vapour, as the case may be, is released, and destroys the partial vacuum. Easiest remedy: Lower the pump-barrel below the level of the horizontal part of the pipe; thus the hot water will flow in by gravity.

A., Liverpool.

[26744.]—I SEE a correspondent on p. 436 wants to know why he can't pump hot water by an ordinary suction pump which works well with cold. If he places his copper containing the hot water above the level of the pump-barrel he will be able to pump hot water; but he must remember that when he puts his pump, as at present arranged, at work, he really produces a reduction of atmospheric pressure in the barrel, and that consequently the hot water becomes steam, and fills the barrel instead of water. If, then, he puts the hot water above the pump-barrel it will flow into it, and he can "force" it up the desired height.

Saml. Ray.

HOW THE SUN PUTS OUT THE FIRE.

[26745.]—IF a small room has a large window facing the west or south-west, it is found that the afternoon sun puts out the fire, especially in spring, when the sky is clear and the sun is low. The reason is that at this time of the day the fire is often allowed to get dull, and the sun's rays warm and rarefy the air in the room as much as the fire warms the air passing over it up the chimney. Hence the draught ceases, and the fire goes out. To remedy the inconvenience open the door or the window, to let warm air out and cold in. K. E.

PATENTS AND LAND.

[26746.]—A CORRESPONDENT, in letter 26696, has pointed out one of the absurdities of our property laws, which I have frequently mentioned in conversation. We have the *Pall Mall Gazette* and other papers raving on behalf of the landlords, saying that "the English people will not steal," and quoting the eighth commandment as to *land*, but showing utter blindness as to *patents*.

When a man brings out a good invention, he *creates* a new combination. The landlord does not create the land; he merely buys or inherits it. Now let us see where the thief is. The nation gives the patentee a right to bring an action at his own cost, *on condition* that he pays the nation an average of £11 a year for fourteen years. It takes away his property at once if he fails to pay the taxes; and, if he does not fail in these, it takes his property away at the end of the fourteen years! Is not this stealing?

To be consistent with land. Let a man reclaim a piece of land from the sea: let the nation charge him £154 for a fourteen years' tenancy of this land, and then take it from him. This they would call stealing; the former they do not. Yet this would be equitable if the former is equitable.

But the landlord does not create his land; he buys or inherits a right (query, wrong) to tax a naturally increasing population for his, and his successors', luxury *for ever*. He is such a favourite with the nation that all the forces of so-called civilisation are enlisted on his behalf; while the poor inventor has the same forces against him. Who is the thief? **Thomas Moy.**

WEATHER REPORT (IN JERSEY) FOR 1886.

[26747.]

—	Mean of Three Barometers.	Mean Lowest Night Temperature.	Mean Highest Day Temperature (in the Shade).	Rainfall in Inches.	Days on which Measurable Rain Fell.
	In.	°		In.	
January ...	29·79	37	No record kept	4·75½	25
February...	30·16	36	" "	1·39	13
March	30·03	38	" "	3·62½	18
April	29·99	43	" "	2·24½	17
May	30·03	50	" "	4·42	20
June	30·09	53	" "	0·74	6
July	30·09	58	" "	2·63	12
August ...	30·15	57	" "	1·89½	12
September..	30·12	57	" "	1·56½	10
October ...	29·83	52	59°	7·52	24
November..	30·05	44	52°	4·77	20
December ..	29·83	39	47°	7·08$\frac{1}{32}$	29
	30·01⅓	47	52⅔ (last 3 months)	42·64	206

I, for one, am much obliged to "B. A." (letter 26656, page 410) for his interesting report of the "Temperature and Rainfall in 1886" at Handsworth; and, believing that a meteorological report for Jersey during last year would likewise interest many of "our" readers, I take the liberty of furnishing a rough digest of the same, though it is not as complete as I could have wished. The last three months here have been marvellously wet; and there is this peculiarity about the Jersey climate that a good deal of rain often falls with a high barometer.

The total rainfall for 1886 was (as above) 42·64in.
" " 1885 " 29·41
" " 1884 " 31·78
Mean rainfall for last three years, 34·61in.

Wm. Locke Lancaster.

St. Helier's, Jersey, Jan. 11.

THE HOP APHIS AND THE PHYLLOXERA.

[26748.]—THE ravages of the hop aphis in this country are probably not quite so ruinous as those of the phylloxera in France; but it will no doubt surprise many to learn that the loss in the hop failure of 1882 was estimated at a million and three-quarters of pounds sterling. Many experiments have been made with insecticides, some of them with a measure of success; but it is obvious that little could be done until the nature of the pest was understood. It is believed that the *Aphis humuli* and the *A. humuli*, var. *Mahaleb* are practically identical, and that the first attack on the hop begins in spring from wingless females and their young, which come up from the hop-hills; but that the main attack is made by aphides, which come on the wing from sloe and damson bushes, where they are developed. Of the remedies used hitherto, the most successful have been a mixture of the mineral oil sold as paraffin, with ashes, sawdust, &c., which is used for dressing the hills, and is apparently effective in destroying the wingless females which are located in the soil. If that could be carried out on every hop plant throughout the country, it is not unlikely that the aphides might ultimately be materially reduced in numbers, especially if measures are also taken to destroy the aphis which develops on the sloe and damson. To do that effectually, more knowledge is required of the life-history of the insect, and here is an object of study which cannot fail to serve a useful purpose.

As regards the phylloxera, the loss in France last year caused by its ravages must have been very great; but as has been pointed out by a recent writer, unfortunately, the vine-grower is not interested in killing the swarm before it flies, for he knows it will be miles away before it can do harm. Again, the vinegrower on whose vineyard the swarm alights makes no sign, for he shrinks from publishing that his vines are infected, fearing that destruction of the vines might be decreed. To him the immediate loss would be great, for the vines bear more fruit for at least the first year after being attacked. Thus in too many, perhaps the majority of, cases has the evil been allowed to go on undisturbed, and not till the damage is patent to all the world have remedies been prayed for.

The life of the insect, which somewhat resembles a beetle, goes on in a continuous round, called by the French a vicious circle. Like the silkworm, it undergoes many changes—always three, sometimes five. Those which have five changes possess wings, are called nymphs, and are capable of flying in a swarm for five miles or so. Let our circle begin in August with the nymphs busily moving on the ground and on the stems of the vines. When ready the swarm takes to flight; and, being aided by a fine sense of smell and vision, alights a few miles off on a vineyard then in its greatest fragrance. The nymphs are all females, and soon begin to lay their eggs, of which the large ones are females, the small ones males—the only appearance of the male in the vicious circle. In 20 days the young insects are fully grown, when the pairing at once begins, and in a few days more one egg is laid, generally in the exfoliations of the stem. It is called the winter egg. The parents die, and the egg remains where it is laid until the following April, when it is hatched. The young insect, a female, travels usually down the stem and enters the ground. There it fixes its proboscis into the root, lays 30 eggs, all females, and dies. The eggs soon come to maturity, and the young ones, behaving as their parents, pursue their course further into the ground, when each lays 30 eggs, all females, and dies. There may be eight generations in one year, but if only five generations the number produced at the same rate would be 25,000,000 insects from one ancestor. In winter the process is suspended, but is continued during the summer months of the three following years, at the end of which period it is supposed to be exhausted, having produced from one ancestor a number of millions of insects far beyond the power of the human mind to conceive. Who, then, can wonder that the vines no longer retain their vitality?

After a variety of researches only one method has been found to effectually kill this insect, and that is by inundation, begun in November and continued for 40 days. The experiment was made for many successive years by M. Fauçon at Mas-le-Favre, near Avignon, by means of the water of the splendid Durance Canal, which commands the vineyard. The canal is supplied by the River Durance, and runs southward for 80 miles at an immense elevation to supply Marseilles with perfectly pure water. This vineyard was the first to be attacked. In 1867 the wine produced was 925 hectolitres; in 1868, 40 hectolitres; in 1869, 35 hectolitres; in 1870, the first year of submersion, 120 hectolitres. After 1870 the produce of the vineyard gradually increased until it nearly reached its normal quantity, and the vines regained their vigour. But how few are the vines placed in such a fortunate position!

The chemical chiefly relied on is sulphide of carbon, which is introduced into the ground in any required place by means of an injector with a pointed end, and comparatively slight success has doubtless attended the application of this and other chemicals. Still, the course of the roots must always be difficult to follow, and there is too much chance that many more insects will escape the poison than will be brought under its influence.

The phylloxera is not microscopic, so that, after a very little tuition by the aid of a magnifying glass, most peasants are able to detect the movements of the insect when above ground with the naked eye. While it is important to do the utmost to exterminate the insect from the roots, for which purpose it is hoped that better means will still be found, no effort should be neglected to kill the swarms before they take the wing, to kill them after alighting on their new vineyard, and to destroy the winter egg. Either of these three processes effectively performed for four successive years would probably rid France of her potent and deadly enemy.

It seems useless for one man to attempt to destroy insect pests when his neighbours allow them to breed; but if combined action could be brought about, there does not appear to be any reason why many of the insect pests should not be so materially reduced as to be practically of no importance. At present the actual loss of money they occasion is a serious matter in a densely populated country. **E. G. M.**

JOY'S VALVE-GEAR.

[26749.]—IN reference to "G. S.'s" query in letter No. 26713, *re* Joy Valve-Gear in Great Eastern engines, I may state that Mr. Holden has only replaced the valve-gear referred to by the link motion in one engine at present, viz., No. 562, a 4-coupled radial express engine, built at Stratford in 1882; the splashers have also been altered. Radial tank engine, No. 674, has link motion; the Joy's gear intended for that engine was put in goods engine No. 696 (Stratford, 1885; particulars of this engine will be found in back numbers). The new radial tank engines Nos. 790, 791, &c., the express engine, No. 710, and the new goods engines No. 810, 811, &c., all have link motion. No. 710 has valve-chest underneath cylinders, but all the other new engines have valves between cylinders. Mr. Holden's radial tank engines have cylinders 1in. smaller in diameter than Mr. Worsdell's engines.

Could "G. S." kindly supply sketches of new N.E. engines? **A. B. Campling.**

NON-FLESH DIET AND HARD WORK.

[26750.]—THE "Lydney Dispenser" makes a gratuitous assertion when he says that men cannot work hard without flesh. (See reply 60982.) I here copy for his benefit an extract from a work by Sir Francis Mackenzie, of Gaerloch. It was published in 1838, and is entitled "Hints for the Use of Highland Tenants and Cottagers." It is in English and Gaelic. At page 16 it says: "An English contractor for building the Conon Bridge informed me of his surprise at the exertion of the natives whom he employed, and that having contracted for excavating a canal in England, he engaged about twenty Highlanders to accompany him southwards. Several disputes occurred between those thus introduced and the native workmen, and many jeers passed relative to the fare (bread and milk) on which they were contented to exist, saving the greater part of their wages to bring back to their friends and families. To settle these bickerings, a match was made and considerable sums of money betted that twelve of the Highlanders could not excavate a certain number of solid yards in the same time as an equal number of the better-fed Englishmen. And everything being fixed, a table was laid out with meat and ale for one party, whilst the other had no preparation for refreshment beyond what a can of fresh water afforded. But the point in dispute was, after a fatiguing day's labour, decided in favour of the latter; and whilst the former were totally exhausted by their exertions, the latter, full of spirits at their success, danced their national strathspey in token of victory." Besides this example, I can give him the instance of men in the Thames Ironworks doing their work without the flesh of animals, and other cases as well were it necessary. I hope the "Dispenser" will for the future recollect Montaigne's advice and tell only what he knows, and not what he conjectures.

T. R. Allinson, L.R.C.P.

Author of "A System of Hygienic Medicine," &c.

ROAD REFORM.

[26751.]—I ALSO agree with "B. B." as to pleasure in seeing the subject of road reform discussed in the columns of the "E. M."; but I think the advocates of Macadam overlook the fact that there are now, owing greatly to the abolition of turnpikes, ten vehicles on the road, against one in Macadam's time. Also that he did not have traction engines weighing 14tons, drawing loads of 45tons in three waggons, and I think if stones were only 1in. square, they would stand a poor chance against such heavy traffic.

On wide roads, and for the traffic they used to have upon them, no doubt the smaller the material the quicker it became consolidated, and the light traffic went over it much more smoothly; but I don't think that would apply now. I don't mean to say that stones are to be 3in. square; but I think 1in. too small when you take the nature of the subsoil and the formation of the roads. To bring the roads up to a proper state would be a very heavy tax upon tenant farmers, who now have to contribute the greater portion of the cost of maintenance, and surely those people who complain so much about the roads ought to contribute towards the repair of them. **G. F. F.**

HORIZONTAL WINDMILLS.

[26752.]—SEEING that considerable interest exists among our readers in the horizontal windmill, and that doubts of its efficiency are felt by many and expressed by some, I will state a circumstance that took place soon after we had applied the mills to ploughing the land.

Being at Lewes market, a millwright named Midhurst, who had a business at Lewes, asked me why I did not use vertical mills instead of horizontal, stating that a vertical mill of equal length of sweep and 4ft. sail would give off four times the power of the horizontal. I replied that if that were the case I should use vertical; but I doubted it. He then offered to make a vertical mill of that size for trial, and I said, Our mills cost us about £5 each; if you make a mill of the size you mention, and it gives off four times the power of one of the mills we now use, I will pay you £40 for it. If it gives off double the power of our mill I will pay you £20 for it. If it gives off equal power I will pay you £10 for it; but if it does not give off so much power as one of our mills, I will have it for nothing. This was agreed to, and in about a fortnight he wrote to say the mill was ready, and I sent for it. A day of trial was appointed, and he came over to be present.

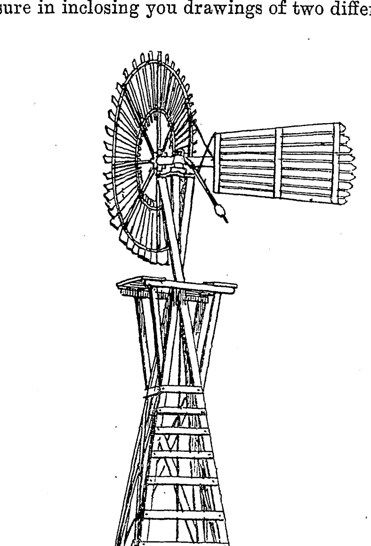
We fixed the vertical mill at the bottom of the piece to be ploughed, and a horizontal mill at the top, the rope to draw the ploughs going through both mills, as explained in the former number. The sails were put on the horizontal mill first, and it drew two ploughs steadily, and at the usual pace of about $2\frac{1}{2}$ miles per hour. The sails were then taken from that mill, and the cloth of the vertical mill spread; but not a motion of the two ploughs could be got. We then took off one plough, and the mill moved it now and then when the wind was stronger than usual, but nothing like the other mill which drew the two ploughs. We then altered the sails, putting only three out of the six on the horizontal mill, and it drew the one plough better than the vertical mill.

I made many experiments with this vertical mill, and from them I have reason to believe that, with equal spread of sail, the horizontal mill is quite equal to the vertical. The mills we used for ploughing had six sails, 6ft. wide and 12ft. high = 72ft. on each sail, making in all 430ft. of sail. The vertical had four sails, 12ft. long and 4ft. wide = 192ft. Of course Mr. Medhurst had no more to say. I gave him £5 for his mill.

Philip Vallance.

WINDMILLS.

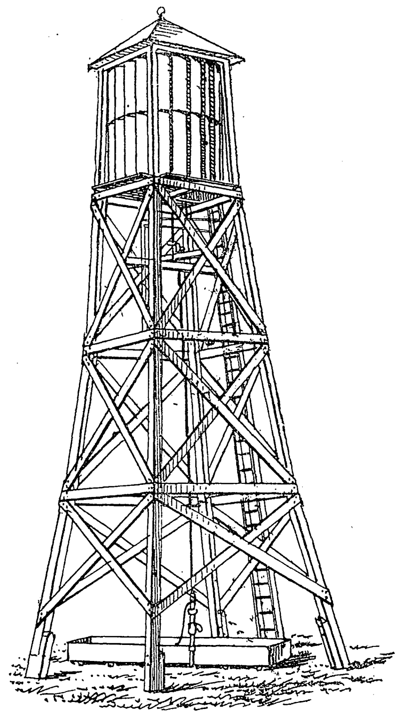
[26753.]—I HAVE observed a good deal of correspondence lately in your paper (which I read regularly) in regard to windmills. I herewith have pleasure in inclosing you drawings of two different



The "Stover."

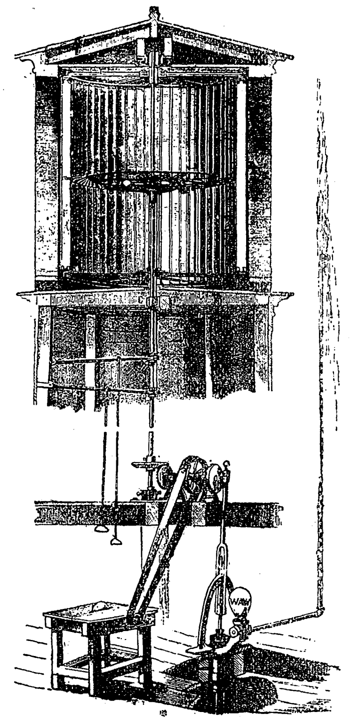
kinds of American windmills, the one named the "Stover," and the other the "Hercules."

The first mentioned is one that I know a good deal about, having had one working on this farm for the last seven or eight years, pumping water for farmhouse, steam-engine, cattle courts, and boxes, &c., and during that time it has given me most entire satisfaction, and it could do a great deal more work than I required of it. This mill is so constructed that if left running, and it encounters a storm or gale, it will quietly turn itself



Open Frame Tower, with 6 × 8 "Hercules" Wind Engine.

partially out of work, by simply presenting the wheel edgeways to the wind, and continue to run slowly, and when the storm subsides will commence working again as usual. My mill is used and made only for pumping, having an up-and-down stroke;



Sectional view of "Hercules" Wind Engine in operation, showing counter shaft and connections for running force pump and buzz saw.

but they are now made also with geared wheels for a rotary motion. In regard to the "Hercules," I don't know so much about it yet; but I am corresponding with a view to get one for drying a meadow by pumping about 500 gallons per minute. I think the principle of this mill is good, something of the "Turbine water-wheel" applied to a wind motor: the wheel is cylindrical in form, with adjustable sails or wings around the periphery of the cylinder. Each sail is pivoted, and attached to the governor, which automatically varies the angle, according to the velocity of the wind. The mill is inclosed in a cupola, around which deflecting boards are placed, which deflect the wind upon the sails; at the proper angle the wind thus exerts its force upon the sails, both at the front and back of the wheel where it enters, and where it leaves. When you do not want the mill to be in operation, by simply drawing a rod the sails are folded around cylinder, and motion ceases.

Æolus.

[26754.]—AS Mr. Albert Collingridge has been good enough to answer my inquiries (p. 434), for which I thank him, I cannot object to answer his, which, indeed, have no discourtesy in them. The age of miracles having passed away for ever, as we are taught, and having some doubts in my mind as to the wonderful doings of horizontal windmills on Mr. Vallance's construction, it seemed to me that the best test of their merit would be the work they were doing in a good breeze of wind. A wind engine so cheap, so powerful, and so portable as it was represented, wanted only to be found pretty generally in use or in demand, to convince the most incredulous of its value. I therefore inquired where I could get a sight of it at work.

We have since heard from Mr. P. Vallance himself—who claims to be the inventor—that it was brought conspicuously before the public long years ago, when two of them accomplished the feat of the seven ploughs as aforesaid at the agricultural show, and had performed wonders in other places as well; but all the answer I can get from those who are acquainted with the machine is that one of them is going to be erected "before long," which, in fact, is quite sufficient, and my curiosity asks no more. The idea of a wooden fly-wheel of that bulk being of any use up in the air if the wind suddenly dropped is rather amusing. It would still have the atmosphere to contend with, and must be going at a good velocity when the wind fell to accomplish half a turn afterwards by its own momentum. A hundredweight of lead distributed among the outer ends of the arms, which would offer no appreciable resistance to the breeze, would, I have no doubt, be much more effective in that way than a ton of wood.

Mr. Collingridge also says "canvas will not do." Not for his machine, possibly; but it does not follow that it may not be the best for a good working horizontal windmill for all that. Mr. Hosken, for instance, on the same page, evidently believes it is, though he frankly confesses that his machine, of which, by your favour, Sir, he gives us a drawing, "does not give satisfactory results." His plan is to use a segment of a boat's fore-and-aft sail, not quite sheeted home, and his difficulty that of keeping the mast in its place without twisting the arm which holds it. How if he prolonged his mast or spar at the end, and carried it as much below as above the arm? He might double his power—the same sheet or rope would do, and the strain in a puff of wind would be equal on both ends of the spar, so that it would have no tendency to wrench what he terms "the crossbeam" to which it is attached, and need not, therefore, be of any inconvenient scantling. But the chief defect in all wind motors, which set their sails at or near a right angle with the arm that carries them, is that every sail as it comes to the point right before the wind, *where the chief pull is wanted*, is comparatively useless, presenting only its after edge to the wind till it jibes, and again settles itself to its work. Mr. Hoskin shows this, in his sketch, by the fluttering rope, and this happens at the precise moment that the opposite arm on the return side comes to its stiffest point of resistance against the wind. Mr. Hosken will, I dare say, hit on some better way of keeping his mast perpendicular than my crude suggestion. The under side of a horizontal wind motor should be free from all awkward projections, especially at its outward extremity.

I avoid points of controversy of no general interest, regarding them as so much trespass on your valuable space. I ventured into your instructive columns to ask for information on a specific piece of mechanism and its variations. Much I have already obtained, and the discussion is not yet exhausted. I believe, with Mr. Collingridge, that wind-power has still a future before it; but I am not sure that the best mode of turning it to account on land has yet been discovered.

London, Jan. 17th. **Raymd. Browne.**

[26755.]—THERE are many fallacies to be noted in the statements of A. Collingridge (26701 p. 434), which may be sufficient to pass unnoticed, as no sane person is likely to contemplate the erection of any such unwieldy affairs?

With regard to windcatchers, as described by P. Vallance in p. 346, I take it that the machine which develops the quickest speed "must be" that one which is capable of giving off the most power, and any one who constructs a model with, say, four arms of any given size upon both systems

and compares results, will find that the vertical is infinitely superior in power to any horizontal, and would not require nearly so strong a framework of any description to resist storms, as would be necessary for such a cumbrous and top-heavy concern. No one need trouble with the idea that it could be induced to run away by any pressure of wind; and will "A. C." (see p. 434, end of letter) explain the statement that "when in work, a part of the weight is taken off the step-brass by centrifugal tendency." The spindle of such a mill could not develop any centrifugal force practically; but were it to develop any conceivable amount, this could not reduce the weight one fraction.

A., Liverpool.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60987.]—**Organ Query.**—I am much obliged to "Uranium" and "T. D." for their replies to above query; but "Uranium" must have overlooked the size of room, as his specification appears to me to be too large. "T. D.'s" specification seems more suited to the room, and if not troubling him too much, would ask him to send a few more particulars of the organ he speaks of—viz., way in which the S.D. bass is placed, depth including keyboard, size of bellows, and if one or two feeders, how blown, any octave couplers, way front is finished off, width of windchest, and sliders on same.—A. C. AND J.

[61048.]—**Electric Conductor.**—I have noticed that your query of Dec. 24th has not been replied to, and as the question is no doubt of usefulness and interest to many readers of the "E.M." I have roughed out an approximate table of size leads, &c., which will, I think, explain itself, and possibly be of service to you.

Dynamo.	Distance. miles.	Size of conductor, B.W.G.	Resistance of conductor.	Difference of potential at dynamo in volts.	Current in ampères.	E.M.F. of line in volts.	H.P. absorbed by conductor.	Sec. area of cable.	Weight of copper in lb.	Loss in volts of E.M.F.
D[1]	1½	19/16	1·0734	300	100	195	13·4	·063	1914	105
D[2]	3	19/14½	1·466	400	150	195	41	·08846	5371	205
D[3]	2	19/16	1·431	345	106	195	21	·063	2552	150
D[4]	3	19/14½	1·466	370	120	195	26·9	·088	5371	175

The current per square in section of conductors is 1,400 to 1,700.

From the table you can, no doubt, work out (by varying the difference of potential at the dynamo and a current) any loss in E.M.F. you wish. The size of conductors given is the smallest advisable for a safe E.M.F., which is within the Board of Trade limits. If you have only a small given load to deal with and require increased speed, you can increase the difference of potential at dynamo, reducing the current and size of conductors. The loss along the line would depend upon its design and construction, which would have to be known before useful calculation could be made. Your maximum could be at maximum load. I regret that pressure of business has prevented me giving fuller particulars and details.—LANCASTER.

[61049.] — **Electric Lighting.** — The only primary batteries that can economically be used to charge secondaries are the Upward and the Lalande-Chaperon. To take your last question first, you will find the reason mentioned in any textbook; but I have never managed to get a Daniell to show it clearly. The action is called endosmose, and is produced by the different specific gravities of the two liquids, and partly by the current. I see you used a Woodhouse and Rawson 8-volt lamp. I have tried them; but now use Edison-Swans only, as they have a higher efficiency and can be overrun with greater safety. You would, in charging the secondaries, have a current of about $\frac{1}{25}$ ampère flowing for 12 hours; but small secondaries have a very low efficiency so that your reverse current would only be about half charging current. Charging, $E - e = 3 - 2 = 1$ volt; resist. of Daniell's about 4 or 5w. $3 \times 4 = 12$w. res. of battery. So $C = \frac{1}{12} + 1$ (resist. of secondary) $= \frac{1}{13}$ ampères; at first when working e increases to 2·25, and res. of Daniells increase to about 6w, so then $C = \frac{E - e}{R + r} = \frac{3 - 2{\cdot}25}{18 + 1} = \frac{{\cdot}75}{19} = \frac{3}{76} = \frac{1}{25}$ nearly, $\frac{1}{25} \times \frac{12}{1} = \frac{1}{2}$ ampère hour, and ampère efficiency 50 per cent. $= \frac{1}{4}$ ampère hour, or the secondaries should light your lamp for about 15 minutes, if it only takes one ampère. If you increased the size of your Daniells, or what is nearly the same thing, converted them into scrap cells, you would lower the resistance, and your charging current would rise. May I ask what size are your accumulators? You should have three or four plates, say, 6in. by 4in. punched with as many holes as possible, and filled with red lead. I am afraid you will never be able to work direct with such small Daniells. To get one ampère you would need to make $R = {\cdot}75$w. per cell, which is far lower than a Daniell even of large size usually is. Why not try chloride or granule cells? I had eight cells working an eight-volt lamp direct, two hours a night for twelve evenings, with one charge and cells untouched.—IOTA.

[61063.] — **Wheat Straw.** — HCl won't touch this. To make straw-paper pulp, the straw is boiled with caustic alkali under pressure, so a simple solution of alkali will not do unless you patiently wait for a long or unknown time.—R. S. T.

[61101.]—**Stars Visible from Bottom of Well.**—Has anyone ever actually so seen a star by daylight? I once looked up a new chimney 200ft. high, and as far as I could judge the light of the sun at the top would as effectually conceal the stars as if I had been in the open. Recollect King Charles and the fish.—DUBITANS.

[61101.]—**Stars Visible from Bottom of Well.**—I must first remind "E. D." of what I said at the commencement of my last reply. With regard to his implied assertion that I had not given "a definite answer" to the original query, I beg to refer him to my first letter on p. 352, which I think he will find a sufficient refutation of his statement. In reply to "E. D.'s" query as to the time of visibility of γ Draconis, I should say offhand that it would first appear at sunset (assuming that the word "daytime" represents the period between sunrise and sunset only) about the beginning of October, and attaining the centre of the field of view 3m. 56s. earlier each day would be last seen at sunrise about the beginning of March.—B. A., Handsworth.

[61112.] — **Do Quartz Crystals Grow?**—"F. C. S." has found out the question, but he has not answered it; unless he thinks that saying that a crystal of quartz would grow out of the mother liquor—i.e., out of water-glass, alias silicate of soda or silicate of potash. If so, he is in error. Crystals are never formed out of water-glass except crystals of soda or potash, when an excess has been used in making the water-glass, as has happened with me. But the pith, if I may say so, of my question is this—Do crystals of quartz grow, or are of sudden formation? It was to raise this question that I stated that the undissolved pieces of a piece of pure Brazilian crystal of quartz did not show any shape, as the large crystal had been built up of smaller ones. All the pieces were smooth. Again, if you take a piece of pure crystal of quartz and break it, the fracture is conchoidal like the fracture of a flint, which is crystalline and not a crystal —i.e., has no definite shape. But take a piece of Iceland spar and break it, and you will find it will split up into perfectly-shaped crystals, and each fractured piece will again split up into perfectly-shaped crystals. Take another illustration—sulphur, the crystals of S are needle-shaped—seldom seen, but easily gotten by melting some sulphur in a pot, and then when partly cooled down, pouring out the still liquid S. Again, take bismuth; the crystals of this (the origin, I believe, of the Greek pattern put as a border to a ground glass window) are formed like sulphur; at least, I should say, can be obtained like S crystals by melting and pouring out when partly cold. Can these crystals (bismuth) be formed by growing, i.e., by continual addition? Does not their shape lead to the conclusion that they are formed suddenly to their complete form (a crystal). Perhaps "F. C. S." will tackle the question and enlighten us, and not simply indulge in a sneer.—R. S. T.

[61117.] — **Horse's Action.** — The horse is trained to lift his feet by fitting them with heavy shoes, or by securing lead plates to the front portions of ordinary shoes. Youatt on "The Horse" (Longmans, 7s. 6d.) is a standard book, and will probably suit you. I do not think there is one which explains the training of trick horses.—NUN. DOR.

[61125.]—**Cobalt.**—You may perhaps find what you require in the late Mr. Phillips's "Metallurgy," or in Payen's "Industrial Chemistry." Metallic cobalt is rarely (if ever) employed in the arts, but it is used in some alloys, and when required is generally obtained by what are known as laboratory processes.—F. I. C.

[61128.]—**Paper Valve.**—The paper does pass over the reeds, but they are so placed (vertically) that the tongues are free to vibrate. What is it this querist means?—GRAY'S INN.

[61131.]—**Electric Cautery.**—I can appreciate "Ohm's" remarks in issue of Jan. 14th. A surgeon lately asked me for a battery to—1st, Light small lamps; 2nd, heat cautery; 3rd, work a coil; 4th, charge small accumulator; 5th, electrolyse superfluous hairs (*vide Lancet* a few weeks ago), and was surprised I could not produce a portable set guaranteed to do the above. The reason A. Dunlop Stewart, M.B., &c., cannot be satisfied is, I expect, that, like many others, he does not know the theoretical basis of the applications of electricity, and, therefore, does not perceive he is asking too much. A friend of mine uses a cautery often, and finds it very handy, the current required being 12 ampères, which an 11 S.E.P.S. accumulator gives easily. One charge of the secondary is sufficient for 25 or 30 cauterisations. I am afraid it would take three or four large bichromes in parallel to work the cautery properly, as even in four and a half seconds a bichrome falls off measurably; besides, the first rush of current would be apt to burn the cautery and fuse the point. A secondary gives a steady current, and is so much cleaner and handier. There is, of course, no use putting cells on in series when the external resistance is only ·06 w. By the bye, what 5-volt lamp of 10c.p. does "Ohm" refer to? It will bear pretty heavily on the battery if it takes 6 ampères. 10c.p. at 3 watts per 1c.p. = 30 watts per 10c.p., and $E = 5$ volts $\frac{30}{5} = 6$ ampères. I believe S. Bottone's instruments, though without high finish, are rough, good, and easily used—being simple, do not get out of order. An ammeter and voltmeter, one or two secondary cells, and Sprague's "Electricity" should show Dr. Stewart out of his difficulty.—IOTA.

[61131.]—**Electric Cautery.**—The cautery Dr. Stewart refers to has a resistance of ·06 B.A. ohm cold, and before using was made of No. 22 platinum wire; but was filed and hammered, so that now it is impossible to say what dia. the wire is. The point was fused and then filed thin, but when tested the cautery took 12-15 ampères to work it. By far the best means to work the cautery would be a cell or two of E.P.S. accumulators: the size giving 8 ampères' discharge with two in parallel would work it well. A larger size would sustain the action better, and not need to be so often charged. Current is always what we need; but if the resistance of an instrument is high, we need a high E.M.F. to produce a sensible current. Ohm's law $C = \frac{E}{R}$ shows the ratio in its simplest form. The resistance does not define the current required to heat the cautery to working point, as a short, thin, or a long, thick wire may have the same resistance; and the same current will make the one very hot, but hardly affect the other. An ammeter is the only practical way to measure the current, as it does not flow long enough to allow of electro-deposition. I can recommend S. Bottone's, as I use one myself, and it does my experimental work splendidly. The price of Sir W. Thomson's, about £15, is prohibitory, and Sprague's is only of use in a laboratory, far too complicated and fidgety to use in a hurry or for general work. May I ask, Does Mr. Conry recommend Leclanche's for cauterising, and how long are they expected to work? Not only Dr. Stewart, but a great many amateurs, would be much obliged I know for instructions how to make a reliable long-range ammeter and voltmeter, as it would allow of accurate calculation in much of what at present is guesswork. The good ammeters generally are rather dear, and many amateurs have spare time to devote to practical work if they only knew how to proceed.—CAUTERY.

[61131.]—**Electric Cautery.**—TO "OHM."—I fear our worthy correspondent, "Ohm" must have been in the grip of the fiend of indigestion when he wrote his communication as above in last week's number, for to the extent of half a column of the "E.M." he rails at Mr. Dunlop Stewart, myself, the medical profession, and things generally, and winds up without having in the slightest degree elucidated the question, except by the information that Mr. Stewart could do what he wants by the aid of three large bichromate cells—a matter that Mr. Stewart never inquired about. Probably Mr. S. could produce a whole battery of cells that would give the necessary current; but what he asked about was the exact current that would be required for his purpose. Prithee, kind sir, be a little less hasty in your denunciations. I never said I had had much experience in the heating of wires. I even expressly told Mr. Stewart that I should prefer to ascertain the required current by simple experiment, and measure it afte-

wards. Furthermore, the "elaborate formulæ" I quoted are, as I mentioned at the time, not my own; but are those of Mr. Sprague and Messrs. Munro and Jamieson, and as to specific heat and weight of wire having nothing to do with such matters, I think Mr. Sprague would say different. I make no apology for quoting undoubtedly "elaborate" formulæ, because (if "Ohm" will please notice) Mr. Stewart had specified that he was no novice in electrical science. "Ohm" further goes on to prove my deficiencies by data derived from an experiment of his own, the accuracy of which we have no means of ascertaining. Having thus begged one half the question, he betakes himself to an "elaborate," formula, and starts forward bravely to prove the remainder. Even Mr. "Ohm's" personal capacity as a judge is not unquestionable, since he has not the sufficient courage in his own convictions to write over his own name. As to the Leclanché jars which "he would like to see," if he will forward me the necessary cash to cover cost of procuring or making same, he shall not only see them, but have them. What would "Ohm" say to incandescent lamps being actually lit by Leclanchés, and for 20 minutes right off?—a thing I have seen and can do any day, as any practical battery maker can. Lastly, considering that Mr. Dunlop Stewart required the "exact" current, why does Mr. "Ohm" twaddle about ammeters at 5s. a-piece? He ought to know perfectly well that such very cheap instruments cannot be expected to "exactly" measure any current, let alone one so small as a current for a cautery. If "Ohm" has any real information to give, why did he not give it when Mr. Stewart first wrote, instead of leaving it to incompetent individuals like myself to tackle the subject? I asked Mr. Stewart for a particular item of information which, as far as I know, he has not yet furnished, but I will look back again and see. There is but one assertion of Mr. "Ohm's" to which I can subscribe, but which I agree to with pleasure, and that is where he says that a few hours spent in the perusal of Mr. Sprague's admirable work would be well repaid. —EDWARD CONRY.

[61138.]—**Yacht Steering.**—Why not have a wheel, or try one of the patent steering gears?—H. G.

[61145.]—**Does it Boil?**—TO "W. A. S. B."—I understand you to raise objection against view that vaporisation is a case of solution, your plea being, that process goes on more actively under air rarefied. If you refer to ebullition brought on by exhaustion of air, such evidence does not touch issue. Do you, however, really mean that water, even when so cold as not to boil at reduced pressure, will evaporate faster in partial vacuum than in natural air? Please understand query centres on evaporation below boiling-point. If you now complain of me for not having maintained "solution hypothesis at first," *vide* original query, p. 333, last three lines.—WEALD.

[61145.]—**Does it Boil?**—I have read with interest the numerous answers to this query; but I do not consider that any of them fully explain it. All of them state that water evaporates at all temperatures. This is a matter of fact which Mr. Weald knows well enough; but what he really wishes to know, if I mistake not, is the scientific explanation of this fact. A liquid consists of an aggregate of molecules whose mutual attractions restrain the individual molecules within the mass, although they are free to move among themselves. A molecule, in the midst of the mass, moves freely, because the attractions are equal in all directions, but a molecule near the surface is in a very different condition. As it approaches the surface, the attraction towards the mass of the liquid becomes greater than the attraction towards the surface, and when it reaches the surface the whole force of the inward attraction is pulling it back, and, unless the moving power of the molecule is sufficiently great to overcome this force, its motion is arrested, and it draws back on its course. It may happen, however, especially when heat is entering the liquid, that some of the molecules, through the effects of their mutual collisions, acquire sufficient energy to fly off from the liquid mass, and hence result the well known phenomena of evaporation. "When a pool abates its level," of course, the water vapour dissolves in the air; but it is not precisely similar to the solution of sugar in water, for water evaporates at a greater rate in vacuo than in air.—A. E. F., Manchester.

[61145.]—**Does it Boil?**—I venture to think that the idea of the steam "displacing" the atmosphere is proving a stumbling-block to "Weald." I take it that the steam only displaces the air in something the same sort of way that claret in a tumbler is displaced by letting water run into it from a tap. The wine and water mixing, both run over together, and the proportion of wine constantly diminishes till it practically disappears. This is quite a different process from the displacement of the water in a pump cylinder by the intrusion of the plunger. "Weald" must realise that two gases in communication with each other mix completely, whatever their relative pressures and densities may be, so that the displacement of one by the other is a question of quantity rather than of pressure. It requires a wonderful deal of thinking to get any clear ideas into one's head concerning such impalpable bodies as gases. I find it a great help in trying to realise unfamiliar aspects of familiar things to learn about the corresponding phenomena of a less homely nature. In this case other gases behave in analogous ways, and the demonstration of the fact is a marvellous triumph of experimental physics, and the study of it throws great light on our every-day kettle-boiling, if we will be at the pains to consider it. Yes, it seems that nature does forbid water and other liquids to be heated beyond certain points, varying with the pressure, without passing at once into vapour, for every particle of water that attains that temperature at once flashes into steam if it be in an open vessel. If the vessel be closed, temperature and pressure rise together. It will not do to regard the atmosphere above a pan of heated water as acting like a lid that has to be lifted to allow the steam to escape. Neither does it do to rely on "solvent action" as an explanation of vaporisation. Recurring to books, I think that one reason why people often find them unhelpful is that when for any reason they fail to get the meaning out of the words they cannot question the author and get him to use other words. I find that in such cases reading another book differently expressed often clears away the mist. The objection itself is as old as Socrates.—W. A. S. B.

[61145.]—**Does it Boil?**—With reference to this query the following extract may be of interest. "Among the many extraordinary natural phenomena attending the recent eruption of Mount Tarawera, one which appears to me not the least singular, says a correspondent of the *New Zealand Herald*, has been passed over in comparative silence, and without exciting comment among the scientific or unscientific public. During the last week those attending Mr. Burton's interesting lectures have heard there related one of the strange and so far inexplicable circumstances witnessed by Mr. McRae and others of that devoted little band, to whom it must have seemed that hell itself had opened to destroy them—I allude to the fact of their being unable to make water boil on that terrible night, when earth itself appeared to be in a state of ebullition. Mr. McRae says:—'I made George Baker, the cook, put some water on the fire to make cocoa for the women, who were cold and shivering, poor souls, though holding up grandly. About three-quarters of an hour afterwards he met me in the passage and said to me 'Come here, sir.' 'What is it?' said I. 'I can't get the water to boil,' he said. 'Tut,' said I, 'poke up the fire.' 'It's a good fire,' he replied; and so it was, a glowing fire of blazing rata logs—a splendid fire. 'Put your hand in there and feel it,' said he, taking the lid off the boiler. I did so—very gingerly, I assure you—and found the water as cold as when he put it on. There were so many extraordinary things happening around me that this particular one did not excite my wonder very much. I thought it was owing to the electricity in the air. George Baker can vouch, as well as myself, for the fact of the water having been on the fire for three-quarters of an hour, and at the end of that time being as cold as when it was put on. We spoke of the circumstance to the others at the time as being curious, but soon had matters more serious to distract our attention." Now, surely, here is a natural phenomenon worthy the investigation of all our scientific men, not only in New Zealand, but throughout the civilised world. We, of course, all know that the greater the atmospheric pressure the greater the number of units of heat required to make the water boil; but some other deterrent cause must have been at work in this instance, as after having been placed for three-quarters of an hour on a good fire the water remained absolutely cold. What other cause was there? is the problem I suggest to our scientific men as one well worthy of their research. —ALEX FRASER.

[61150.]—**Hydraulic or other Press.**—Any maker of hydraulic presses will supply what you want. See their catalogues.—E. G. M.

[61153.]—**Blowing Fan.**—The density of a fan blast is usually given in "ounces per inch." Divide the velocity of the fan tips in feet per second by 4; square the result, and then divide by the product of the diameter of fan in feet by 120. The pressure in pounds per square inch is usually found by squaring the velocity of the fan tips in feet per second and dividing by 97,300. To find the cubic feet delivered per minute write—

$$C = \frac{v\,a\,k}{2{\cdot}6},$$

where a = area of outlet in sq. in., v velocity in ft. through a, and k a co-efficient varying slightly with temperature, 1·01 for 37°, 1·1 for 82°.—H. N.

[61152.]—**Spanish.**—The grammar you have is a good one; but for learning a language quickly there is nothing like the Hamiltonian system, as it is termed—that is, interlined translation. I mean, of course, for those who want to learn—not for schoolboys.—TUTOR.

[61155.]—**The Pantanemone.**—I have not seen any reply to this query yet, although it refers to a windmill which, if I recollect, several of your readers were going to make. The only reports of its performance were in model form; but now that we have a discussion on horizontal windmills it may be interesting to ask what about the Pantanemone. I am inclined to think the "horizontal" will beat it for work done and durability, although as the pantanemone might have steel wire for strengthening, it would be much lighter. That seems its chief recommendation. See Nos. 504, 510, and 511 for some suggestions.—SAML. RAY.

[61190.]—**Differential Feed.**—While thanking "T. C., Bristol," for his reply to this query, I beg to say that I inadvertently omitted to state that screw was left-handed. How does this alter the case, and what wheels would cut 3 threads and 4 threads per inch, and a pitch ·148in. respectively, with a screw 4 threads per inch? What alteration does the introduction of 1, 2, or more intermediate wheels make: must there be always an even number of intermediate wheels? I would feel obliged to "T. C.," or any other of our able correspondents, for information on the above; and no doubt it will be interesting to a large number of our engineering friends to see the question of differential feeds clearly demonstrated.—A BELATED FOREMAN.

[61234.]—**Bursting Pressure.**—I can hardly think that the evident error of 14476 × 2 = 28952 which is given as 22952 can be the error to which you draw attention; but I can see no other, as the movement is in proportion of 14476 to 1. Kindly say where you believe I am wrong.—T. C., Bristol.

[61233.]—**Permanent Way.**—"Holland" is not quite correct in stating that the only rails in use on the Continent are flat-bottomed. Last September I travelled over the Western of France, from Havre, via Paris, to St. Malo, altogether about 450

FIG. 1.

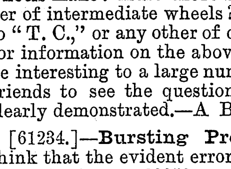


FIG. 2.

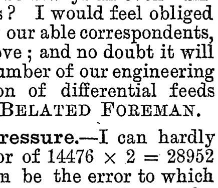
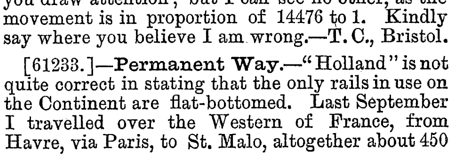


FIG. 3



miles. Throughout this length I did not notice a single length of flat-bottomed rails, except on some single branch lines and state lines. The double-headed rails and chairs have evidently been in use some time, and are short and light except in newly-laid places. The sketches below show the method of laying and fishing rails on several leading

FIG. 4

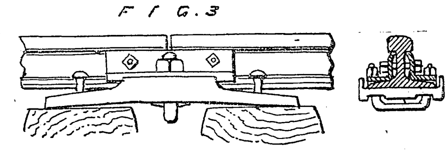
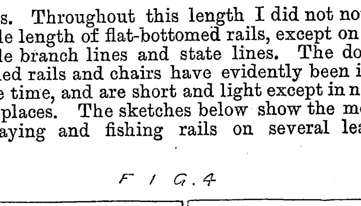


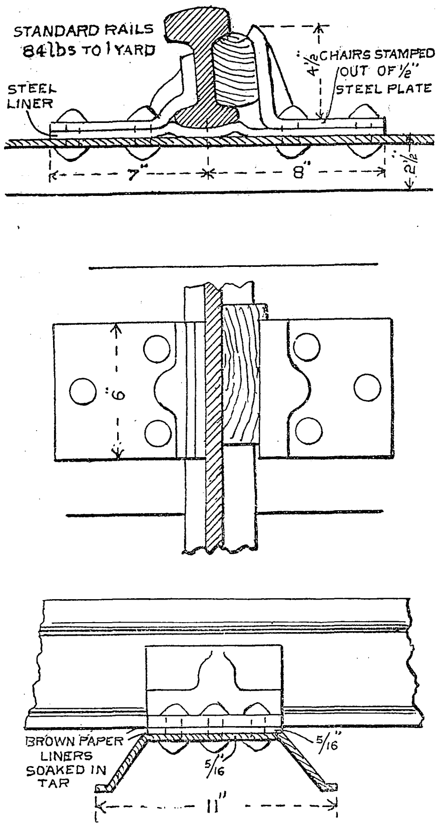
FIG 5



American lines. Fig. 1, Leigh Valley Ry., 66lb. per yard; Fig. 2, Pennsylvania Ry., 60lb. per yard; Fig. 3, the "Fisher" rail joint in use in America; Fig. 4, West Shore Railway method of joining rails (N.B.—The joint of one rail s laid opposite the centre of the other. Number of sleepers, 2180 to one mile of single rail); Fig. 5, standard rail 67lb. per yard. There is, I believe, much difference of opinion

over there as to whether suspended or supported joints are best. The supported joints were adopted in making the West Shore line, which is the first trunk line in America which has been built from

FIG. 6



the outset as a double line, with easy gradients and few sharp curves. The same joints have now been adopted on the New York Central. I also inclose a diagram of Webb's steel road, as in use on the L. and N.W.R. (Fig. 6).—NO NAME.

[61274.]—**Portable Battery.**—A very good battery for ordinary testing purposes is the Insulite. The smallest size goes into the pocket easily, and there is no chance of spilling the liquid. Besides, one advantage is that the resistance is much less than that of a so-called dry battery. I use one having a cork tightly squeezed into the charging hole, and then made a small hole—sufficient to let gas escape, but too small for the liquid to spill—in the centre of it with a red-hot wire. With a horizontal Trouvé detector, it works well, giving 5° deflection through 10,000w. Insulation tests are easily taken with this portable apparatus. If galvanometer is shunted it reads from ·05 ampère to 2 ampères. A month or two ago there was an article on "A Dry Battery," by a Mr. Roberts in the *Electrical Engineer*, but since then I have heard nothing of it. Does anyone know what it is or where it is to be had? It has a total capacity of 20 ampère hours, so it might suit the needs of this querist?—IOTA.

[61274.]—**Portable Cell.** —"Ohm" ought to know better than to recommend anybody such an antiquated and clumsy affair—a thing that would begin to "creep" before it had been three days in use, and would drive its possessor wild through every now and then drying up and giving no deflection at all, and would bewilder any experimenter by the eccentric results it would give frequently by total or partial evaporation. If anybody wants a portable cell for testing, let him take the following: Make a small rectangular box (1½in. by 2in. is a convenient size), get a small Leclanché or other carbon (arc-lamp carbons will do) with either a leaden head and terminal, or a brass clamp, and strap to the face or faces of it one or more "agglomerates" (hard blocks of peroxide of manganese, which are made in all sizes) by a couple of elastic bands. Line the box with sheet zinc, having the necessary terminal; amalgamate the zinc well, and then place the carbon, with its agglomerates, in the middle, and pack it round carefully with the following mixture: Powdered sal-ammoniac two-thirds; plaster of Paris one-third, or a little less by bulk. Spoon the mixture in small quantities into the cell, drop a little water in, and mix it up thoroughly with a piece of stiff wire, putting some of it under the bottom of the carbon, so that it touches nothing but the mixture, which swells rapidly, and sets in a few minutes, and you have a thoroughly good testing cell, which will last for many months, if well made, and of E.M.F. 1·42. The action, on closing the circuit, is (1) an electric current caused by (2) sal-ammoniac attacking zinc; H liberated, which combines with the O of the MnO_2 (agglomerate) to form H_2O—i.e., water, which thus keeps the cell wet enough to work without anything running out, and the mixture, being porous, allows of the free escape of the gas, that proves so troublesome in hermetically sealed cells (e.g., Clarke's chloride of silver and others), while there is no loose liquid to run out, the water being generated in exact proportion to the electrical action—i.e., to the need for it. The whole affair may be only the size of a pepperpot. Cast zinc cases, if procurable, are still better, and save all trouble of making a case; but the zinc must be cast, not soldered. They are also very cheap in cost.—EDWARD CONRY.

[61293.]—**Compound Loco. on Cal. Ry.**—"Rover" is entirely misinformed as regards above engine. It is not a compound engine; it has the Bryce-Douglas valve motion, which is just light enough for the work it has to perform—hence the breakdown. The fault lies with the Cal. Ry., not with the builders, who turned out a first-class job, according to drawings supplied by Mr. Drummond. —ONE WHO KNOWS.

[61295.]—**Turning Slate.**—Yes, carbonado is dear; but everlasting, so to speak. It will cut anything, and does not seem to wear.—R. S. T.

[61299.]—**Capricious Dynamo.**—The statement made by "Selim" leads one to think that "Miller" was right in his conjecture as to the probable cause of the defect in his dynamo. If the series coils had been of such small proportions that the machine would have worked satisfactorily without them, the polarity would not have been reversed. Evidently the fields are wound with too large a proportion of series wire. In case the polarity is again reversed, "Selim" might try rewinding the field magnets as a shunt, and discarding the series coils altogether. Very probably the gauge of wire at present in use for the shunt coils would not answer very well, as the additional wire would increase the resistance to such an extent (in comparison with that of the external circuit) as to prevent the fields from being properly magnetised. If "Selim" measures the res. of the present shunt coils, and uses a thicker wire in the new ones, so that their resistance about equals that of the present coils, he can't be far wrong.—J. H. H.

[61302.]—**Billiard Tables.**—The difference in championship tables is that pocket openings should not exceed 3in. in the most narrow part. The championship table does not otherwise differ, except in size of pocket openings, from usual. The ordinary table varies from $3\frac{5}{16}$in. to 3½in. in pockets. Tables for private use should be slightly smaller than if intended for public use (in the pockets). Size of slate bed top (this is the measurement always taken) 12ft. by 6ft. 1½in. equalling 11ft. 8in. by 5ft. 9½in. from point to point of cushion.—J. ASHCROFT, Liverpool.

[61310.]—**Electricity for Killing Dogs.**—A man is better than a dog or a cow; but that is no reason why, if for man's benefit, the dog or cow has to be killed, it should not be done in the least painful way consistent in the case of a bullock with the flesh being good to eat. Let W. J. Grey use his pen to assist men and women, and he will find plenty to follow suit.—R. S. T.

[61319.]—**Photographic.**—TO "BOBADIL" AND G. EDWINSON.—The gold terchloride should be rendered perfectly neutral by driving off all excess acid. This should be done at a lower temperature than that employed in an earlier part of the evaporating process. When the acid solution has been evaporated down to a dark red thick liquid, it should be frequently made to flow around the sides of the capsule, and allowed to dry there, forming a mass of dark red crystals. Free acid left in the solution will cause a loss of gold and cyanide. Watts is right in advising a correction with a few more drops of terchloride solution.—GEORGE EDWINSON.

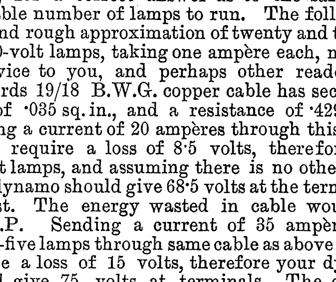
[61324.]—**Hardening and Tempering Small Saws.**—Saws for cutting the slots in screw-heads are often made of a steel that does not require hardening or tempering, the warping being consequently avoided. You had better use the same kind.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[61327.]—**Potentiometer.**—TO "SIGMA."—For accurate results (accurate, of course, subject to the definition of what value of volt is used) the standard cell and the battery producing a current are both necessary; but for approximate measures the plan referred to will answer well enough; its uncertainty is due to the fact that the E.M.F. of the Daniell cell is variable, and that unless the resistances are large, the experiment itself tends to disturb the E.M.F. I have frequently used a plan closely resembling the one proposed: Take 1, 2, or 3 cells, according to degree of force to be measured, and close their circuit through a total resistance, including that of the cells, a thousand times as great in ohms as the acting E.M.F. in volts, so that a current of one-thousandth of an ampère passes. In these conditions we can take any part of the resistance which is divided out, and if we connect to the two ends the wires from the E.M.F. to be measured, be it a cell or part of a circuit, with a large resistance and a delicate galvanometer, shifting one connection along the resistance until the galvanometer shows no current, we have two equal E.M.F.'s opposed (of course making the connections so as to oppose them). Now the ohms of the interposed resistance will be the measure of the E.M.F. (or a thousand fold) which is employed in driving current through that resistance; thus another Daniell would take a space of 1,075 ohms interposed to show no current. —SIGMA.

[61330.]—**Legal.—Bad Dry Plates.**—I can sympathise with J. W. Elphee in the matter of bad plates, and so can all photographers who do not use quantity enough to entitle them to buy direct from the makers. Most dealers will exchange a box of plates, if it is unbroken; but I do not think they could be compelled to do so in a court of law without a great deal of trouble. For instance, you complain of loss of sensitiveness. In whose hands can you localise this loss; was it in the makers, or the carriers, or the dealers, or your own? Again, what is the standard of sensitiveness, and does the maker, or dealer, profess to sell them as possessing this or any other standard.—B. SC. (and Solicitor), Plymouth.

[61331.]—**Electric Light.**—Providing they are not of such very low resistance as to absorb a large current, and that your dynamo will give you a little higher E.M.F., you can certainly run more than twenty 20c.p. lamps on a 19/18 B.W.G. copper cable. I should say you could safely run up to 30 or 35 lamps. You should have given the E.M.F. of the dynamo, and E.M.F. and C. required by the lamps, for a correct answer as to the safe and advisable number of lamps to run. The following safe and rough approximation of twenty and thirty-five 60-volt lamps, taking one ampère each, may be of service to you, and perhaps other readers:—600 yards 19/18 B.W.G. copper cable has sectional area of ·035 sq. in., and a resistance of ·429 ohm. Sending a current of 20 ampères through this cable would require a loss of 8·5 volts, therefore for 60-volt lamps, and assuming there is no other lead, your dynamo should give 68·5 volts at the terminals, at least. The energy wasted in cable would be ·215H.P. Sending a current of 35 ampères for thirty-five lamps through same cable as above would require a loss of 15 volts, therefore your dynamo should give 75 volts at terminals. The energy wasted in cable would be ·7 H.P. If you use higher resistance lamps, the conditions will, of course, be more favourable. You can, I think, from the two approximations choose the number of lamps you would wish to increase to. I have tried to make it as plain as possible under pressure, and shall be pleased to give you any further information you may wish. The breakage of filaments was, no doubt, from fault in carbon or jointing, or over running.—LANCASTER.

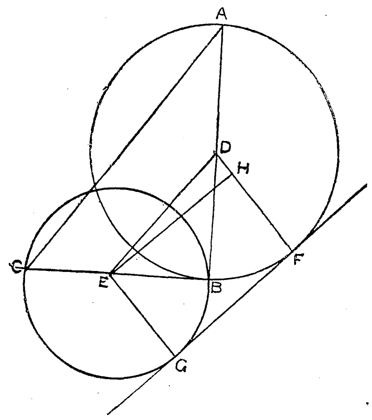
[61336.]—**Geometrical.**—Let A D C, B E C be semicircles described on A C, B C, the side of a right-angled triangle; O, P, their centres, D, E the points of contact of the common tangent D E. Join O D, P E, and O P, and draw P F parallel to D E. Then F P is equal to D E, and F D to P E; therefore, F D is equal to P C, and since O D is equal to O C, O F is equal to O C − C P. Now, in the right-angled triangle O F P,



$$F P^2 = O P^2 - O F^2;\ \text{but}\ O P^2 = OC^2 + C P^2;$$
$$\text{and}\ O F^2 = (O C - C P)^2 = O C^2 + C P^2 - 2 O C . C P.$$
$$\therefore F P^2 = 2 O C . C P;$$
$$\text{or}\ D E^2 = \frac{A C . C B}{2}.$$
$$= \text{area triangle } A B C.$$—MILVERTON.

[61336.]—**Geometrical.**—Let A B C be the given right-angled triangle, and D and E the cen-

tres of the circles described on A B, B C, the sides containing the right angle. Let G F be the common tangent to these two circles, and draw

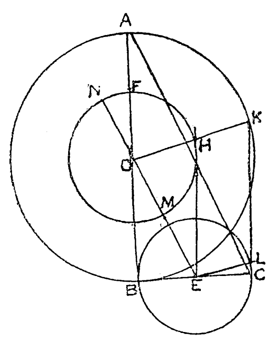


E G, D F, and E H parallel to G F. Let D F = R, and E G = r. Then we have—

$$D E^2 = R^2 + r^2,$$
$$\text{and } D E^2 = D H^2 + H E^2 = (R - r)^2 + G F^2$$
$$\therefore R^2 + r^2 = (R - r)^2 + G F^2;$$
$$\text{or, } R^2 + r^2 = R^2 + r^2 - 2 Rr + G F^2;$$
$$\therefore G F^2 = 2 Rr.$$

Now, 2 Rr is evidently the area of the triangle A B C. Hence the square on G F is equal in area to the triangle A B C.—J. E. GORE.

[61336.]—**Geometrical.**—Let A B C be a right-angled triangle, B being the right angle. Let circles be described on A B and B C as diameters. The square on the common tangent to these circles is equal to the triangle A B C. Bisect A B and B C in D and E. Make A G = B E or E C. With D as centre and D E as radius, describe a circle, and from E draw a tangent meeting it in H. Produce the line D H to meet the circle on A B in K. Draw E L parallel to D K to meet the circle



on B C in L. Join K L. K L is a tangent to the circles on A B and B C. Join H E. H K is equal and parallel to E L, K L is equal and parallel to H E, and the angles at L and K are right angles. ∴ K L is a tangent to both circles. Join D E, and let it cut the circle N G H M in N and M. Then, since H E touches the circle N G H M, H E² or K L² = N E. E M = (D E + D N) (D E − D N) = (D E² − D N²) = (D B² + B E²) − (D B − B E)² = 2 D B. B E = A B × $\frac{B C}{2}$ = area of triangle A B C.—*Q. E. D.*—J. C. KELLY.

[61341.]—**Colouring on Parchment.**—This is one of the most trying and difficult jobs an architect or surveyor has to contend with, and requires considerable practice before a large surface of parchment can be coloured a nice even and level tint. The colours should not be dark, and Prussian blue avoided altogether, as it dries too quickly and in patches. After inking in the plan, start colouring at the top, with your parchment on an inclined plane; use a medium-sized brush and fairly well filled with colour, so that the lower edges will not get dry before you can follow on; get over the work as quickly as possible, always taking care not to get the brush dry; keep a piece of blotting paper under your hand ready to empty the brush when getting close to the bottom of your work, and finish off with a half-dry brush round the bottom lines. No damp should be applied to the skin before colouring, neither should it be too dry. The least drop of liquid ox-gall (see Sale Column last week) mixed with the colour makes it flow better and more evenly over the greasy parts of the parchment. Further instructions are given for colouring on parchment, ivory, &c., with the above ox-gall.—ARCHITECTUS.

[61345.]—**Pneumatics.**—There is an important omission in this query. The sectional area of the large gasholder at water level should have been given; also the contents of the small holder are too small, as it will be found that if the sectional area of the larger holder is more than 23 sq. ft., the problem is impossible to solve. If a volume of gas, represented by V cubic feet at the pressure of the atmosphere, is compressed into a space of C cubic feet, we get by "Boyle's Law" the proportion—

$$V : C :: 15 + P : 15$$

P being pressure per square inch on the interior of the close vessel, and 15lb. being the atmospheric pressure, from which we get $V = \frac{C\,(15 + P)}{15}$. The contents of the large holder are 200 cub. ft., call this C; the pressure 5lb., call this P; the pressure in the small holder 5¼lb., call this p; when the two are connected, the pressure will be 5¼lb., or p in both, under the circumstances stated in the query, and we require to know how many cubic feet must pass from the small to the large holder in order to produce this equilibrium. Call this quantity n cub. ft. at pressure p. Now, if this n cub. ft. were allowed to expand to atmospheric pressure, and also the C cub. ft. to expand to the same pressure, and the two added together, the volume (call it V′) would be from the equation given above—

$$\frac{n\,(15 + p)}{15} + \frac{C\,(15 + P)}{15} = V'.$$

Now, suppose the water in which the large holder floats to become solid (as it well might in this weather!), then suppose V′ to be compressed into the space C above the water in the large holder, we get

$$V' : C :: 15 + p : 15,$$

V′ having taken the place of V, and p that of P. Restore the value of V′, and form an equation, and after reduction it will be found that $n = \frac{C\,(p - P)}{15 + p}$, which represents the number of cub. ft. of gas at pressure p, which have passed from the small to the large holder to produce a pressure p in both. Now suppose the water to become liquid, the extra pressure of p − P, or ¼lb., will force the water down; and as every lb. of pressure on the square inch would force it down about 2ft., the extra pressure of (p − P) lb. would force it down 2 (p − P) feet. This, multiplied by the area A, will give 2 A (p − P) cub. ft. as the additional space in the holder caused by the extra pressure. As this space is to be filled with gas at pressure p of the small holder, we get 2 A (p − P) cub. ft. of gas at pressure p, which passes from the small to the large holder, and this must be added to the value of n found above, so that the total cub. ft. which pass from one holder to the other is represented by

$$(p - P)\left\{\frac{C}{15 + p} + 2\,A\right\}$$

Not having been given the value of A, I cannot work this out numerically; but it will be found that if A is made equal to 23 sq. ft., there will be no gas left in the small holder.—M.I.C.E., Bath.

[61346.] — **Cementing Lenses.** — Canada balsam has always a yellowish tint. Dilute with chloroform if it is too thick. You will require some practice before you can cement a 3in. lens without air-bubbles.—B.SC., Plymouth.

[61348.]—**Length of Chord.**—The following will give the chord (where arc and radius are given), approximately without using mathematical tables:—

$$\frac{c}{2} = \sqrt{(2\,R - V)\,(V)}$$

$$\frac{c}{2} = \sqrt{2\,R\,V - V^2}$$

$$\frac{c}{2} = \sqrt{2\,R\,\frac{0{\cdot}13\,L^2}{R} - \left(\frac{0{\cdot}13\,L^2}{R}\right)^2}$$

When c = chord, R = radius, L = length of arc, and V = versed sine.—DUD. DUDLEY.

[61348.]—**Length of Chord.**—ERRATUM.—By some unhappy chance, in the answer given to this question on p. 439 the coefficient of the series has been omitted. The answer should be:—If D be the diameter of the circle, and A the length of the given arc, then the length of the chord

$$= A\left\{1 - {\cdot}1666\left(\frac{A}{D}\right)^2 + {\cdot}00833\left(\frac{A}{D}\right)^4 - {\cdot}0002\left(\frac{A}{D}\right)^6 + \&c.\right\}$$

To use this formula, A should not be much greater than D; if A is not greater than D, three terms might be sufficiently exact in ordinary cases.—MILVERTON.

[61352.] — **Lantern Exhibition.** — I should think three hours too long for an exhibition; from one and a half to two should suffice. Five to six dozen slides would give a good entertainment. I have one slide that would take twenty minutes itself to describe; others that would take from one to five minutes. As to what subjects are most suitable, you should be best able to answer that yourself: much depends on your own taste, aim, and object in exhibiting, also audience—adult or junior. "Many men many minds." If you wish to enforce temperance principles choose temperance subjects; if religious, Bible subjects, "Pilgrim's Progress," &c.; and so on. Any slide maker will send you a list, in which you will find subjects to suit all tastes. I cannot give definite information about "litho. lantern pictures." I thought these were supplied ready made only. You can purchase chromo transfer pictures and put them on glass yourself (full instructions accompany sheets). They do not make very good slides; but being coloured please children very well. I have a number of them which I exhibit with an oil lantern. I do not think they would answer so well with limelight, as the defects would be too well seen. Further advice, if desire, by writing to—R. BARCLAY, Gariochsford, Forgue, Huntly.

[61353.]—**Spirals.**—If the equation of any spiral showing the nature of the curve and the co-ordinates of its extremity be given, then its length, as compared with a straight line, can be found either exactly or approximately. If the equation be given in polar co-ordinates, the length of the curve $= \int (d\,r^2 + r^2\,d\,\theta^2)^{\frac{1}{2}}$. For example, take the spiral of Archimedes, which is a curve in which the radius vector varies directly as the vectorial angle. Its equation is $r = \frac{a}{2\,\pi}.\theta$, in which a is the value of the radius vector. When starting from the origin it has made one complete revolution. From the given equation we have—

$$d\,r = \frac{a}{2\,\pi}.d\,\theta$$

$$\therefore d\,r^2 + r^2\,d\,\theta^2 = \frac{a^2}{4\,\pi^2}(1 + \theta^2)\,d\,\theta^2$$

$$\therefore S = \frac{a}{2\,\pi}\int (1 + \theta^2)^{\frac{1}{2}} d\theta$$

$$\text{But } \int (1 + \theta^2)^{\frac{1}{2}}\,d\,\theta = \frac{\theta}{2}\,(1 + \theta^2)^{\frac{1}{2}} + \tfrac{1}{2}\log._{\varepsilon}(\theta + \sqrt{1 + \theta^2})$$

∴ the length of the spiral from the origin for any value of θ—

$$= \frac{a}{4\,\pi}\,[\theta\sqrt{1 + \theta^2} + \log._{\varepsilon}(\theta + \sqrt{1 + \theta^2})]$$

As a numerical illustration, suppose it is required to find the length of the first whorl of this spiral.

$$\text{Then } \theta = 2\,\pi = 6{\cdot}2832,\ \sqrt{1 + \theta^2} = 6{\cdot}363$$
$$\theta + \sqrt{1 + \theta^2} = 12{\cdot}6462$$
$$\log._{\varepsilon}\,\theta + \sqrt{1 + \theta^2} = \log._{\varepsilon}\,12{\cdot}6462 = 2{\cdot}5373$$
$$\therefore \text{length of first whorl} = a\,(3{\cdot}1865 + {\cdot}202) = a \times 3{\cdot}3885$$

—MILVERTON.

[61354.] — **Photographs** (1) Turn yellow after mounting, through want of thorough elimination of the hypo. Another cause is the use of an old mountant: the paste should be fresh made on the day it is used. (2) Moonlight photos can be taken with any make of plates; of course, the more rapid they are, the less time is lost.—B.SC., Plymouth.

[61358.] — **Dead Point — Legal.**—Supposing "Another Workman" were as stupid as the person who signs himself "Not a Workman," and followed his ridiculous, not to say wicked, advice, and the naturally-to-be-expected smash resulted, would "Not a Workman" be liable for damages, manslaughter, &c.? Truly the place "where the piston stopped" might be the "dead point"—of "Another Workman"—but certainly not (except by the merest chance) of any ordinary horizontal engine.—J. BROWN, Belfast.

[61360.]—**Revolving Apparatus.**—I opine you will be unsuccessful in making the mechanism unless you are a watchmaker. It would be cheapest to buy what you want.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[61375.]—**Dispensing Chemist.**—Write to the Secretary of the Pharmaceutical Society, London, for the rules as to examinations and admission. You should also try to read the *Chemist and Druggist* weekly; you will find from the examination subjects the course of training necessary.—B.SC., Plymouth.

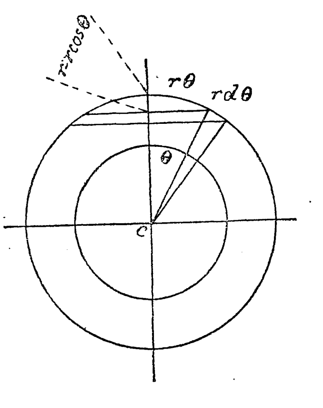
[61378.] — **Mechanics.** — The total pressure on the pair of gates $= \frac{10 \times 6^2 \times 62{\cdot}5}{2} = 11250$

$\frac{11250}{2}$ = pressure on one gate. As centre of pressure is one-third of the depth from bottom—viz., 2ft., the gate between the hinges can be treated as a loaded beam, with 5,625lb. at distance of 1ft. from lower hinge, ∴ pressure on lower hinge $= \frac{5625 \times 3}{4}$ = 4218·75lb. or 4,218¾lb.—DUD. DUDLEY.

[61363.]—**Decrease of Sun's Heat.**—I am of opinion that the reason of the decrease of the sun's heat when it is near the horizon is due to the

density of the atmosphere, which has a much greater resisting power to light and heat when the sun's rays strike through it horizontally, than when perpendicular. I am not of the opinion that there is an agency of any kind to transmit the heat or light from the sun; but that it is the absence of resistance is the reason why we are subject to its effects: otherwise the heavens would be much more luminous at night.—WILLIAMS.

[61378.]—**Mechanics.**—The second question in this query, although not addressed to me, gives us such a neat little problem in the integral calculus, that I cannot resist sending my solution of it. It is to show that when a hollow sphere is filled with water (or other liquid) the total pressure against the inner surface caused by gravitation is equal to three times the weight of the water in the sphere. I will use the polar system, which has always attracted me by its extreme elegance. The outer circle in the figure represents a section of the hollow sphere whose radius is r; the inner circle is supposed to have a radius equal to unity, which may be 1ft. or 1in., or other unit. θ is an arc on the inner circle which, as the radius sweeps round from a vertical position above the centre, to a corresponding position below the centre, varies from 0 to 180° or π; the corresponding arc on the outer circle will therefore be $r\,\theta$. Now, when the radius is in any position, such as is shown in the figure,



suppose the arc θ to be given a very minute increment $d\,\theta$, then on the outer circle this will be $r\,d\,\theta$. We can then suppose a ring to be marked out on the inner surface which is shown by the two horizontal parallel lines drawn near together; the width of this ring will be $r\,d\,\theta$, and its radius when $d\,\theta$ is infinitesimal will be r sin. θ; the area of this ring will therefore be $2\,\pi\,r$ sin. $\theta \times r\,d\,\theta$, or $2\,\pi\,r^2$ sin. $\theta\,d\,\theta$. Now if we were to integrate this expression, we should have the sum of all these rings from 0 to π, which would give us the surface of the sphere, or $4\,\pi\,r^2$; but we require more than this—viz., the pressure on that surface. Suppose p to represent the pressure of water on a surface equal to unity, and of depth unity, say on 1 square foot and depth 1ft., then the pressure on any other surface, and for any other depth, will be p multiplied by the area of the surface and by the depth; hence the pressure on the ring (the area of which is given above) will be given by multiplying that area by its depth below the highest point of the sphere and by p, or by $(r - r \text{ cos. } \theta)\,p$. Hence the expression $2\,p\,\pi\,r^2 \text{ sin. } \theta\,(r - r \text{ cos. } \theta)\,d\,\theta$ represents the pressure on one of the rings for any value of θ between 0 and π. The whole of the internal pressure will therefore be—

$$2\,p\,\pi\,r^2 \int_0^\pi (r \text{ sin. } \theta - r \text{ sin. } \theta \,.\, \text{cos. } \theta)\,d\,\theta.$$

The integral of the first term is $-\,r$ cos. θ, and the integral of the second term is $-\frac{r \text{ sin.}^2\,\theta}{2}$, as this latter vanishes both when $\theta = 0$ and $\theta = \pi$, it may be discarded, and we have only to find the value of $-\,r$ cos. θ between 0 and π. When $\theta = 0$, the value of this is $-\,r$ (as cos. of $0 = 1$), and when $\theta = \pi$ its value is $+\,r$ (as cos. of $\pi = -\,1$), the former must be subtracted from the latter, so the result is $2r$; multiply this by the constants outside the sign of integration, and we get the final result, total internal pressure $= 4\,p\,\pi\,r^3$. Now we know that the contents of a sphere are $\frac{4\,\pi\,r^3}{3}$, and as we have taken p as the pressure on one square foot for a depth one foot, p will be the weight of a cubic foot of water; hence the weight of the water in the sphere is $\frac{4\,p\,\pi\,r^3}{3}$, hence the pressure is three times the weight of the water.—M.I.C.E., Bath.

[61380.]—**Engine.**—I wrote 4in. by 6in., not 12in. by 8in. as appeared on p. 440. With a smaller diameter of cylinder, I should expect frequent stoppages.—A. F. SHAKESPEAR, Lüttichaustr. 14 III., Dresden.

[61382.]—**Instantaneous Exposures.**—The cause of your failure is that you are mistaken in the idea that the plates are under-exposed: they are over-exposed. With a R.R.S. lens, drop-shutter, summer, and mid-day sun, you require the smallest stop, and not full aperture, for any rapid plate; that is my experience in identical conditions.—B.Sc., Plymouth.

[61379.]—**Trocadero Organ.**—I have much pleasure in giving "C. C." the specification of the organ erected by M. Aristide Cavaillé-Coll, in the Salle des Fêtes of the Trocadéro:—

1ER CLAVIER GRAND ORGUE.

d'Ut à Sol, 56 Notes.

Jeux de Fond.

1. Montre .... de 16 pieds
2. Bourdon .... 16 „
3. Montre .... 8 „
4. Violoncelle .... 8 „
5. Flûte harmonique .... 8 „
6. Bourdon .... 8 „
7. Prestant .... 4 „

Jeux de Combinaison.

8. Flûte douce .... de 4 pieds
9. Doublette .... 2 „
10. Cornet .... 5 rangs
11. Pleine-jeu .... 5 rangs
12. Bombarde .... de 16 pieds
13. Trompette .... 8 „
14. Clarion .... 4 „

2ME CLAVIER POSITIF EXPRESSIF.

d'Ut à Sol, 56 Notes.

Jeux de Fond.

15. Bourdon .... de 16 pieds
16. Principal .... 8 „
17. Flûte harmonique .... 8 „
18. Salcional .... 8 „
19. Unda-Maris .... 8 „
20. Flûte octavient .... 4 „

Jeux de Combinaison.

21. Quinte .... de $2\frac{2}{3}$ pieds
22. Doublette .... 2 „
23. Plein-jeu harmonique ... de 3 à 6 rangs
24. Basson .... de 16 pieds
25. Trompette .... 8 „
26. Cromorne .... 8 „

3ME CLAVIER RECIT EXPRESSIF.

d'Ut à Sol, 56 Notes.

Jeux de Fond.

27. Quintaton .... de 16 pieds
28. Flûte harmonique .... 8 „
29. Viole de Gambe .... 8 „
30. Cor de nuit .... 8 „
31. Voix célestes .... 8 „
32. Flute octavient .... 4 „
33. Carillon .... de 1 à 3 rangs
34. Basson-Hautbois .... de 8 pieds
35. Voix humaine .... 8 „

Jeux de Combinaison.

36. Octavin .... de 2 pieds
37. Cornet .... 5 rangs
38. Basson .... de 16 pieds
39. Trompette .... 8 „
40. Clarion harmonique .... 4 „

4ME CLAVIER DE SOLO.

d'Ut à Sol, 56 notes.

Jeux de Fond.

41. Bourdon .... de 16 pieds
42. Flûte harmonique .... 8 „
43. Diapason .... 8 „
44. Violoncelle .... 8 „
45. Flûte octavient .... 4 „
46. Octavin .... 2 „

Jeux de Combinaison.

47. Tuba Magna .... de 16 pieds
48. Trompette harmonique 8 „
49. Clarionette .... 8 „
50. Clarion harmonique .... 4 „

CLAVIER DE PEDALES.

d'Ut à Fa, 30 Notes.

Jeux de Fond.

51. Principal Basse .... de 32 pieds
52. Grosse Flûte .... 16 „
53. Contrebasse .... 16 „
54. Violon-basse .... 16 „
55. Soubasse .... 16 „
56. Grosse Flute .... 8 „
57. Violoncelle .... 8 „
58. Basse .... 8 „
59. Bourdon .... 8 „

Jeux de Combinaison.

60. Contre Bombarde .... de 32 pieds
61. Bombarde .... 16 „
62. Basson .... 16 „
63. Trompette .... 8 „
64. Basson .... 8 „
65. Clarion .... 4 „
66. Baryton .... 4 „

PEDALES DE COMBINAISON.

1. Effets d'orage.
2. Tirasse du Grand orgue.
3. Tirasse du Positif.
4. Tirasse du Récit.
5. Anches Pédales.
6. Octaves graves Grande orgue.
7. Octaves graves Positif.
8. Tremblant du Positif.
9. Octaves graves Récit.
10. Octaves graves Solo.
11. Expression du Positif.
12. Expression du Récit.
13. Anches du Grand orgue.
14. Anches du Positif.
15. Tremblant du Récit.
16. Anches du Récit.
17. Anches du Solo.
18. Copula du Grand orgue.
19. Copula du Positif.
20. Copula du Récit.
21. Copula du Solo.
22. Copula du Récit au Positif.
23. Combinaison de la gr. pédale.
24. Combinaison du Solo.

—G. A. AUDSLEY.

[61383.]—**Inertia of the Reciprocating Parts of a Steam Engine.**—The answer to this question is very laborious, but nearly all the values of i required have been computed and put in the following table, together with those computed by Mr. Finlay:—

	$c = 3$	$c = 4$	$c = 5$
At	i	i	i
0	1·640	1·5375	1·476
15°			1·401
30	1·282	1·2238	1·1907
45		·8748	·8723
60	·411	·4614	·492
75			·10123
90	— ·435	— ·3176	— ·25107
105			— ·53421
120	— ·819	— ·7686	— ·738
135		— ·8647	— ·8672
150	— ·848	— ·8965	— ·9397
165			— ·9738
180	— ·820	— ·9225	— ·984

MILVERTON.

[61384.]—**Steam.**—If you can alter the action of your fan so as to suck from the wooden shaft instead of trying to create an air blast, you may perhaps succeed. If unable to do this, put a $\frac{1}{4}$in. steam jet in instead of the air blast; this, however, takes a good bit of steam, and you would find a suction fan best.—T. C., Bristol.

[61384.]—**Steam.**—"Perplexed" will find the best remedy in causing the fan to exhaust from the uptake over the boiling pan; the fan should be of the Blackman type, and, say, 24in. diameter. The uptake must, of course, be made of sufficient area to supply the fan freely. This method of clearing the air is now very generally employed; take off the vapour as near to the pan as possible.—FRANCIS M. ROGERS.

[61386.]—**Focus of Lenses.**—The actual focal length of a single lens is the distance from the back surface to the principal focus (or burning point), measured usually in inches and fractions of an inch. The back focus of a doublet is the distance from the back surface of the back lens to the principal focus; but the equivalent focus is the actual focus of a single lens, which would form an image of a given object at a given distance of exactly the same size as the doublet forms. For the simplest method of determining this see Dallmeyer's pamphlet on "The Choice and Use of Photographic Lenses."—T. PERKINS.

[61388.]—**Browning Gun-Barrels.**—I fear I can't add much to what I have already said on the subject in the "E.M." As an amateur the present weather is all against you; but how is it you got on all right with the single and failed in the case of the double? But try again, and pay very strict attention to the following:—Be sure you remove all traces of grease from your barrels, and keep any grease away from your appliances. Don't have much liquid in your sponge. After dipping the sponge in the mixture, squeeze it with your fingers so as to take some of the liquid out. When applying the mixture, take long, even strokes from muzzle to breech; no pressure required—as light as you can. Try and put the mixture on even—not thick in one place. You must give the necessary time to dry between the applications—viz., twelve hours from first coat to second, and six hours between each coat after; from four to six coats should do. You must or should have a room or shop where you can get a temperature of not less than 60° Fahr., but between 70° and 80° will be much better. If you have no such convenience,

and you have to merely do your drying in front of a kitchen fire, you must keep your eye on the barrels and see that they don't get hot—in fact, not even warm; never apply the mixture while the barrels are warm. If the mixture does not dry evenly on the barrels you will have them streaky and patchy. The barrels should be dipped into the boiling water just for a second or two. The more they are scalded the darker they get. If you have an iron or tin trough for your hot water you will be able to do your scalding regular; but if you scald your work from a kettle-spout, then most likely you will scald one part of your barrel more than another. The part most scalded will be darker; so if you do the scalding from a kettle-spout you must endeavour to distribute the water as evenly as possible. Your wood plugs can have had nothing to do with your failure. Gun-barrel browning is one of those processes which if not carried out according to "Cocker" must fail. I would advise you to scratch-card your barrel before scalding; do it lightly, and scratch again after scalding. Have the plug in the muzzle end; not that it will make any difference in your work. If you have a trough, before scalding remove the wood plug. Get two pieces of stout wire, say about 16in. long, bend one end 1½in. or so at right angles, insert the short bends one in each end of the barrel, using the long ends as handles. Thus you can lift your barrels in and out of the water in a horizontal position. If you scald with a kettle, have a plug in each end, so that you can reverse and pour water on from muzzle to breech and breech to muzzle. Don't leave plug in while barrel is getting dry after mixture is put on. This has nothing to do with the browning; but leaving the plug in may cause rust on the inside, where it is best away. You may at any time handle your barrels with a piece of clean rag, not necessarily clean, but free from grease. Grease is death to browning. The best method of removing grease from barrels, and the one recently adopted for Government rifles, is to boil the barrels for ten minutes in strong soda water, not using the same water for two sets of barrels. This process is cleaner and better than lime; ½lb. of soda to a gallon of water will do: more soda would do no mischief. After taking barrel out of soda water it would be as well, while yet warm, to rub down with scratch-card; then let the barrels get cool before putting on mixture. Now I hope you will succeed.—ARMOURER.

[61389.]—**Wimshurst Machine.**—It is not possible to say where "Hendon" is wrong, without having the machine to examine; but let him attend to the following:—(1) See that more than eight sectors be on each plate; (2) see that the plates run not more than ¼in. apart; (3) see that the front driving band is straight, and the back one is crossed; (4) make quite sure that each of the brushes is in actual metallic contact with the other and with the sectors (even a thin coating of lacquer is fatal); and, lastly (5), see the brushes rightly placed—viz., on the front plate the lower brush is to the right hand of the stanchion of stand, the top brush to the left-hand side; the brushes at the back to be at about right angles with the front brushes and rod. If he attends to these matters, and then turns the driving-handle, it is quite certain that he will obtain self-excitement. The tubes will answer very well; but he should put resin plugs into the ends of them to prevent damp and dust entering. He should read the work by Silvanus P. Thompson to find a number of useful experiments, the details of which are very clearly given. —J. W.

[61390.]—**Engine Query.**—The "model" inquiries generally omit to say the speed engine is required to run, and if only to be looked at or to do some real work. This engine to do the latter would require a boiler, say, vertical, 20in. high and 15in. diam., with internal firebox, and of $\frac{3}{16}$in. plate, and work at 50lb.—T. C., Bristol.

[61391.]—**Soldering.**—"Galen" apparently thinks he is to put the copper-bit into a pailful of soldering-fluid. Here's one way of doing it: Make a shallow hole in a bit of brick; put some bits of solder in the hole, and on them drops of soldering fluid. When copper bit is hot and cleanly filed, immerse, and the solder will run all over the clean part unless it is prevented. The cheapest way to make the fluid is to procure clean scrap zinc, and dissolve as much as possible in commercial spirits of salt. If you want to increase the bulk you can add water. Is any flux required in coating iron with lead except the usual preliminary dip in the hot grease bath?—REGEL.

[61391.]—**Soldering.**—"Galen," with a little experience, will be able to tin and solder very well. Buy, say, 1lb. of spirits of salts, which costs about sixpence, pour as much as you want into a jar—a jam pot will do—and now you want to do what is termed killing it; that is, cut up some small pieces of zinc and drop in the spirit, it will then begin to boil up; keep on adding the zinc till it will boil no more, at the same time keep it away from all bright iron or steel work, as well as your nose. Now put your iron in the fire and make it nice and hot, not red-hot mind; then file the face and sides bright, then dip quick into the spirit, and out again, then press the end of a stick of solder on to the face of the soldering iron, dip again into the spirit, then you will have a bright tinned surface to begin work with. All work to be soldered must have a clean bright face to it, by filing or scraping; then apply the spirit—a penny gum brush will do. It will answer the purpose of galvanising as well as tinning, on small jobs. Pleased to answer again, if required.—PICKLOCK.

[61393.]—**Electric Indicator.**—TO MR. CONRY OR MR. BOTTONE.—Not knowing this make I am unable to advise.—S. BOTTONE.

[61394.]—**Dynamo: Cast-Iron Bed.**—TO MR. BOTTONE.—The use of a cast-iron bed would short-circuit the magnetic field of this dynamo, and render it totally inactive. You may turn the machine upside down, like this U, and use a cast-iron plate, to which the bent ends of the F.M.'s may be bolted, if it be desired to drive the machine by power; but by no means let the pole pieces be in any way connected together by iron. A dynamo double the size would have about 32 times the power. The size of the wire must also be doubled; its weight must be quadrupled. Speed about 1,600 revs. It will light an arc-light well of about 1,000c.p.—S. BOTTONE.

[61395.]—**Legal.**—This query cannot be answered without an inspection of the will; but probably the trustees are right. Suppose (which is quite likely) that the property does not vest in C., D., and E. until B.'s death, that the trustees paid C. his share now, and that C. should die before B., D. and E. could claim the whole estate from the trustees, and they might personally lose the money they paid to C. 2. C., D., or E. can make a will if they are of age; but it depends on the period of vesting whether or not it is of any use so far as the grandfather's will is concerned.—B.SC., Plymouth.

[61397.]—**Disposal of House Sewage.**—Use an earth closet.—OHMI.

[61397.]—**Disposal of House Sewage.**—This is a wide query, and to answer it one would require to see the house, its position, and surroundings. A cesspool well built and cemented water tight is probably the answer.—B.SC., Plymouth.

[61398.]—**Electric Battery.**—If you use two boxes precisely similar to the one figured and described at p. 435 of the ENG. MECH. for Jan. 14, 1887, you will obtain the desired results. The size of plates described by you—viz., 5in. by 2in.—will do very well. Each box should contain four cells. As the exciting fluid, try my receipt—viz., chromic acid, 3 parts; sulphuric acid, 3 parts; water, 17 parts. Not every 10c.p. lamp can be lighted with 8 cells, as they give only 16 volts; but I have been using a very good 10c.p. lamp, which takes only 12 volts to work it.—S. BOTTONE.

[61399.]—**Leclanche Batteries.**—Yes. It would cause them to run down much sooner.—S. BOTTONE.

[61399.]—**Leclanche Batteries.**—I have known cases where the porous pots have been cracked, and with no apparent detriment to their working capabilities. Are all the terminals clean? Perhaps the cheapest way is to throw the defective cells on one side and replace by new ones.—J. H. H.

[61399.]—**Leclanche Batteries.**—The bursting of the porous jar should not be injurious to the working of the battery, unless the contents of the jar are coming out and mixing with the liquid; in this case the action would certainly be feeble. Either get new jars, or cover the burst part with a patch of cloth tied round; of course, if a quantity of the manganese has been lost the cloth will be no remedy so far as the regaining of strength is concerned.—BOBADIL.

[61399.]—**Leclanche Batteries.**—The bursting of the porous cells would certainly be injurious to the working of the battery. You may possibly have a partial or actual short-circuiting of your line wires. Try new porous cells, and run a fresh wire from battery to bell (well insulated). See that extra contacts of the bell are clean, and that the holes or tubes at the top of the porous cells are quite clear.—LANCASTER.

[61399.]—**Leclanche Batteries.**—Salts of ammonia form in the pores of the cell. You will probably find it work much better now, as the porous cell was probably clogged. Tie round it a piece of blotting-paper with string, and then soak in warm water for a time, and most likely all will be well. Mind, though, no carbon or manganese gets in the outer cell with the zinc, or great local action will take place. See Roberts's paper on Batteries, *Journal* of Soc. of Tel. Eng. Vol. VI. p. 257.—AN A.S.T.E.

[61399.]—**Leclanche Batteries.**—The bursting of porous cells should not do the battery any harm; but if the cells have not been allowed to become dry after having been in use for some time, I should be inclined to think they were bad and fairly worked out. I have for some time discarded the above batteries with porous pots in favour of a large cylindrical compound block, said to consist of carbon, manganese peroxide, and copper oxide, the whole being mixed into a plastic mass and put together under pressure. The resistance of this cell is less than half that of cell same size with porous pot. If your battery is in the mine, then it will always give you trouble, unless your circuits are thoroughly insulated; and in collieries this is the exception not the rule.—OHM.

[61400.]—**Electric Light.**—A small turbine would best meet this case, and estimating its efficiency at 60 per cent. would give off, say, 1½H.P.; the rate of speed would, however, be exceedingly high, and if the water be gritty, a small wheel would soon cut out. Cost about as under:—

Turbine without flume	£20 0 0
Shunt dynamo for, say, 10 lamps of 20c.p.	17 0 0
Lamps, 5s. each (Swan)	2 10 0
Leads, 9d. yard, switches, &c., say, 50s.	2 10 0
	£42 0 0

If arc lamps be employed, say 2,000 candles nominal. —F. M. ROGERS.

[61400.]—**Electric Light.**—Is "Colliery Manager" sure about the particulars he gives? 1,500 tons of water per day of 24 hours (?) = 1 ton per minute, or about 36 cubic ft.; then by Molesworth's formula, 36ft. by 40ft. head × ·001892 = 2¾ *theoretical* horse-power nearly. Thirty to 40 per cent. of this will be lost in the wheel or the turbine, and about 20 per cent. of the remainder in the dynamo, besides loss in the leads and from other causes, so that the electricity available at the works will finally be very small indeed. However, I would not deter "Colliery Manager" from laying down the necessary plant, and if the quantity of water in cube feet per minute is different to that stated, it alters the case altogether. He had better get an estimate from some reliable firm as to the cost of the wheel or turbine, and the probable horse-power (actual). I shall then have much pleasure in giving him a rough estimate of the cost of plant and its maintenance, either on the arc or incandescent systems, whichever he purposes to use.—J. H. H.

[61400.]—**Electric Light.**—You seem to have a large amount of power available—unless mistaken, something like 4,000H.P., a portion of which diverted from the main fall might possibly suffice, and be easily utilised for lighting your works, and for motive power should you require it. It would, I think, be best for you to give particulars of the maximum number of lamps (arc or incandescent) you would require, with approximate candle-power, exact distance from available power—that is, where the water motor and dynamo can be placed to lamps. You would then, no doubt, get some reliable information. If you will advertise your address in "Address Column," I shall be pleased to communicate with you, and give you all the information that I can.—LANCASTER.

[61400.]—**Electric Light and Water-Power.**—With a good turbine a fall of 10ft., with a discharge of 180 cubic ft. of water per minute, gives about 2½h.p. This is just about what your fall would give you if I have understood your statement rightly. Now 2½h.p. would give about 400 c.p. if employed for incandescent lighting, or 1,000 to 1,500 if used for arc light. The requirements would be turbine, dynamo (or two, one for reserve), belting, cables, leads, lamps, holders, brackets, switches, fusible plugs. Total cost of plant should not exceed £200 at the outside. Maintenance, with renewal of lamps, oil, waste, labour, interest, or plant at 5 per cent.; depreciation of turbine and dynamo at 10 per cent.—say, £50 per annum. Of course, this is only a very rough estimate.—S. BOTTONE.

[61400.]—**Water Power for Electric Light.** —With 1,500 tons of water falling 40ft. in 24 hours you have about 28H.P. regularly, and you ought to be able to get about 20H.P. with a good turbine, and from this at least 150 incandescent lights, each 60 watts, and about 16 to 18c.p.: or, if you want arc lights, then you could have 10 lights of about 1,000c.p. each. If you will say which lighting you wish to do, then you might get more information. Of course you would require to carry the whole of the water down a pipe from head to bottom of fall. Could you carry wires overhead, or must they be underground? If all was erected to the works, could arrange to use the power during the portion of day when lights not required to drive a motor. Unless you could do this, it would be expensive in maintenance, and for the few hours per day during which lights would be required; but you might take current into workings if not fiery, and use it either for haulage or lighting—or perhaps both.—OHM.

[61403.]—**Renovation of Violin.**—If your

violin has ever been a good one, you should limit the scraping operation to, say a ship's bottom, and remove the offending varnish by means of methylated spirits. Use French polish, with the use of as little oil as possible, as it would injure the tone. —A., Liverpool.

[61406.]—**Glow Lamps.**— Four cells coupled up in series will be ample. The positive pole is the one starting from the graphite, the negative the one coming from the zinc. Experimentally, you can prove this by letting both wires dip in a solution of copper sulphate. The negative pole will become coated with metallic copper, the positive simply gets corroded.—S. BOTTONE.

[61406.]—**Glow Lamps.**—As usual, see back numbers, and be a "Juvenile Ignoramus" no more. Four or five pint bichromes would light a 5c.p. lamp for nearly an hour, when they would need to be recharged. But unless the plates are kept in motion, or liquid stirred, or something of that sort, the light falls off very rapidly. Connect the carbon of cell A to zinc of cell B, and carbon-cell B to zinc cell C, and so on. Place both wires to the tongue to find which is + and which – and the one that tastes sour is the positive.—IOTA.

[61406.]—**Glow Lamp.**—A 5c.p. lamp of low resistance should be lit with four or five pint bichromate cells; charged with the usual bichromate solution, however, they will not work for a couple of hours. The best charge will be chromic acid, in regard to which you will find much information in recent back numbers. The negative pole of a battery is always the zinc, the positive pole the carbon; but you should get a text-book and read this up. Connect the cells in series, that is, carbon to zinc, carbon to zinc, all through, and lead a wire from zinc in first cell, and from carbon in the last to the lamp.—BOBADIL.

[61407.]—**Glass Spinning.**—I remember seeing this at the Polytechnic, and the wheel went 200 or 300 turns a minute. I know nothing about the quality of the glass rods; but the flame of lamp was large, and worked by a foot-bellows. I rather think you may see it at the new "Palace" near Battersea Park.—T. C., Bristol.

[61407.]—**Glass Spinning.**—This is very easy after a little practice. My wheel is a foot in diameter, and revolves at the rate of a mile a minute. I find the faster you spin the finer the glass. The wheel should be slightly moistened to start with. Ordinary rods of soft glass, about the size of a cedar pencil, are the best. I use a benzoline blowpipe flame with a foot blower, but would prefer gas if I could get it. The flame should be pointed and steady. I have seen glass-workers in Tottenham Court-road, where they sometimes take a room and charge so much to go in and see them. I shall be glad to give "S. B. B." any further hints he may require.—M. R. C. S.

[61408.]—**Violin Query.**—It is very probably caused by some part of the back, or the belly, being loose; this usually takes place where the chin comes into contact, or the hand as it shifts, and is caused by the perspiration decomposing the glue; if on tapping it be found to be loose, insert the blade of a penknife gently; then dab in some good thin hot glue, work it well in, and apply a clamp.— A., Liverpool.

[61409.]—**Violin Query.**—Try the breast and back whether they are loose; try well, for although you may not be able to see it, they may be partly loose. If they are intact, the bass bar or finger board may be the cause.—J. H. SCHUCHT.

[61409.]—**Coating Springs with Copper.**— Here is a recipe for coppering solution without a battery, which I have found to answer well for articles of iron:—Nitrate of copper (dry), 4oz.; cold water, 1 gal.; sulphuric acid, 12oz.; sal-ammoniac (powdered), 4oz. Smaller quantities may be made up if the proportions are adhered to. —BOBADIL.

[61409.]—**Coating Springs with Copper.**— This question has been frequently answered. The ordinary "sofa springs" are coated with copper by first cleaning them and then immersing in a solution of sulphate of copper. Gore gives several recipes, the best of which is, perhaps, that in which the iron previously cleaned by immersion in a mixture of nitric acid 1, hydrochloric acid 50, is placed in a bath of 10 parts of nitric acid, 10 parts chloride of copper, and 80 of hydrochloric acid. Immerse several times, and rub with woollen cloth between each immersion. Another good process is to dissolve in 1,000 parts of water, 150 of Rochelle salt, 80 caustic soda, and 35 of sulphate of copper. Clean the iron by immersion in dilute sulphuric acid, washing in water and in solution of soda. Then scratchbrush, wash, and immerse in above solution, hanging the articles on zinc wires. There are many recipes of the kind; but it should be noted that the simple process of dipping in the sulphate solution gives a coat that will not stand handling.—SAML. RAY.

[61410.]—**Medicinal Action of Dynamos.**— To the best of my experience (now extending over more than 20 years), the dynamo, unless its current is passed through the human body, is absolutely without action upon it. Owing to the proximity of the poles to one another and to the armature, very little magnetic action is excited on surrounding bodies, and this little only on those in very close proximity, owing to the fact that the effects diminish as the cube of the distance.—S. BOTTONE.

[61410.]—**Medicinal Action of Dynamos.** —Various persons have told "snake stories" about dynamos, but certainly "the Dispenser at the Free Dispensary, Lydney," in the yarn related on page 441, has fairly made the highest possible score. It is, however, a pity that Dr. M. (why is the name not given?) did not investigate the matter further; he might then have found that, while series-wound dynamos made people irritable, shunt-wound machines had a soothing effect, and that separately excited dynamos induced devotional and reverential feelings. Did Dr. M. visit the large building (why are name and place omitted?) on the first of April? — WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[61411.]—**Drilling.**—Fasten the upper portion of a slide-rest to table of machine, and remove the screw of slide, and instead of this fasten a length of flat iron to slide. You can now drill this piece of iron the same distance apart as the holes are required to be. Now make a lead chuck, shape of lower part of castings, and fasten to slide, so that you can drop the castings into chuck for drilling. You can at same time fasten a template to slide so that a collar on drill or spindle comes down to it to regulate the various depths required. All you will now have to do is to drop a taper pin in the holes of flat bar and a hole in table, and bring down the drill until collar stops it on the notched template.—T. C., Bristol.

[61412.]—**Twin Screws and Paddle Engines.**—The increased power of manœuvring ships with twin screws or disconnected paddles arises from the fact that one propeller can be driven ahead while the other drives astern. The ordinary disconnecting clutch is used in many tug-boats; but some, I believe, have a disc on the intermediate shaft instead of a crank arm, and that disc is fitted to the shaft with feathers, so that it can be drawn on the shaft clear of the crank-pin when it is desired to disconnect. I think examples will be found in Bourne's works. NUN. DOR.

[61414.]—**Electro-Motor.**—To MR. BOTTONE and E. CONRY.—Put about 2oz. of No. 20 on armature, and 2lb. No. 20 on fields. Six bichromates will cause it to drive a sewing-machine. Yes; one by Urquhart, 7s. 6d.—S. BOTTONE.

[61418.] — **G.W.R. Engines.** — The largest driving wheel on the G.W.R. is 8ft. These are found on the Great Britain class, originally built about 1847. Of the four B. and E.R. 10 wheeled double bogies, with 9ft. driving wheels, which came into possession of the G.W.R., one was wrecked in an accident near Bristol in 1876; the three remaining ones were then altered into 8 wheeled tender engines, with a leading bogie and 8ft. driving wheels, and are, I believe, still running. No. 10 is the only one yet built of a new class; she somewhat resembles No. 9, but has not outside eccentrics. Her driving wheels are 7ft. 8in.; she is a single 6 wheeled engine with dome. The drivers speak very well of her performance.—T. PERKINS, M.A., Shaftesbury.

[61419.]—**Loco. Wheels.**—I have been told that there was once made at Crewe a loco. with 10ft. 6in. drivers, which never moved out of the shed. I should very much like to know if this is true. I suppose the necessary height of the centre of gravity militates against drivers over 8ft. I saw it once stated that to obviate this an engine was once erected with very large single drivers on the tender. This seems too absurd. I should imagine the Caledonian 8ft. 2in. singles are the largest narrow-gauge drivers out, unless L. and N.W.R. loco. "Cornwall" is still on the road. Perhaps the readers of the "E. M." may be interested to know the largest drivers of the more important railway companies:—

L. and N.W.R. "Cornwall"	8ft. 6in.
C.R.	8ft. 2in.
G.N.R.	8ft. 1in.
M.R.	8ft. (?)
L. and N.W.R. singles and G.E.R.	7ft. 6in.
G.W.R., N.E.R., N.B.R., S.E.R., L. and S.W.R., and G. and S.W.R.	7ft.
L.B. and S.C.R.	6ft. 9in.
L.C. and D.R., L. and Y.R., and M.S. and L.R.	6ft. 6in.

As regards the Midland, I don't know whether the new singles are out yet. I should very much like to know this, and if so, what road and load they are working. The Metropolitan and District Railway's coupled tanks are, I believe, 5ft. 9in.; I won't be sure. The above sizes are on narrow-gauge lines. I believe the largest broad-gauge single drivers run between Bristol and Exeter, and are about 9ft. 2½in. in diameter. I would like to know whether they have names or numbers; I think the latter.—SEVERN TUNNEL.

[61421.]—**Case-Hardening.** — If "Querist" has many set-screws to case-harden he will probably find it quickest to heat them up to blood-red in an iron box containing bits of leather, or horn, or bone-dust, and then quench in cold water. If, however, he has only one or two to do, it will be found less trouble to heat the screws. After polishing to a bright red, rub them or dust them with prussiate of potash (poison), allow to cool to a dull red, and quench.—FIVE MILES FOUR.

[61421.]—**Case - Hardening.**—If your screws are made of Bessemer steel they will not be required to be case-hardened, as you term it, as that instance only applies to wrought iron; but you can harden them all the same. Put the screws into a short piece of gas-pipe, about 7in. or 8in. long; bung both ends up with a piece of clay; put it in the fire and heat to a cherry red; then tip them into oil; then polish the heads and place them on a red-hot plate till they turn blue; then tip into oil again.—PICKLOCK.

[61421.]—**Case-Hardening.**—I was told by a manager of a large printing machine shop how to case-harden iron and give a perfect coating of steel which will harden like ordinary steel. Take your iron (good soft wrought iron) and make your screws or any other small article; finish off except polishing. Now you want every finished part to be of steel. Proceed as follows:—Take some black marble and some oak charcoal (oak best, but any hard charcoal will do); pulverise both not too small. Take an iron vessel much larger and much deeper than the article to be steeled (not stolen), mix the pulverised black marble and the charcoal together, put a good layer of the mixture (if you like add other carbonaceous matter, such as leather, or what you like, as long as it is carbon-yielding with heat) on the bottom of the iron vessel, then insert the article, then cover deeply with the same mixture, then, if a lid is handy for the vessel, put it on; if not, put some fireclay on top, as, or in lieu, of the lid to the vessel; then put the vessel into the hottest heat you can get (a Fletcher's muffle or air furnace will do the trick), and keep the whole at a good heat (white, if possible) for as long as you can afford time and cost. The result, according to heat and time, will be that every part of the article will be steel on the outside to a certain fixed depth, equal all over. The steel may be ·01 thick, or ·1, or ⅛th thick. Now test this. Take the article, say a round bar, cut it off at an angle of 45; heat, quench, temper as of steel, polish, and you will see the ring of steel. Tried and vouched for.— R. S. T.

[61423.]—**Strength of Materials.**—The torsional strength of iron rods is proportional to the cube of the diameter, and in the case of hollow rods the strength is found by taking the difference of the cubes of the internal and external diameters. Hence, taking the original strength of the shaft as 1,000, the strength will be reduced to 936 when the 4in. core is removed. The amount of weight removed will be proportional to the squares of the diameters, for it will amount to about one-sixth. A cubic inch of cast iron weighs about 1,820 grains.— WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[61423.]—**Strength of Materials.**—Areas of circles are to each other as the squares of their diameters. $\therefore \frac{4^2}{10^2} = \frac{16}{100} = {\cdot}16$, or $\frac{4}{25}$ = fraction of weight removed. Torsional moment of resistance $= \frac{\pi}{16} f a^3$

$f = 4500$ for cast iron; d = diam. of shaft.

For 10in. diam. $= {\cdot}19625 \times 4500 \times 1000 = 883500$

For 4in. diam. $= {\cdot}19625 \times 4500 \times 64 = 56549$

$\therefore \frac{56549}{883500} = {\cdot}064 = \frac{2}{31}$ = fraction of strength to resist torsion removed. The weight of a cubic inch of cast iron varies from ·252 to ·273lb.—ELAG.

[61423.] — **Strength of Materials.**—The weight of round iron varies as the square of the diameter, and of a hollow shaft is that of a solid shaft, full size, less the weight of a shaft the size of the hole—that is as $10 \times 10 - 4 \times 4 = 100 - 16 = 84$, consequently 16 per cent. of its weight is removed. The actual area $= 84 \times {\cdot}7854$. The strength of a shaft varies as the cube of its diameter, and the relative strengths are therefore $10^3 = 1000$, and $10^3 - 4^3 = 1000 - 64 = 936$, or as 100 : 93·6. You will see by this that although the shaft is 16 per cent. lighter, it is only 6·4 per cent. weaker than a solid shaft 10in. diameter, owing to the better position of the material to resist the strain. Practically, you may take ¼lb. as weight of a cubic inch of iron, either wrought or cast; it is a little less really.—T. C., Bristol.

[61423.]—**Strength of Materials.**—Naturally, the weight of two bars of the same length varies

as the areas of their cross sections. The area of a 10in. cylinder is 78·5398 sq. in.; while the area of a 4in. cylinder is 12·5664 sq. in.; so that the area of the hollow cylinder whose outside diameter is 10in. and inside is 4in. will be 65·9734in., so that the weight of the 10in. hollow cylinder will be $\frac{65 \cdot 9734}{78 \cdot 5398} = \cdot 84$ (nearly) of the weight of the 10in. solid cylinder, taking equal lengths. As to the reduction of its capacity, when hollowed out, for resisting a torsional stress, I cannot find any reliable formula. The formula generally given gives the ratio of strength of a hollow cylinder to that of a solid one, the areas of the cross sections of both being equal; for instance, a hollow cylinder 12in. external diameter and 6⅝in. internal diameter possesses the same area of cross section as a 10in. solid cylinder (78·54 sq. in. nearly), but is very nearly 1·58 as strong to resist a torsional stress. Weight of 1 cub. in. of cast iron varies, with the manufacture, from ·253lb. to ·273lb.; while an average value—i.e., the one generally used in finding weights of castings—is ·26lb.—SEVERN TUNNEL.

[61424.]—**Model Steam-Engine.**—You cannot do better than buy a set of castings for, say 1in. bore, at about four shillings, as advertised by Lee in "Ours," and most of your queries will be answered in endeavouring to fit them up.—T. C., Bristol.

[61425.] — **Oak Cantilever.**—Taking your figures as to strength, and a factor of safety of 4, the lever would require to be = (using 6 instead of 5·83) $1120 \div (6 \times 9^2) = 1120 \div 486 = 2 \cdot 3$in., or, say 2½in. wide. This is taking the breaking weight of a cantilever 1ft. long as 140lb., and, consequently, if 6ft. long and 1in. square, as 23·31b., or safely as 5·83lb.—T. C., Bristol.

[61425.]—**Oak Cantilever.** — It is generally taken as a rule, that the relative strength of solid rectangular beams varies directly as the square of their depths, and directly as their breadths, and inversely with their length; hence it becomes, in cases of this kind, simply compound proportion:—

x	:	1 breadths in inches
280	:	1120 weights in pounds.
6″	:	72^2 lengths reduced to inches
9^2	:	1^2 depths in inches
1	:	4 margin of safety

$$x = \frac{1 \times 1120 \times 72 \times 1^2 \times 4}{280 \times 6 \times 9^2 \times 1} = 2\tfrac{3}{8}\text{in. nearly}$$

—DUD. DUDLEY.

[61425.]—**Oak Cantilever.**—Using the formula $W = \frac{K\,B\,D^2}{L}$ (cwts. and inches), the breadth of your beam, using a factor of 4 (i.e., a breaking load of two tons), is 2·37in. for English oak, when K has a value of 15cwt.; and should it be African oak, where K = 22cwt., its breadth would be 1⅝in. But I would prefer using a beam having less depth, and therefore requiring a greater breadth than 2⅜in., as with so long a cantilever I should be afraid of an absence of rigidity sideways, in which case it would twist sideways and probably rupture. Say you used a beam 7in. deep, its breadth would then be $3\frac{15}{16}$in. (English oak), and there would be plenty of transverse rigidity probably. Taking the depth of beam (English) as 9in., however, the deflection under a ½ ton load is about $\frac{9}{16}$in., I think. These results will be found to agree with the assertion in the latter part of your query, taking the material to be English.—SEVERN TUNNEL.

[61425.]—**Oak Cantilever.**—

$$\left.\begin{array}{l} L = \text{length of beam} \\ B = \text{breadth} \\ D = \text{depth} \end{array}\right\} \text{in inches}$$

W = breaking weight in pounds
K = greatest bending moment

$$\therefore\ W = \frac{K\,B\,P^2}{L}$$

$$K = W\,L = 6 \times 280 = 1680 \text{ (from small beam)}$$

$$\therefore\ B = \frac{L\,W}{K\,P^2} = \frac{72 \times 1120}{1680 \times 81} = \frac{80640}{136080} = \cdot 593\text{in.}$$

Multiplied by factor of safety 4 = 2·372in. Or it may be reasoned out without formulæ thus:—If a beam 6in. long by 1in. square breaks at 280lb., a beam 72in. long by 1in. square would break at 23·31b.; and as the strength of a beam varies as the square of the depth, a beam 72in. long by 9in. deep by 1in. broad would break at $23 \cdot 3 \times 9^2 = 1889$lb., then breadth to break at half a ton $= \frac{1120 \times 1}{1889} = \cdot 593$in. Multiplying by 4 as before gives 2·372in. = breadth required.—ELAG.

[61428.]—**Legal.**—(1) A. could not legally refuse to deliver the key to B. after having sublet the house to him on the ground that he wished him to buy a "small garden valuation." (2) A. could not let the premises again after having let them to B. (3) B. can only recover the money he paid to A. if he shows that A. got it on false pretences. (4) B. can recover loss actually sustained by reason of A. refusing him the key.—B.SC., Plymouth.

[61431.]—**Dynamo for Plating.**—Put 4oz. No. 16 on the armature, and 4lb. No. 20 on the fields. Connect up as a shunt machine.—S. BOTTONE.

[61438.] — **Measuring Cloth.** — "Factory Worker" can't get a simple rule for finding the length of cloth on a roller; but he can make a table which will be much more accurate, and give him and others less trouble, by putting on his 100 yards, measuring it off yard by yard, and noting the circumference; or what would be still more practical, put a disc on one side of his wheel, and mark on it the diameter attained by each yard with a dot, and, say, a figure at every 5.—B.SC., Plymouth.

[61438.]—**Measuring Cloth.**—The solution of this question will be the same as to find the sum of an arithmetical series, of which the first and last terms and the common difference are given. From the given conditions it will be easily seen that the common difference is equal to $\frac{36}{\cdot 119}$. Now the first given circumference being 12in., if we take C as any other circumference of the roll, also reckoned in inches, the formula for finding the length of the cloth in inches will be—

$$L = \frac{119}{72} \cdot C^2 + \frac{C}{2} - 232.$$

$$\begin{array}{llll} \text{Thus for } C = 24 & L = & 732 & \\ C = 30 & L = & 1{,}270\tfrac{1}{2} & \\ C = 36 & L = & 1{,}928 & \\ C = 48 & L = & 3{,}600 & = 100\text{yds.} \end{array}$$

—MILVERTON.

[61439.]—**Faulty Musical Box.**—Almost all musical boxes make that whistling noise; but it is usually detected for the first time after it has been repaired or cleaned. Most likely a closer observation is made after that operation. The cause of it is this. When a pin of the barrel puts a reed in vibration, another pin comes up before the reed has stopped vibrating, and then it touches the pin several times before they close. In the bass part of the instrument little springs are fixed underneath the reeds; these springs meet the pin first, and by that means the vibration of the reed is stopped before it is touched by the pin.—J. H. SCHUCHT.

[61439.]—**Faulty Musical Box.**—If "Box" will unscrew the steel comb from his musical box he will find under the points of the teeth in the comb little fibres; it is some of them that are either broken, loose, or out of place, and that is the cause of the whistling. His best plan is to take it at once to a practical man, when it will only cost him a trifle to put right. Watchmakers can clean them, put mainsprings, &c., into them; but very few of them can stop the whistling. They generally make bad worse, and either return them unrepairable or they send them to a practical musical-box repairer, and charge you a fabulous sum. In case "Box" does not know how to take the comb off in safety, I may tell him to be sure the mainspring is quite down before he takes the comb off, for if the spring is only wound up a little way, he may do great damage; but it will pay him best to take it to a practical man as it is, for it requires a deal of practice to alter this simple thing.—DUNCAN.

[61441.]—**Notes on the Church Organ.**—TO "C. R. O.," DEVON.—I feel much gratified at the kind way in which you have alluded to my writings on the Organ. With reference to the purport of your query, I have to assure you my quotation, and the copy of the notation from Helmholtz's "Sensations of Tone" (page 33) are perfectly correct. I give you below the relative number of vibrations for each harmonic in the just or untempered scale, from which you will see that so far as the ninth and tenth upper partials are concerned, Helmholtz is correct. The only apparent inaccuracy exists in the seventh upper partial tone, the just b″ flat requiring 1843·20 vibrations, while seven times the number of the vibrations of the prime equal 1,792 vibrations. This last number places the seventh upper partial in the enharmonic diesis, or between a″ sharp = 1777·77 vibrations, and b″ flat = 1843·20 vibrations—

1.	Tenor C =	256	vibrations per second.
2.	Middle c′ =	512	„ „
3.	g′ =	768	„ „
4.	c″ =	1024	„ „
5.	e″ =	1280	„ „
6.	g″ =	1536	„ „
7.	b″ flat =	1843·20 (in just scale)	„
8.	c‴ =	2048	„ „
9.	d‴ =	2304	„ „
10.	e‴ =	2560	„ „

Any further information on this subject, which it is in my power to give, you may command; and I shall be pleased to have any ideas of your own on the question.—G. A. AUDSLEY.

PLUMBERS should be careful not to use lead in contact with oak, unless the latter is perfectly dry and free from sap; otherwise the gallic or acetic acid in the wood will turn the lead into acetate of lead or ceruse.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

QUERIES.

[61442.] — **Weight of Moist Air.** — In Watts' Dictionary, art. "Hygrometry," there is a table calculated on the assumption that the weight of a cubic foot of saturated air at pressure p, temp. t, is equal to (weight c. ft. dry air + c. ft. vapour) $\times \frac{p - E}{p}$; where E = tension of sat. vap. at temp. t. Should this not be "(weight c. ft. dry air) $\frac{p - E}{p}$ + wt. c. ft. vapour"? For 1ft. dry air at p, $t = \frac{p}{p - E}$ ft. at $p - E$, t. This mixed with $\frac{p}{p - E}$ ft. of sat. vap. at E, t produces (Dalton's law) $\frac{p}{p - E}$ ft. sat. air at p, t. ∴ 1ft. sat. air at p t contains $\frac{p}{p - E}$ ft. of dry air (at p, t), and 1ft. sat. vap. If I am right, Watts' table is in error by $\frac{E}{p} \times$ wt. c. ft. vapour. This, at high temperatures is considerable.—L. S. A.

[61443.]—**Ebullition.**—Will some reader explain the following facts? If steam of water is passed into liquid carbon disulphide, or if carbon disulphide vapour is passed into water, a mixture is obtained which boils at 42° C., being 4° C. lower than the boiling-point of carbon disulphide alone.—H. C.

[61444.]—**Dynamo.**—Will Mr. Bottone give me advice how to get out of the muddle I have got in? I have made a dynamo from the description given in his book, but cannot get it to work. When I couple the two brushes up, small sparks appear on the commutator. I have tried commutator with two plates and eight plates, and wound armature with No. 22 s.c. wire, with same result.—STILL IN HOPE.

[61445.]—**G.W.R. Compound.**—I understand that the Great Western Railway Co. are building, or have built, a broad-gauge compound engine, No. 8. Can Mr. Perkins, or any of "ours," give particulars, and, if running, state by what train from Paddington?—COMPOUND.

[61446.]—**Lead Waste.**—I have the opportunity of obtaining a large quantity of lead ashes and sulphate of lead. I shall be glad if any of my fellow-readers will inform me how to extract the lead profitably. Should the stuff be fused, and with what mixture, and would an ordinary iron pot, used for melting lead, be of any use to perform the operation in? I know how to assay lead over at the laboratory; but am unacquainted how to work on a large scale. How can ordinary lead be softened? Are there any cheap books published on smelting, &c.?—J. MONTAGUE JACQUES.

[61447.]—**Sugar in Boiler.**—We put 7lb. of common sugar in the boiler to prevent the scale from clinging to the sides. A few days after, we noticed that the steam emitted from the safety-valve smelt very sour, and since the odour has gone on increasing. Could anyone tell us how to prevent this?—E. A. B.

[61448.] — **Sulphocyanide of Barium.** — I am anxious to obtain a theoretical knowledge of the manufacture on the large scale of sulphocyanide of barium—the most approved and economical method, together with any practical hints. I write this in hopes that, through the medium of your paper, I may obtain the desired information, or be referred to some work treating on the subject.—REGULAR READER.

[61449.]—**To Mr. Bottone.**—Will you kindly say how much wire and size is required on my dynamo of following dimensions of wrought iron: Frame, 18in. long by 6in. wide in centre, 3in. at ends. 6in. high; poles, 5in. long by 1in. thick, with pole-pieces 6in. by 3in. by ⅜in., with brass discs, G ring, 16 gauge iron wire, built up to size 4in. diam., 3in. long, ½in. thick. I have some 18-gauge d.c.c. wire, which I think would do for armature; and kindly say the best way to wind the armature.—A. BAINES.

[61450.]—**Engine Details.**—I have a cylinder for a horizontal engine, 4½in. bore, 9in. stroke, I intend fitting up myself for my own use. Will any able reader oblige by answering the following questions? (1) What length should the connecting rod be? (2) I propose having crank shaft 1⅝in. dia. What should be the dia. of crank and width between shoulders to take brasses of connecting rod? (3) What dia. and weight flywheel? I shall have

to make a pattern for bed plate, but want the length of connecting rod before doing so.—YOUNG BEGINNER.

[61451.]—**Defective Fire Engine.**—Will some of our fellow-readers who have had experience in Merryweather's fire engines help me out of the following dilemma? I have had one to repair, and have got the left-hand engine to work all right; but the right-hand engine stops on the out stroke, and will not return without touching the valve with the hand. Can anyone tell me how to set the valves or the twisted slide bar so as to make it self-acting same as the left one?—ONE IN A FIX.

[61452.]—**Electrical Apparatus.**—I should be much obliged if some of our electrical correspondents would help me to design a switch-board for a small experimental installation. I want to charge nine secondaries from some primary battery, then discharge the accumulators through my lamps. I have five circuits, but only three will be working at one time. I want to take E.M.F. current, &c., by means of switching in the instruments at any time, and require to vary number of secondaries charging. I have plenty of switches and fuses of every pattern, but can hardly see the best arrangement for them. We have not heard much about the Upward primary battery lately. Can anyone say anything of its working, or give details of an installation where it is in use? What would be the best practical means of lighting a house of four rooms and kitchen by electricity? About what would be the probable expense? I see Messrs Shippey's lamps recommended highly; but I have tried and tested a great many different kinds of lamps, and I am best pleased with the new pattern 8 and 10-volt Edison-Swan lamps for primary battery lighting. I should be glad to hear from somebody who has tried them and find what he thinks of them.—ELECTRICAL STUDENT NO. 2.

[61453.]—**Lacquers and Dips.**—TO "IGNORANT." —Please tell me if I can convert hot lacquer into cold. If not, how is cold made? Also, is it possible to make a dip that will turn copper brass colour, and how to proceed in lacquering Florentine colour? I know how to lacquer green of the dip you so kindly gave in No. 1136.—BROSCENICUS.

[61454.]—**Hints on Purchasing a Lantern.**—A society with which I am connected thinks of purchasing a good lantern for use at its meetings. It is to be fitted so as to work with either oil or limelight, to give, say, a 16ft. or 18ft. disc with the latter, and to have a lantern microscope attachment, as well as the fitting for ordinary slides. I should be very much obliged for a few hints on the points to be attended to in purchasing such an instrument; also opinions as to whether it is worth while to have a biunial when the object aimed at is instructing rather than amusement purely.—J. BROWN, Belfast.

[61455.]—**Electric Bells.**—TO MR. CONRY.—I have a large building to fit with electric bells. It is composed of three flats, with a number of rooms on each flat. Over each room will be an indicator. On each flat there will be a special room. In the main hall there will be a 3-hole indicator, with a small bell. When contact is made, one hole will tell which flat, so that the attendant will go there, but the special rooms are to have a larger bell of different tone. Could I connect both bells to the indicator in such a way that only the one required will ring?—J. B.

[61456.]—**Caustic-soda Process.**—I have heard that this process of generating heat is used by some railway companies for heating foot-warmers. Will some reader kindly say if this is so, and explain in what way it is used, and whether the process is patented?—C. L. S.

[61457.]—**Orsat's Apparatus.**—I should be very much obliged to any reader of the "E. M." who could give me description, solutions required, and method of working this apparatus, more especially for the estimation of CO_2, O, and CO in chimney gases.—NICOMEN.

[61458.] — **Circular Saw Shaft.** — Having an amateur's lathe, 9½in. centre, I want to put an 18in. circular saw to work in it by power. I have got the saw; and the centre hole for the shaft is 1¼in. diam. What length shall I require the shaft to be, and which is the cheapest way to buy it—get a piece of rolled shafting or get one with a collar turned all ready?—WALTER PAYNE.

[61459.]—**Galvanometer.**—Will some of the readers of "ours" kindly give proper sizes and quantity of wire for coils of high and low-resistance galvanometer?—A. B. C.

[61460.]—**Stonemason's Shellac.** — Would any reader give a recipe for a good stonemason's shellac (white)?—S. H. W.

[61461.]—**Keeping Albumen.**—I have some eggs that have been kept in lime water, and through some of them getting cracked the others have been condemned for cooking. I want to save the whites for fining wine in a few months' time. If I whip the whites and let settle, what shall I do or add to it to keep the albumen good until I want it?—W.

[61462.]—**Legal.**—Will "Sperans" kindly answer the following? The parish wants to pave new streets with York paving, where ashphalte would answer the purpose. Have the owners of houses who are called upon to pay for this paving any voice in the matter? They also want to charge for paving front, side, and length of back garden, the said back garden bordering on another road. Is this legal?—NO SIG.

[61463.]—**Propulsion and Weight.**—Will somebody kindly help with the following? What is the proportion of power to weight required to propel weight? Is the proportion greater or less in water and air than on land? Which gives the best proportion—a man, horse, or loco. under ordinary conditions? Does a bird require a greater or less proportion than the best of these? As weight increases, must power be increased in same ratio? If not, how does it vary, and is it the same on land in water and in air? Do the best forms of electric accumulators with motor weigh less than loco. with paraphernalia to give same power?—W. J. G.

[61464.]—**Iodine.**—Will any subscriber kindly inform me the process seaweed is put through to obtain iodine? Also whether seaweed growing at the top or bottom of the sea gives the most iodine, and which gives the best quality? Any information on same will kindly oblige—JONA.

[61465.]—**Sinking Ropes.**—Will any reader kindly inform me the best type of rope to use for this purpose, and, if possible, give a formula for working out the strength it ought to be to carry certain weights? Size of pulleys, drums, &c., they would recommend for same, and any other information, will be gladly received.—J. O.

[61466.]—**Gold Gilding.**—Will someone kindly tell me how to put gold leaf on to rough models and wood?—J. F.

[61467.]—**Crayon Drawing.**—Will someone kindly inform me the best crayons and stumps to use for this work, and the best method of shading with same?—F. H.

[61468.]—**Brass Surface.**—Can any of your readers kindly tell me how the granulated surface is given to brass, such as you find in the centre of good old Queen Anne clock faces?—B. F.

[61469.]—**Lantern Slides.** — How are enamelled lantern slides made (not enamelled photographs)? They cost about 14s. per dozen, are coloured, and resemble pictures to be seen on dishes?—R. B.

[61470.]—**Legal.** — "Bulging out" of outer wall of house, a few feet under roof. Is freeholder liable (or leaseholder with usual repairing lease)? Causes decay, settlement, or vibration of railway trains. Also, which is liable in the case of leaking roof through decay of zinc covering?—BOB.

[61471.]—**Steam Heating.**—Having to fit up a large place with steam for heating the rooms, should be glad of any information respecting the same. (1) The arrangement of pipes? (2) How is the condensed water taken away? (3) How is the boiler supplied? Also if there is any work published on steam heating?—IGNORANT.

[61472.]—**Damp Houses.**—I shall be glad to know whether there is any simple and inexpensive apparatus whereby the dampness in a room may be detected and measured (a hygrometer is too costly). It seems quite useless to tell a landlord that his house is damp; he merely smiles at you, and does nothing. In these circumstances it would be of immense service to have a standard of dampness, so as to be able to say definitely how much dampness there is. The amount of misery, through various forms of illness, leading to consumption and death itself, inflicted on families is incalculable, and from constantly inhaling damp air.—HEALTH IS WEALTH.

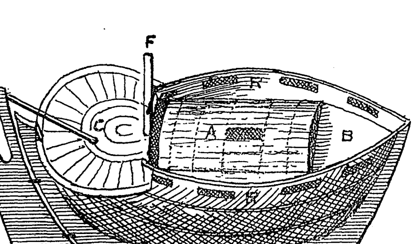
[61473.]—**Cell.**—TO E. CONRY.—In the number for Jan. 1st you were kind enough to say you would send particulars of a cell suitable for testing if I advertised my address. This I did in the edition published Jan. 8th. I fear the advt. has escaped your notice. I shall be quite willing to communicate with you before you send details, if desired, when I know your address.—FIX.

[61474.]—**Silver Cell.**—Querist has made a cell on the chloride-of-silver principle, which was intended to work a small coil. It was made up of a few old silver earrings, riveted together to form the silver plate. Upon this was melted chloride of silver. He put this and zinc plate into a test-tube about 3in. by 1in. Now here is the mystery: The excitant was to be zinc chloride, which he imagines is ordinary soldering fluid—viz., zinc dissolved in hydrochloric acid. This was done, but the cell gave no current at all. He then tried a solution of salammoniac, which worked it a bit; but not strong enough, and the zinc turned black. Should be glad if someone could put to rights the—CLEVER FELLOW.

[61475.]—**Automatic Blowpipe Apparatus.**—Can anyone inform me of an apparatus for blowing two blowpipes (¼in. holes)? It is worked with water. Hydraulic pressure can be got up to 500lb. by means of a treadle. This apparatus will work some time without treadling, and keep a continual blast.—TAL-CATO.

[61476.] — **Brass Foundry.** — (See Vol. XLIV. No. 1,135, page 362.) Would you be so kind as to tell me what would be the best stuff to fasten the brick of the furnace together? Would ordinary mortar do? Also, what would be the best fuel for the same, and the length from ashbox to chimney?—H. E. B.

[61477.]—**Name of Craft Wanted.**—Could anyone favour me with the name and nationality of the craft of which a rough sketch is inclosed, and the position and style



of the mast and spars, as I have a good model from the collection of the late Vice-Admiral Wilmot, K.C.B., but no description. A is the awning of rice-straw over hold; **B**, deck forward; C, platform or stern deck widely overhanging counter; R, bulwark, dark spaces being openings; F, upright with crutch at top for crest.—W. E. HALLS.

[61478.]—**Lenses.**—I have the drawings for a draw-telescope. Will some experienced person give me their advice as to lenses—i.e., who would be the maker to obtain them from? Am at a loss, there being so many makers said to be possessing merit.—B. B.

[61479.]—**Medical.**—Will one of our medical correspondents give me the best remedy for destroying the smell of smoke, &c., in mouth, which is very disagreeable when talking to anybody. The sweets sold for that purpose generally are so vulgar in perfume. Any advice will oblige—B. B.

[61480.]—**Medical.**—I have two bottles, one full of white quinine, the other steel drops. Are these to be used in combination, or separately? Please mention quantity. Also, for what purpose are they used, and their action on the system?—B. B.

[61481.]—**Newcastle and Carlisle Railway.**—Will Mr. Stretton kindly supply drawings of the "Comet" along with particulars of construction, for benefit of readers of "E. M."?—ROVER.

[61482.]—**To Loco. Correspondents.**—What is the difference in the heating powers of the firebox and the tubes in a loco. boiler? In Webb's compound passenger engine it is stated that the heating surface of the firebox is 84·84ft., and the tubes 908·87ft.; total, 993·71 sq. ft. What is the value of each in raising steam—i.e., how many sq. ft. of heating surface of the firebox are equal to 1H.P., and how many sq. ft. of heating surface of the tubes is equal to 1H.P.?—W. S.

[61483.]—**Heat of Water.**—Would "T. C., Bristol," or any other of your correspondents, kindly answer the following in plain figures? If a portion of cast-iron pipe, 12in. long, 4in. diam. (internal), and ¼in. thick, were heated to a temperature of 1050° Fahr., and it was suddenly filled with water at a temperature of 32° Fahr., to what temperature would the water be raised, supposing the whole of the heat was absorbed from the pipes? Specific heat of water nine times that of iron.—W. H.

[61484.]—**Metallic Hone.**—I have heard of a hone which is said to be remarkably efficacious for razors, made of some metallic substance, or mineral containing metal. It does not require oil, being soaked in water a few minutes before use. I believe it comes from Austria. If any of "ours" know of it, I shall be much obliged for the correct name, as I have failed to procure anything answering the description I have given.—D. G.

[61485.]—**Steel Spiral Springs.**—Will any kind reader tell me the greatest weight a steel spiral spring will force up a tube with ⅝in. bore? The spiral spring must go inside the above-sized bore, and the weight is to be attached to the end of the spiral spring; length of spiral spring when expanded, after throwing the weight as far as it will go, not to exceed 10in.—SPRING.

[61486.]—**Petroleum Gas Engine for Launch.** —As I intend getting a launch of galvanised steel built, about 40ft. long, would any subscriber be so good as give me some idea of proportions and lines of hull? Also a description of the engine and generating apparatus required to obtain a speed of not less than ten miles per hour?—GLASGOW.

[61487.]—**Gnomonic Projection.**—TO "F.R.A.S." —I wish to project a map of the British Isles, and the purpose I need it for requires that great circles on the globe be straight lines on the map. Kindly give me a hint how to draw the meridians and latitudes, supposing the plane of the map to touch the sphere in latitude 55° N. I can draw and divide central meridian and project the Pole and Equator.—K. E.

[61488.]—**Brass Tubes.**—I need a very large quantity of brass tubes, similar to those used as caps for pencil ends, ½in. long, half a line thick in the wall, half of them twenty-two lines in diam., the other half twenty-three lines. How are they to be drawn? Next I need to have them flattened in the top, as is done with small brass cartridges. How is this done? Lastly, I wish to have four turns of a spiral groove pressed into them, so that they will screw into one another when placed mouth to mouth. Can this be done? If any practical man thinks he could explain by letter, though not through "E. M.," he will be at no loss if he advertises his address.—A. E. S.

[61489.]—**Speeding Engine.** — A high-pressure engine, with cylinder 1ft. 6in. dia., 3ft. stroke, makes 80 revs. per min.; governors, known as Porter's, make 320 revs. The engine runs too fast: it wants to run 70 revs. per min. Would some correspondent kindly inform me what alterations to make in governor speed, &c.?—GOVERNOR.

[61490.]—**Acoustic Telephone Construction.**—Will some reader be kind enough to give me a sketch with size to work to, showing the construction of an acoustic telephone? Also if non-covered copper wire will answer better than galvanised wire? Also inform me if hard wood insulators, with indiarubber cores through, will answer for this telephone, as I wish to construct one to speak from my engine-room to boiler-house, a distance of 120 yards, overhead, to act as transmitter and receiver both, so as not to require any electric battery.—WORKHOUSE.

[61491.]—**Copper Castings.**—Would any of our numerous readers kindly tell me how to make copper castings from wood patterns? I have tried two or three places, but without success. Also, I have heard that there is a metal much resembling copper, which I think I could make do. Any information about either will be gladly received.—PERTH.

[61492.]—**Cells for Motor.**—Will some kind reader inform me how many pint bichromate cells would work a motor which I have, with Siemens armature, 3in. long, 1¼in. diam., fitted with 22 silk-covered wire; the field-magnets 4½in. by 4½in., fitted with 20 silk-covered wire?—COIL MAKER.

[61493.]—**To Change the Colour of Diamonds.** —Can any reader give particulars of the new chemical varnish which apparently has the effect of changing a yellow or off-colour diamond into a valuable white stone? It is stated that very few, except an experienced expert can detect this fraud (see the police report in the *Times* 3rd Jan., 1887).—SUBSCRIBER.

[61494.]—**Spurwheel Query.**—Will some reader kindly inform me the best method for constructing curves for the flanks and faces of teeth?—AMATEUR.

[61495.]—**Hot-Neck Grease.**—What is the composition of hot-neck grease, as used in rolling mills?—ANXIOUS.

[61496.]—**Wooden Pumps.**—I wish to know how the joints of the old-fashioned wooden pumps were made, and if there is any kind of tool turned by hand which will form the male and female cone, so as to be perfectly air and watertight when driven together. I wish to make water pipes, 2½in. bore, from a number of blown-down larch trees, and have shell auger used for boring beetling beams.—XXXIII.

[61497.]—"**Singing" Hammers.**—What are the best dimensions for a hammer which, when heated and placed on a block of wood, will give a sound of sufficient intensity

to be heard in any part of a large room? I have made some of various sizes without getting a satisfactory result. —S. H. W.

[61498.]—**Battery.**—On page 435, Jan. 14, 1887, there is a battery published by Mr. S. Bottone. Will he be kind enough to give me the length, breadth, and width of the carbons and zincs? Also, how many cells would it take to light a 10c.p. lamp?—J. H. WILSON.

[61499.]—**Storage.**—Have any of our electrical correspondents noticed, when discharging secondary batteries, that bubbles of gas rise between the plates, but stop if the discharging circuit be opened? If anyone has noticed it, I should like to have his help in the matter, or else be directed how to prevent it, as there must be a loss in capacity if the chemical energy of the battery be allowed to escape the way it appears to. In most textbooks we are told that a stranded conductor has a greater weight and carrying capacity and less resistance than the same number of wires unstranded. What is the explanation of this? I have looked through all the textbooks I possess for a description of the Thomson-Houston arc lamp, but have not be able to see any as yet. If anyone could give me a full description of its mode of working I should be much obliged. What is the best way to silver the back of an electric reading lamp, as I can't get the silvering to stick to the bulb?—IOTA.

[61500.]—**Lens.**—Will some reader kindly tell me the scope of a lens I purchased in London some time ago? I bought it for a half-plate; but I have only a quarter-plate camera, and I am contemplating purchasing a half-plate camera, if the lens will cover the plate. The image given is so small that I am in doubt about it. It is a double combination portrait lens, and glasses measure 1 9-16in., and on lens is "W.A. 4705." Who is likely to be the maker? —H. C. C. S.

[61501.]—**Battery Plates.**—Some time ago an idea was given in "Ours" that it would be an improvement in battery plates if they could be cast with mercury in due proportion. This I have been trying to do, but find the resulting plates so brittle as to render them useless. Can some of "ours" help me to remedy this?—H. C. C. S.

[61502.]—**Gilding Solution.**—I wish to make up half a gallon of gold solution, either by the chemical or battery process, the solution to contain about four pennyweights of gold. I have a one-gallon battery (Bunsen). Is this suitable for the job?—WOULD-BE GILDER.

A Telephone Palace.—There are probably no capitals in Europe where the telephonic system has been brought into more general use than is the case in Stockholm, nor can any other town vie with the Swedish capital as regards perfection of arrangements, &c. The plan adopted there, as in most Swedish towns, is a high degree of centralisation, which simplifies the service and saves time and money. There are in Stockholm two independent companies, of which the Almänna Telephone Company seems to be taking the wind out of the sails of the Bell Company. The former has at present some 3,600 subscribers, a large number for a moderately-sized town like Stockholm; and when its new building is completed there will only be two stations or centres, of which the new building will accommodate 3,100 subscribers. The new building referred to has, not without cause, been christened a telephonic palace, as, with one or two minor exceptions, the whole of the large edifice, from cellar to top, is given up to the various departments of the company. The most interesting feature is undoubtedly the large telephone room, its length being 110ft., with 30ft. breadth, which obtains its light partly through the ceiling and partly through windows. It is at present intended for 4,000 subscribers, but can be increased up to 7,000 subscribers. These 4,000 are divided among twenty tables, with 200 subscribers "proper" for each table, but according to the new and ingenious, although somewhat complicated, arrangements, all the other subscribers can "call on" each table, where the connection can then be established without communicating with other tables. There is also a special signalling system, which shows when a subscriber is engaged at another table. All this necessitates 16,000—and, should the service be extended to 7,000, 28,000—connections at each table. The number of connections increases in proportion to the square of the number of subscribers, so that 7,000 subscribers require 49 times as many connections as 1,000. The staff of clerks in this room is two at each table, and, as there is a double set, the total is 80 clerks. The wires in the telephone room are arranged in net fashion, and the wires within the room will have the fabulous aggregate length of 160 Swedish miles.—*Engineering.*

Steel from Horseshoes.—The following novel method of converting wrought iron into metal suitable for knife and sword blades is going the round of American technical papers:—"A shrewd Chinaman has hit upon an article of export from Germany which has thus far escaped the attention of the money-getting Teutons. It is neither more nor less than cast-off horseshoes, of which some Berlin firms are about to ship some 3,000 or 4,000 tons. The 'heathen Chinee' has found out that the wrought iron of which horseshoes are made, owing to the constant and even hammering on the pavement, together with the equine animal heat, gradually assumes the hardness of steel, combined with great malleability and elasticity, qualities which fit them more especially for the manufacture of knives and sword blades."

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

HOSPITAL SUBSCRIPTIONS.

THE suggestion made that hospital patients should benefit by the kindness of readers of the ENGLISH MECHANIC willing to defray the cost of a year's subscription for the benefit of any particular hospital, has been responded to by "D. G.," who sends us £1 2s. for two such subscriptions, which we have appropriated respectively to St. Bartholomew's and Guy's Hospitals; and by "R. S. T." (who first suggested the idea) who sends £1, which will be appropriated as far as it will go to the London and Charing-cross Hospitals.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 19, and unacknowledged elsewhere:—

W. GOYEN.—John Wood.—F. M. E.—A Fellow of the Royal Astronomical Society.—O. P. Scourfield.—C. A. W. —H. B. Fulton.—W. A. S. B.—F. A. M.—A. W. Stokes, F. C. S.—Amateur.—J. R.—M.M.I.Sc.S.—Edward Conry. —B. Payne.—W. M. S.—Young Ghazi.—Enquiry.—An Old Man and Upper Strapper.—Dusty Million.—Volt.— B. Boothroyd.—Dynamo.—T. C. C.—J. H.—Spectator.— Anxious Improver.—H. C.—W. A. W.

THEODORE ROUSSEL. (We are not aware that any prize has been offered for a geometrical solution of the problem of the trisection of angles.)—SAILOR. (Read the "Scientific Dialogues on the Tides" in Vol. XXXIX., and look through the indices of recent volumes for methods of calculating.)—A 12 YEARS' SUBSCRIBER. (Procure a catalogue from Messrs. Churchill, 11, New Burlington-street, W., and you will be able to suit yourself. You do not specify what anatomy you mean.)— WORKMAN. (Unwin's "Machine Design," Longmans; Campin's "Details of Machinery," Crosby Lockwood and Co.; but it would be advisable to ask the teacher of your class.)—J. C. (If you cannot refer to back volumes, procure a manual of "Practical Taxidermy," published by Mr. L. U. Gill, 170, Strand, W.C.)—BLOOMSBURY CONFECTIONER. (Mix any desired flavouring with the melted gelatine; pour out on slabs to cool, and cut up with a lozenge-machine. Perhaps, however, you mean gum lozenges.)—YOUNG TURNER. (Draw a line with a sharp point, and grind off to that.)—J. W. B. (Writing inks without galls are usually made of decoction of logwood and green copperas, or bichromate of potash.)— WATCH JOBBER. (Articles on watch-repairing have appeared in many back volumes—nearly all, in fact. Probably you mean the articles in Nos. 886, 888, 889, &c., through Vol. XXXV.)—F. J. A. (The brilliancy of the sun at noon is equal to that of about 600,000 full moons. Zöllner's determination is perhaps the best, and by two methods he found the light of the full moon to be one 618,000th that of the sun, and one 619,000th respectively.) —UNDER KEEPER. (Browning gun-barrels described several times; with full details in No. 1035, p. 456.)— ENGINE. (Equal parts rubbed together. 2. That is a defect of the horizontal form, which is generally remedied by carrying the rod through back cover.)— SHOPMAN. (Given many times. See pp. 463, 485, Vol. XXXVII., and the indices of back volumes.)—GLOVASKI. (You will probably find what you want in No. 1017, p. 61; but you had better send the wheels you want matched.)—NEW READER. (Perhaps the coil described in No. 1121 will suit you. 2. Galvanic belts can be made of pieces of zinc and copper separated by canvas, or with wires of zinc and copper wound on pieces of wood. 3. Leclanché described many times. The "new" Leclanché is made with patent agglomerate plates held to the carbon by rubber rings, and then immersed with a rod of zinc in a strong solution of sal-ammoniac.)—AN AMATEUR. (For details of nickel-plating, see Nos. 993, 994, 995. Not easy with a battery plant; but see the catalogue issued by the Electro-Metallurgical Co., Charlotte-street, Blackfriars, S.E. 2. You must not expect to do lacquering properly in half a dozen attempts.)— JOHN RIPLEY. (We have no knowledge of any cheap batteries except those described in our columns.)— WRITER. (Hall's type-writer was illustrated in No. 928. There is much about others in back volumes. 2. Of too little interest; for when made so few people can have any use for it.)—T. M. P. (It is early yet; perhaps it may be answered. Probably you would succeed in getting an electrotype by covering the mould with plumbago in fine powder, and connecting the battery wire to the plumbago. The actual process of electrotyping has been frequently described.)—C. E., M. E. (If the machine is not the subject of a patent, anyone can make it. What they do with it is quite another matter; but if your patent is infringed abroad, you have a remedy against the infringers, provided you have obtained a patent in the country where the invention is used.) — H. LANGSTON-CLIFFORD. (You will find answers to all your questions in the Act itself, and in the rules issued by the office. We have given full particulars, and the only amendments were specified in No. 1067. Ten months is the time now, and the specification can be seen as soon as its acceptance is advertised.)— INCUBATOR, B.O.T. (For incubators, see No. 1075, p. 181; No. 1007, p. 425; No. 1009, p. 471; and No. 935, p. 562.)—W. H. H. (It depends on what you mean by "enamelling." See p. 243, last volume, and the indices generally.)—MECHANIC. (Certainly there is solid silver and gold; but articles of jewellery are generally made hollow or with a filling, and in the case of gold are rarely made with pure metal. 2. Not more dangerous than at other times; but it depends on the nature of the enamel, or china, as you call it.)—H. CHEWNELL. (You must say more definitely what is meant by "ancient weather glasses"; but you will find several old-fashioned forms described in back volumes.)— FLOWER-POT. (Why make holes in them? It is usual to stand the ordinary pots inside. A sharp drill kept wet will go through, or you can use a bit of copper tube and emery with oil. Notch edge of tube slightly, and keep up a steady pressure while revolving the drill.)— J. M. (No doubt there is some affinity; but at present very little is definitely known about the matter. Why should they be pressed flat when the silex is deposited from liquid?)—SKATER. (A patent costs £4, £1 being paid on application and £3 with the complete specification which need not be lodged until 10 months after the application. Procure one of the handbooks advertised by patent agents in our columns.)—IVORY. (Ivory is bleached by exposing it under glass to the action of the sun. The bleachers use frames which resemble those to be seen in gardens for protecting or raising plants. It must not be exposed to the sun without the protection of glass.)—GIDEON. (The obvious remedy is to hang them up somewhere to dry. If you mean they are already "dry," the preparation with which they have been dressed extracts moisture from the air.)—A CABINET-MAKER. (The photo-zincotype process is cheapest. Make drawings in firm lines twice the size required, and any of those firms who make "process" blocks will supply you with what you want.)—MONO. (Several recipes in back numbers; but whether they will suit your purpose can be determined only by experiment.)—A. C. (Use silk-covered wire for all coilwork. You will find all necessary particulars in even recent numbers.)—C. S. (The paint is laid on with an oil varnish; probably a clear spirit varnish over that would produced the effect desired.)—A COUNTRY COUSIN. (There are several recipes in back volumes. All "wines" of the kind "go bad" unless they are "fortified" with spirit.)—AMATEUR CARPENTER. (Perhaps you would find what you want in our back volumes; but Charles's "Practical Cabinet-Maker," Spon, and Tredgold's "Elementary Principles of Carpentry," Crosby Lockwood and Co., may possibly meet your desires.)—SOMERSET LAD. (The question is too wide or too vague. There is no formula that will suit all conditions. The simple rule is that the air-vessel should be three or four times the capacity of the pumpstroke for ordinary work; but for high pressure, quick-working pumps seven or eight times.)—A. SMITH. (The question should have indicated what is meant by enamelling. See p. 243 last volume, or No. 952 for a general article on enamelling.)—A. B. C. (See indices. There is no book on its construction that we know of. The other questions are simply advertisements, which should appear in the Wanted Column.)—PUZZLED. (The rod can actuate a lever carrying the hammer, or work a jack with a spring hammer, as in the well-known tablebells.)—SANITAS. (We cannot tell you how to get admission to the Plumbers' Company. They have, we believe, some scheme on hand for the registration of workmen and masters as efficient plumbers; but the number registered yet is very few comparatively. We should think a certificate of examination by the Sanitary Institute of Great Britain would be much more useful to you.)

Engineers and Stokers.—The work in an Atlantic liner is difficult, arduous, and unrelenting. It demands energy, presence of mind, and technical skill of a high order. The bare enumeration of these qualifications is a guarantee that in a British ship no special preference will be given to foreigners. The engineers are mostly Scotch, the stokers Irish. The qualities most required in the stokehole are a dogged resolution to face discomfort and a sturdy frame. The stoker is begrimed with coal dust. He has to endure an atmosphere which sometimes rises to a temperature of 130°. In this intense heat he has to shovel every day five tons of coal into the furnaces, and to keep the fires clear and bright by constant raking and by the periodical removal of ashes. Upon none have the burdens of the mechanical development of our age fallen more heavily than upon the men who undertake the duties of firemen in an Atlantic liner. Who can refuse to follow Mr. Ruskin in his admiration for the life of a sailor, and the beauty of the swelling canvas which it is his business to handle, or withhold his sympathy from those who are engaged in the wretched labours of the stokehole? It has often been proposed to feed furnaces mechanically. The method would obviate the necessity of employing men in one of the most distressful forms of manual labour. —*Lord Brassey, in the Nineteenth Century.*

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 28, 1887.

NOTES ON THE CHURCH ORGAN.
IV.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

NEXT in importance to the foundation stops, and their harmonic companions, commented on in the preceding article, come the *Doubles*, or manual registers of 16ft. pitch. There can be no question as to their utility and importance in a Church Organ. Considering the instrument in its more important function—that of accompaniment to a number of voices singing in harmony—it will be observed that the unisons, combined with the octave and harmonic stops, sustain the Trebles in a perfectly satisfactory manner; but that the Tenors and Basses are by no means adequately supported and enriched. To give them the support required a *Double Diapason* or some telling 16ft. register is absolutely necessary. Hence the importance of having such a stop in every Church Organ of any pretensions. In addition to the necessity of having a *Double* for ordinary accompanimental music, such a step is of the greatest value in imparting fulness and dignity, unattainable by any multiplication of unison registers. Dr. Hopkins, who has carefully studied this important question, remarks:—"If a chord be played in the Treble part of the Great organ of an instrument placed in a large building, and not having any stops lower in pitch than the unison, there will be perceived a certain *smallness* of effect, which makes it evident that, although the Treble may possess sufficient brightness and intensity, perhaps even amounting to shrillness, yet it lacks the amount of fulness and volume necessary to produce an ample and dignified tone. This arises from the fact of even the Unison Pipes in the Treble being comparatively acute in their sound; and, therefore, in the very nature of things, unpossessed of stately impressiveness. It thus becomes obvious that the harmonic-corroborating series of Stops alone do not present *all* the resources necessary to form a satisfactory organ. Something that is essential appears to be wanting; and a fresh element is felt to be necessary to supply that absent property. The property wanting is *gravity*, which possesses a character peculiar to itself, and for the absence of which no amount of *intensity* in the other sounds will compensate. Of the travelling and filling-up character of grave sounds we have already spoken; and of the fact itself, a sufficient illustration is given in the circumstance of a chant sung by twenty tenor and bass voices, in unison, pervading a building more completely than if sung by thrice the number of trebles. Again, the deep tone of a Pedal Diapason will travel through a building more entirely than a double chord of six or seven notes played on the Manual Diapasons from middle c^1 upwards. Its sound will certainly not be nearly so well defined; but it will be of a more pervading character. The want felt, and above specified, however, is not a *substitute* for the harmonic sounds, but a new element, which, *added* to them, shall render the general tone larger and more ample. It is worth mentioning that this want was so much felt, nearly three centuries and a half ago, abroad, that means were, even at that period, taken to supply the deficiency. It was about the year 1508, that a Covered Stop of 16ft. size of tone was invented in Holland; and which, to some extent, imparted the necessary, deep, resonant, *humming* effect to the other Stops, and was hence expressly called *Bourdon*—a name that means a hum or drone; and which Stop has never ceased to be highly valued abroad to this day."

From what is above written, the reader can hardly fail to realise the great importance of a stop of 16ft. pitch on the manuals; and it now remains for consideration what description of stop should be introduced in organs of different sizes; and at what point, with reference to the contents of the organ, the *Double* becomes advisable if not imperative. The latter question may conveniently be taken first. So soon as sufficient unison, octave, and harmonic tone is provided to accompany, in a fairly effective manner, the voices of the choir and congregation, then the *Double* should be added to the manuals in preference to any further multiplication of unison stops of an orchestral or fancy character. Once the manual departments furnish the true elements required to support, equally, *all* the voices in four-part harmony, then and then only may imitative and fancy stops be contemplated, with the view of further enriching the general tone, and securing the means of imparting variety of colouring to the lighter accompaniments, and to the incidental music of the services. Speaking roughly, and merely by way of general guidance, I should say that every Church Organ, which has an independent Pedal organ, should have a *Double* added to the manual department, even when it comprises only ten stops in all. Turning to Roosevelt's Specifications, I find my opinion supported. In his Church Organ, Style Thirteen, the single manual department comprises nine speaking stops, one of which is a *Bourdon*, 16ft. tone, throughout. Every Church Organ from this size upwards to twenty speaking stops should have one manual *Double*; and when it reaches that number it should have a stop of 16ft. pitch on each manual, one of which should be an open register—*Double Open Diapason*, *Double Dulciana*, or *Contra Gamba*. The present almost universal practice of having only one covered stop of 16ft. tone, usually placed in the Swell department, even in organs of considerable size, I unhesitatingly condemn, and it unfortunately happens that such instruments have lamentably deficient Pedal departments, making matters still worse.

Now, with reference to the description of 16ft. toned stops most suitable for Church Organs of different sizes, and for insertion in their separate manual departments, the following brief hints may be worthy of consideration:—When funds and space are both limited, and the church is of small dimensions, a *Lieblich Gedackt*, which neither occupies much room nor costs a large sum, will be sufficient to give the required support to the Bass and Tenor voices, and to impart dignity and gravity to the general organ tone. If the organ is a two-manualled instrument, of about 12 or 15 stops, with the full complement of couplers, the *Double* should be placed in the Swell department. In somewhat larger instruments a *Bourdon* of medium scale should be introduced in the Swell department, and where circumstances permit, a soft stop of 16ft. pitch should be added to the Great department. This may be an open metal stop from Tenor C, the bass octave being carried down in stopped wood pipes. When a Church Organ comprises from 25 to 30 stops, in addition to a *Bourdon* in the Swell, there certainly should be a full-scaled *Double Dulciana* or small *Contra Gamba* throughout in the Great. In a still larger instrument, a medium-scaled *Double Open Diapason*, voiced to a full round tone, becomes a necessity in the Great department, especially if the organ is placed in a spacious building, and has to support a large and properly balanced choir. I need scarcely point out that the Swell to Great sub-octave coupler gives the organist ready means of adding several strengths and varieties of 16ft. tone, down to Tenor C, on the Great clavier; and, further, a soft 32ft. tone to the same note when the *Bourdon* in the Swell is drawn. The utility of this valuable coupler is thus made apparent. Few Church Organs have a stop of 32ft. pitch on the manuals. I may mention two instances in this country — the organ in the Parish Church, Leeds, the Great department of which has a *Sub-Bourdon* of metal and wood, 32ft. tone from Tenor C; and the organ in the Parish Church, Doncaster, where a *Sub-Bourdon*, from Tenor C, occupies a similar position. The Great department of the latter instrument has three stops of 16ft. pitch, the Swell two, and the Choir, Solo, and Echo one each. The great importance of the manual *Doubles* is here fully realised.

On the subject of other flue stops desirable in the Church Organ, it is unnecessary to dwell at length; for, as I have already said if the foundation-work is adequately represented in all departments, the Church Organ, properly so-called, will be safe. Up to the present point I have, with the single exception of the manual *Double*, spoken of open metal stops only—the stops which form the vertebræ of the tonal structure of the organ —now I may direct attention to another class of stops which is only of secondary importance to the open foundation stops. I allude to the stopped or covered registers, known by the names, *Stopped Diapason*, *Lieblich-Gedackt*, *Doppel-Flöte*, &c. These stops, when of proper scales and carefully voiced, produce tones of good mixing and filling-up character, imparting to the foundation tones singular roundness and increased volume. This is caused by the entire dissimilarity of their sounds, and, accordingly, the total absence of that sympathy which is destructive of volume and tonal effect in combination. Of the stops just named, the *Doppel-Flöte*, or double-mouthed flute, is by far the best for the Great department, where a great volume of quiet pervading tone is desirable. The *Stopped Diapason* and *Lieblich-Gedackt*, are suitable for the Swell and Choir departments. It is much to be regretted that the *Doppel-Flöte* is practically unknown in England; and that none of our builders seem disposed to undertake its manufacture. The stupid notion that the characteristic tones of such stops can be imitated by ordinary metal pipes has done and will continue to do much to retard the proper use of wood stops. I unhesitatingly affirm that the peculiarly full and filling-up qualities of the true *Doppel-Flöte* cannot be obtained from a single-mouthed metal stop. The only modern builder who recognises the full value of the *Doppel-Flöte* is Mr. Hilborne L. Roosevelt, of New York. He never schemes a Great department of any importance without including a *Doppel-Flöte*; and in this he gives one of the many proofs of his artistic knowledge and judgment. The stop requires great care in its manufacture, and is troublesome and tedious to voice; these facts, I believe, are sufficient to keep it out of the generality of our English workshops for ever. Again, alas for art! Next to the true organ tone in importance is that known as flute tone, such as is produced by the covered stops just alluded to and by numerous other registers of both wood and metal. Flute tone, when of a refined quality, is extremely valuable for vocal accompaniment, and in imparting that solid variety which is desirable, without impoverishing the general effect. This tone must, however, in all cases, be kept strictly subordinate to the true organ tone.

Stops producing tones which imitate, more or less closely, those characteristic of the family of orchestral stringed instruments, although of much less value in a Church Organ than those previously alluded to, may,

with advantage, be introduced in the Swell departments of larger-sized instruments. They enter into combination with the flute-toned stops, producing bright effects and materially enriching the resources of the organ, especially for incidental music. The string-toned stops should, like all the other registers introduced in the Church Organ, be characterised by richness and body of tone, rather than by that pungency, which, in too many modern examples, approaches a scream-ing or hissing quality.

In such a hasty and necssarily imperfect sketch as the present, I may omit any direct allusion, in detail, to those organ stops which may justly be designated "fancy stops." Such stops may be desirable in large, many-manualled instruments, but are of little value in small Church Organs, where, it is more than probable, their presence is secured at the sacrifice of registers of infinitely greater value and importance. The craze which obtains amongst "sucking organists" and a large section of the organ-loving public for ear-tickling stops is just as absurd as it is pernicious to true Church Organ building. I may, therefore, conclude this part of my essay with a few remarks on the reed stops most suitable for small and medium-sized Church Organs; and with a hasty glance at desirable stops for the Pedal department.

When a Church Organ has been properly schemed as regards its foundation-work and flue-work generally, it requires but little aid from reed-work. Its presence is, however, very desirable, for it imparts what may be called a golden glory to the already richly coloured embroidery of sounds. Dr. Hopkins has tersely and aptly described the offices of all the great classes of organ stops in the following words:—"Open Stops of the Diapason kind, alone, would produce rather a cutting tone; an organ entirely of Covered stops would sound weak and muffled; while one composed entirely of Reeds would be too strong and penetrating. The four great classes of organ Stops—Open, Covered, Flute, and Reed—are, in fact, to a great extent dependent on each other for the production of the most satisfactory result. The Covered Stops impart a quiet solidity to the Open Stops; the Open Stops bestow roundness and firmness on the Covered Stops; the Flute Stops give variety and increased character to the soft combinations; while the Reed Stops impart to the full organ stateliness and splendour, and in return receive fulness and brightness from the Open series of Stops."

The most important of all the manual reed stops is the *Trumpet*. When this is properly scaled and skilfully voiced, it adds a highly desirable "stateliness and splendour" to the full organ tone. The octave of this stop, called the *Clarion*, is a useful adjunct, when the instrument reaches sufficient size to demand a very pronounced octave tone. Next to the *Trumpet*, in general usefulness, comes the *Oboe*, a pleasant, soft-toned unison reed. In very small organs, placed in churches of small dimensions, in which a *Trumpet* would prove somewhat overpowering, the *Oboe* is the most appropriate register.

In order of interest and importance now comes the *Clarinet*, a unison reed stop of imitative and pleasing quality, imparting an agreeable variety to the softer combinations, and a certain richness and colouring to all combinations in which it may enter. This stop is almost invariably placed to great disadvantage in ordinary Church Organs in this country; for, although of all organ stops it is *the one* which most loudly demands means of expression, it is almost universally relegated to a department which, in English Church Organs, is never inclosed in a swell-box. For those instruments of medium size, in which more than the above named unison reed stops may be considered desirable, either the so-called *Horn* or *Cornopean* (usually an indifferent *Trumpet*) may be adopted. As in all my foregoing Notes I have been directing attention to Church Organs of generally useful size and character, rather than to those huge instruments which have of late years been placed in churches, and which only too often remain as reproaches against all persons concerned in their erection, it is unnecessary for me to speak of the several reed stops, high-pressure and otherwise, which only find their legitimate place in concert-room instruments. Where space will permit, and when the organ stands in a large church, it may be found desirable to insert a reed stop of 16ft. tone in a manual department. The stop may either be a soft *Double Trumpet*, or, what is usually preferable, a *Contra Fagotto* or *Double Bassoon*. The *Vox Humana*, of which so many vile examples exist in English Church Organs, occupying the place of really important and badly wanted stops, is a useless and undesirable register. It must be classed amongst the ear-ticklers I have already spoken of. It is of no use in accompaniment, unless it is to show what a miserable travesty it is of the *human voice*.

I may conclude this article with a very brief allusion to the more desirable stops strictly belonging to the Pedal department of the Church Organ. In the proper appointment of this very important department two impediments almost invariably arise—namely, circumscribed space and insufficient funds. An adequate Pedal organ is, of necessity, a costly and a cumbersome affair; but if a perfect or even a useful instrument is aimed at, an adequate Pedal department must be provided. It is out of all reason to expect the booming, master-of-all-work *Open Diapason*, or the tubby *Bourdon* usually met with in Church Organs, to furnish a true or satisfactory bass for the whole or indeed any considerable portion of the manual departments. It must be recognised, once for all, that the true office of the Pedal stops is to carry down and to furnish correct basses for the foundation and other important stops in the manual organs, and unless they do so the Pedal organ is a fraud. I shall have more to say on this topic when I come to the consideration of the Pedal organ in detail.

The unison pitch of the Pedal Organ is 16ft., and the most useful registers of this pitch are the *Open Diapason*, *Violone*, *Dulciana*, *Bourdon*, and *Lieblich-Gedackt*. In all possible cases an *Open Diapason* should be introduced, providing the foundation tone. In scale, this stop (in wood) need never exceed 12in. by 14in., inside, at the C C C pipe; while, in general, 10in. by 12in. will be ample. The *Violone* may either be metal or wood, with open pipes of small scale, voiced to imitate the tones of the orchestral Double Bass. This, when of soft and refined quality, is an invaluable stop in accompanimental music. The *Dulciana* is a very softly-voiced, open metal stop of smaller scale than the *Violone*, yielding pure organ tones, admirably adapted for the bass of the softest accompaniments. The *Bourdon*, a much-abused and much over-used stop—the delight of the cheap organ builder—is a valuable register in its place in the tonal scheme of a Pedal organ; but, except in the smallest Church instruments, should never be depended on for the principal 16ft. tone in the department. The *Lieblich-Gedackt*, when carefully voiced and copiously winded is a most valuable register. It is of very small scale, and accordingly, occupies little floor space. It is a serviceable stop in conjunction with an *Open Diapason*, and should be adopted in preference to the usual large-scaled *Bourdon*.

Every Pedal department should have an *Octave* (8ft. tone) stop. In very small instruments this may be borrowed from a 16ft. stop, by means of an Octave coupler and an upper octave of pipes: but in all possible cases, an independent *Octave* should be inserted, either in the form of a flute-toned or string-toned stop of softer intonation than the chief unison.

In instruments of medium size, a *Quint* (10⅔ft.) may be introduced. When drawn with a stop of 16ft., it produces, though faintly, an impression, on the ear, of the 32ft. tone. In larger organs, instead of the *Quint*, I strongly recommend the adoption of the *Contra-Bourdon* of 32ft. tone. When well made and favourably located this stop speaks in a very satisfactory manner.

Next in importance to the Pedal organ registers already noticed, come reed stops of 16ft. tone. Of these, the *Double Bassoon* and *Trombone* are the most useful. An octave reed, in the shape of a *Trumpet* (8ft.) may be added when the Pedal department approaches completeness.

It is, of course, desirable to introduce an open stop of 32ft. when space and funds permit; although it is hardly necessary to do so unless a stop of 16ft. pitch appears in each of the manual departments. Then follow, in complete Pedal organs, the mutation and harmonic-corroborating series of stops. I shall have more to say on this subject in my concluding article, where I shall also direct attention to Mr. Thomas Casson's new system of organ building, which practically overcomes the great difficulty which has hitherto obtained in providing an adequate Pedal organ for small and medium-sized instruments, and which may, to a large extent, be adopted with advantage in all Church Organs, whatever their size may be.

(To be Continued.)

ASTRONOMICAL NOTES FOR FEBRUARY, 1887.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 13 49·34 PM	20 59 20	17 6 3	20 45 30·32
6	0 14 18·49 ,,	21 19 32	15 37 4	21 5 13·09
11	0 14 27·30 ,,	21 39 23	14 1 27	21 24 55·86
16	0 14 17·26 ,,	21 58 56	12 20 2	21 44 38·63
21	0 13 49·85 ,,	21 18 11	10 33 39	22 4 21·40
26	0 13 6·43 ,,	22 37 11	8 43 13	22 24 4·16

The method of finding the Sidereal Time of Local Mean Noon will be found on p. 382.

Destitute of spots for many days together, and altogether in a quiescent state, the Sun is in a particularly uninteresting phase for the observer.

There will be an Annular Eclipse of the Sun on February 22nd; but as it will only be visible in the Southern Hemisphere, no further reference is needed to it here.

The Moon

Enters her First Quarter at 8h. 26·8m. a.m. on the 1st, and is Full at 10h. 14·3m. a.m. on the 8th. She will enter her Last Quarter at 1h. 32m. in the early morning of the 15th, and be New at 9h. 40·2m. on the night of the 22nd.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	8·4	6 18·8 p.m.
6	13·4	10 49·1 ,,
11	18·4	2 40·0 a.m.
16	23·4	7 3·0 ,,
21	28·4	11 11·8 ,,
26	3·6	2 47·6 p.m.

The Moon is in conjunction with Saturn at

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
3	48 Tauri	6	1 15 a.m.	Dark	110	150	2 9 a.m.	Bright	263	300
3	B.A.C. 1526	6	6 26 p.m.	Dark	144	122	7 24 p.m.	Bright	242	233
6	3 Cancri	6	9 17 „	Dark	100	77	10 27 „	Bright	245	239
7	B.A.C. 2731	6½	2 13 a.m.	Dark	134	172	2 47 a.m.	Bright	200	239
7	54 Cancri	6½	4 29 p.m.	Dark	114	77	5 14 p.m.	Bright	234	195
7	o^1 Cancri	6	†7 21 „	N. by E.	172	132				
11	46 Virginis	6	11 17 „	Bright	58	23	12 19 p.m.	Dark	256	226
12	48 Virginis	6	1 43 a.m.	Bright	355	336	2 7 a.m.	Dark	314	299
13	94 Virginis	6	5 26 „	Bright	28	38	6 22 „	Dark	286	305
14	ξ^1 Libræ	6	1 4 „	Bright	86	52	2 6 „	Dark	230	202

† A near approach. A description of the construction and use of this table, with an illustration, will be found on p. 383.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Ec D	6	34	3 A.M.	11	I	Tr I	1	13	a.m.	22	II	Sh I	2	29	a.m.
2	I	Sh I	3	40	„	11	I	Sh E	2	14	„	22	II	Tr I	4	44	„
2	I	Tr I	4	54	„	11	I	Tr E	3	24	„	22	II	Sh E	5	7	„
2	I	Sh E	5	53	„	11	*I*	*Oc R*	12	44	p.m.	24	II	Oc R	1	23	„
2	*I*	*Tr E*	7	5	„	13	II	Ec D	4	50	a.m.	24	*I*	*Ec D*	6	41	54 „
3	*I*	*Ec D*	1	2	18 „	14	III	Sh I	2	49	„	24	*III*	*Ec R*	11	0	48 P.M.
3	I	Oc R	4	25	„	14	III	Sh E	4	59	„	25	III	Oc D	1	40	a.m.
3	*I*	*Sh E*	12	21	p.m.	14	*II*	*Sh I*	11	55	p.m.	25	III	Oc R	3	4	„
4	I	Tr E	1	33	a.m.	15	II	Tr I	2	17	a.m.	25	I	Sh I	3	47	„
6	II	Ec D	2	15	59 „	15	II	Sh E	2	33	„	25	I	Tr I	4	52	„
6	*II*	*Oc R*	7	13	„	15	II	Tr E	4	49	„	25	I	Sh E	6	0	„
7	*III*	*Sh E*	1	2	„	17	I	Ec D	4	48	42 „	26	I	Ec D	1	10	13 „
7	III	Tr I	4	0	„	17	*III*	*Oc R*	11	26	p.m.	26	I	Oc *R*	4	23	„
7	III	Tr E	5	35	„	18	I	Sh I	1	54	a.m.	26	*I*	*Tr I*	11	19	p.m.
8	II	Tr E	2	20	„	18	I	Tr I	3	3	„	26	I	Sh E	12	29	„
9	I	Sh I	5	33	„	18	I	Sh E	4	7	„	27	I	Tr E	1	30	a.m.
9	*I*	*Tr I*	6	45	„	18	I	Tr E	5	14	„	27	*I*	*Oc R*	10	50	p.m.
10	I	Ec D	2	55	30 „	19	I	Oc R	2	34	„						
10	I	Oc R	6	17	„	19	*I*	*Tr E*	11	42	p.m.						
10	*I*	*Sh I*	12	1	p.m.	21	*III*	*Sh I*	6	47	a.m.						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

Approximate Greenwich Mean Times of the Greatest Eastern Elongations of the Five Inner Satellites of Saturn.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
1	Mimas	2·7 a.m.	10	Dione	2·9 a.m.	19	Enceladus	2·7 a.m.
1	Dione	9·9 p.m.	10	Enceladus	9·5 p.m.	19	Tethys	9·0 p.m.
2	Mimas	1·3 a.m.	12	Enceladus	6·4 a.m.	19	Mimas	11·1 „
2	Enceladus	4·2 p.m.	12	Dione	8·5 p.m.	20	Mimas	9·7 „
2	Tethys	9·4 „	14	Tethys	5·1 a.m.	21	Dione	1·4 a.m.
2	Mimas	12·0 „	14	Enceladus	12·1 p.m.	21	Tethys	6·2 p.m.
3	Mimas	10·6 „	16	Rhea	1·4 a.m.	21	Mimas	8·4 „
4	Enceladus	1·1 a.m.	16	Tethys	2·4 „	21	Enceladus	8·4 „
4	Tethys	6·6 p.m.	16	Mimas	4·6 „	22	Mimas	7·0 „
4	Mimas	9·2 „	17	Mimas	3·2 „	23	Enceladus	5·3 a.m.
6	Enceladus	6·9 „	17	Tethys	11·7 p.m.	23	Dione	7·0 p.m.
6	Rhea	12·8 „	18	Mimas	1·8 a.m.	25	Rhea	2·1 a.m.
8	Enceladus	3·7 a.m.	18	Mimas	12·5 p.m.	25	Enceladus	11·1 p.m.

An illustrated explanation of this table will be found on p. 384.

6 a.m. on the 6th; with Venus at midnight on the 9th; with Jupiter at noon on the 13th; with both Mercury and Mars at 3 a.m. on the 24th; and with Venus at 5 o'clock on the same evening.

Mercury

Is an Evening Star throughout the month, and towards the end of it may be caught by the naked eye after sunset glittering over a point of the horizon a little to the South of West. Although he Souths after *Mean* Noon on February 1st, he will be in superior conjunction with the Sun at 6 p.m. on the 6th.

Mercury.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	20 53·4	19 39·9	0 0·9 p.m.
6	21 21·5	17 37·8	0 16·2 „
11	21 56·6	14 31·7	0 31·6 „
16	22 31·3	10 50·7	0 46·5 „
21	23 4·8	6 42·7	1 0·3 „
26	23 35·5	2 25·6	1 11·2 „

Beginning thus in Capricornus, the path of Mercury extends right across Aquarius, and terminates in Pisces. It is free from any conspicuous stars. At 4 p.m. on the 23rd Mercury will be in conjunction with Mars.

Venus,

Like Mercury, is an Evening Star, but is only slightly gibbous, and her angular diameter increases quite imperceptibly from only 10·2″ to 10·3″. Also like Mercury, she may be caught after sunset towards the end of February. She is a very uninteresting object in the telescope at present.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	21 58·2	13 59·9	1 12·5 p.m.
6	22 22·2	11 47·0	1 16·8 „
11	22 45·8	9 26·3	1 20·6 „
16	23 9·0	6 59·5	1 24·1 „
21	23 31·8	4 28·1	1 27·2 „
26	23 54·5	1 53·6	1 30·2 „

The path indicated by the above ephemeris begins in Aquarius, and terminates in Pisces. It is in a comparatively blank region of the sky.

Mars,

For all purposes of the observer, is invisible.

Jupiter

Is a Morning Star, and is in anything but a favourable position for the observer. As, however, he rises between 10 and 11 p.m. at the end of February, we resume our ephemeris of him. His angular equatorial diameter, which is 35″ on the 1st, increases to 38″ by the 28th.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	14 14·0	12 4·5	5 29·5 a.m.
6	14 15·0	12 8·4	5 10·9 „
11	14 15·7	12 10·8	4 51·9 „
16	14 16·0	12 11·7	4 32·6 „
21	14 16·1	12 11·0	4 13·1 „
26	14 15·9	12 8·8	3 53·1 „

So that Jupiter describes a very short arc (partly returning on itself) between κ and λ Virginis.

Saturn

Is still visible all night long, and from his considerable elevation when near the meridian continues to be excellently placed for the observer. As we observed last month, the South Pole of the planet now hides Cassini's division in the ring, and extends, in fact, quite up to, if not just beyond, the southern edge of ring A. The equatorial diameter of the planet, which is 18·3″ on the 1st, diminishes, absolutely insensibly, to 17·6″ by the end of the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 14·6	22 12·5	10 27·4 p.m.
6	7 13·2	22 15·6	10 6·3 „
11	7 11·9	22 18·4	9 45·4 „
16	7 10·7	22 21·0	9 24·6 „
21	7 9·8	22 23·2	9 3·9 „
26	7 8·9	22 25·1	8 43·4 „

The short retrograde path thus described by Saturn, starts from a point so close to δ Geminorum, that for the first four nights in February the planet and the star will be in the same telescopic field of view. Towards the end of the month Saturn will be a little to the west of this star.

Uranus

Will scarcely come into an available position for the ordinary amateur observer until next month.

Neptune

Is now approaching the West, and should be looked for as nearly about the time of his meridian passage as may be convenient. His height above the horizon at this time renders his position very favourable for telescopic observation.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 32·4	17 21·7	6 45·8 a.m.
6	3 32·4	17 22·0	6 26·2 „
11	3 32·5	17 22·5	6 6·6 „
16	3 32·6	17 23·2	5 47·0 „
21	3 32·8	17 24·1	5 27·5 „
26	3 33·0	17 25·2	5 8·1 „

So that Neptune remains sensibly in the same part of that blank region of the sky rather less than 6½° to the South (and just to the West) of the Pleiades, which he has occupied during the whole of his recent apparition.

Shooting Stars

May be looked for with the greatest chance of success on the nights of the 10th and the 19th.

Greenwich Mean Time of Southing of Fifteen of the Principal Fixed Stars on the Night of February 1st, 1887.

Star.	Souths. h. m. s.
α Ceti	6 9 51·12 p.m.
α Persei...	6 29 41·49 „
γ[1] Eridani	7 6 5·22 „
Aldebaran	7 42 40·29 „
Capella...	8 21 28·70 „
Rigel	8 22 14·17 „
α Leporis	8 40 49·57 „
α Orionis	9 2 4·59 „
Sirius	9 53 3·29 „
Castor	10 40 8·97 „
Procyon	10 46 7·68 „
Pollux	10 51 7·78 „
β Cancri	11 23 1·73 „
ι Ursæ Majoris	12 4 0·02 „
α Hydræ	12 34 28·92 „

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List for any other night in February, as also that of determining the Local instant of its Transit at any other Station, will be found on p. 384.

PAICE'S BORING BIT.

IN the annexed illustrations are shown two forms of boring bit recently patented by Mr. A. Paice, of Ryde, Isle of Wight, whose object is to so construct boring bits that the hole or aperture made by them shall be perfectly level at bottom, and without the indentation formed by a point or screw in the centre as with the boring bit of ordinary construction; and also that the side or circumference of the hole or aperture shall be smooth and free from cutter marks.

Fig. 1 is an elevation of the boring bit, provided with flat cutter; Fig. 2 shows the lower end of bit provided with a spiral cutter, and with an adjustable stop; and Fig. 3 is a section through line A A, Fig. 1. The improved boring bit is made of steel or other suitable metal in the form of a hollow tube F, with a cutter, or cutters, G, extending from the outside to the centre. The cutters G are either fixed immovably to the inside of tube F, or are formed so as to run in dovetailed or other suitably-shaped slots, as best seen at Fig. 3. In the case of the cutter running loose in slots, the upper part is extended in the form of a small rod B which passes up the centre of the tube F; and tapped on the end of this rod B is a small thumbscrew C. The waste wood, when the bit is used, passes up the tube F, and outwards through openings H. The upper end of the tube F is closed in solid, and has a hole provided for the upper end of rod B to work in. It is also formed with two projections D (or it may be one projection extending right across) below the thumbscrew C. The lower end of the tube F is formed so as to receive the cutter, and is sharpened on the inside, and the bit is also provided with an adjustable stop E (Fig. 2). In the case of small-sized bits there may be only one cutter extending to the centre of tube instead of right across. When it is desired to use the bit the thumbscrew C is turned so as to withdraw the cutter from the end of tube F, then when the bit is sufficiently started the thumbscrew C is turned back, and so causes the cutting edge to project to the required distance from the end of tube F, and, consequently, if properly sharpened, the tool leaves the bottom

FIG 1

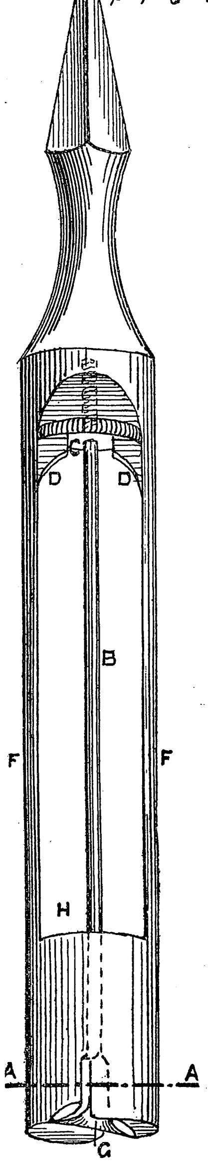


FIG 2

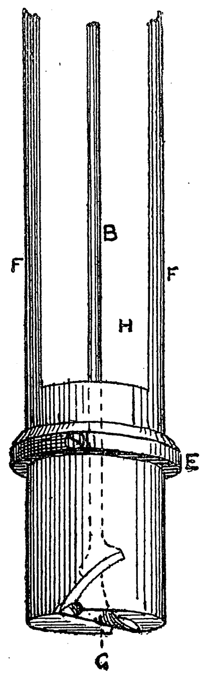
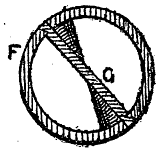


FIG. 3



of the hole perfectly flat, and with no indentations. When it is desired to apply this invention to augers, the patentee fixes the cutter so as to project the required distance from the end of the tube, and the tube may remain intact with the opening at the top for the waste wood to pass outwards.

THE ELECTRO-DEPOSITION OF ALUMINIUM.

IN his "Electricity," &c., Mr. Sprague says, referring to aluminium, "the depositing of this metal would be a process of great value in the arts," and then proceeds to state that several processes have been published, but none is of any practical value. Mr. Sprague also says that all the solutions he tried —acid, neutral, and alkaline—decomposed and gave off gas, but refused to deposit metal. He believes, however, that aluminium may be more readily deposited in alloy with other metals. Sainte-Claire Deville thought it impossible to obtain aluminium from aqueous liquids by electrolysis, though the experiment of Bunsen in the production of barium did much to shake his conviction. Like Mr. Sprague, Deville failed to obtain good results, although he tried all the processes known; and yet it is stated that aluminium can be deposited. Thus it is said that Corbelli, of Florence, deposits the metal by electrolysing a mixture of rock alum and the chloride of calcium or sodium, the anode being formed of iron wire covered with insulating material, and dipping into mercury placed at the bottom of the solution, and the cathode of zinc immersed in the solution. The aluminium is said to deposit upon the zinc. In 1854 and 1855, Thomas and Tilley took out patents for depositing aluminium from a solution of calcined alum in aqueous cyanide of potassium. The patents included the deposition of aluminium alloys. Amongst other statements made, is one by Mr. J. B. Thompson, who asserted that he had been depositing aluminium on iron, steel, &c., at a temperature of 500° Fahr.; but C. Winckler stated soon afterwards that plating with aluminium cannot be effected by electro-deposition. Jeancson's is an American process, a double salt of aluminium and potassium being employed at a specific gravity of 1·161, using three Bunsen cells, and a temperature of 140° Fahr. M. Bertrand asserted that he had deposited aluminium on copper from a solution of the double chloride of aluminium and ammonium; and Goze's process is the simplest of all, for he is said to have obtained a deposit from a dilute solution of the chloride, by placing in it a porous pot containing dilute sulphuric acid and amalgamated zinc, the latter connected to a copper plate immersed in the chloride. Another method of depositing metallic aluminium electrolytically has been recently patented in this country on behalf of Count Rudolphe de Montgelas, of Philadelphia, Pennsylvania.

In this process, the aluminium is first obtained in combination with either lead, zinc, or tin, according as the oxide of either metal is added to the electrolytic liquid. The lead, zinc, or tin is then separated out in any well known way, and the metallic aluminium is thus obtained. The current of electricity employed should be of low electromotive force. As the invention may be conveniently carried into effect in the single decomposition cell, it is described in that connection. The cell may consist of an outer vessel, and an inner porous vessel. In the porous vessel is an element of amalgamated zinc, and an exciting liquid consisting of dilute sulphuric acid. In the outer vessel is an element preferably of brass or copper. The electrolytic liquid, which is placed in the outer vessel, is prepared as follows:— Alumina is treated with hydrochloric acid, and hydrochlorate of aluminium in fluid form is thus obtained. The specific gravity of the liquid is about 1·3 and density 35° B. As above stated, it is placed in the outer vessel of the cell and circuit is closed between the elements. As iron is usually present in the liquid, this metal is first electrolytically deposited upon the brass or copper plate, as a cathode. The operation is to be watched until the deposition of iron ceases and that of aluminium begins, which is apparent by a perceptible change of colour in the deposit. When this occurs, the iron has been removed. The operation is then arrested and the liquid decanted into the outer vessel of another cell similarly arranged to that already described. To the liquid is then added about fifty per cent. by weight, of either lead oxide, tin oxide, or zinc oxide. The terminals of the cell are connected and electro decomposition of the liquid results in the deposition of aluminium and the metal of the added oxide at the cathode. When this deposition is completed, the deposit is removed from the cell, and the aluminium is separated from its accompanying metal in any suitable way known to metallurgists and chemists. It will be observed that the function of the first mentioned cell is simply to remove the iron by electro-deposition. The invention is not limited to this particular mode of removing the iron, because other methods of accomplishing a like result may be adopted. So also the invention is not limited to the deposition of the aluminium in the single decomposition cell. Thus a galvanic bath may be made containing the aforesaid electrolytic liquid, in which electrodes may be placed, and to the electrodes the current—always of low strength—may be conducted from a dynamo or any other suitable source of electricity.

It will be observed from the above that so

far as plating with aluminium is concerned, we are as far off as ever, and it may be doubted whether any process for obtaining the aluminium will compete with the Cowles electrical furnace.

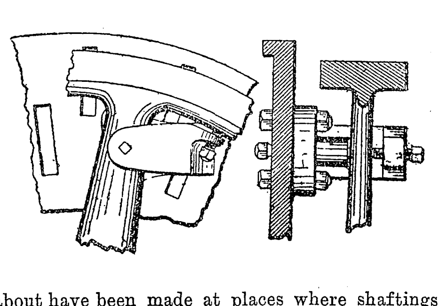
SIR W. THOMSON ON THE ORIGIN AND DURATION OF THE SUN'S HEAT.

IN the course of his lecture at the Royal Institution last week, on the "probable origin, total amount, and possible duration of the sun's heat," Sir W. Thomson said that for several thousand years the sun had been giving heat and light to the earth as at present, possibly with some considerable fluctuations. The natural history of plants and animals within the time of human history abounded with evidence that there had been no exceedingly great change in the intensity of the sun's heat and light during the last 3,000 years; but there might nevertheless have been changes of quite as much as 5 or 6 per cent. But as for the mere age of the sun, we had proof of something vastly more than 3,000 years in geological history, with its irresistible evidence of continuity of life on the earth probably for millions of years past. The sun, then, had been doing work at the rate of 476,000 millions of millions of millions horse-power, and at possibly more than that rate for a few million years. How this was to be explained was a problem which natural philosophy could not evade. The explanation which possessed the highest degree of scientific probability that could be assigned to any assumption regarding actions of prehistoric times was Helmholtz's form of the meteoric theory, the essential principle of which was that at some time long past the sun's initial heat was generated by the collision of masses gravitationally attracted to one another from distant spaces to build up its present mass; and the shrinkage due to cooling gave, through the work done by the mutual gravitation of all parts of the shrinking mass, the vast thermal capacity in virtue of which the cooling had been and was so slow. The rate of shrinkage corresponding to the present rate of solar radiation was $33\frac{1}{2}$ mètres on the radius per year, or one ten-thousandth of its own length on the radius per 2,000 years. Hence, if the solar radiation had been about the same as at present for 200,000 years, the sun's radius must have been greater by 1 per cent. 200,000 years ago than now. If we wished to carry our calculation much further back or forward than that time we must reckon by differences of the reciprocal of the sun's radius, to take into account the change of density. If in past time there had been as much as 15 million times the heat radiated from the sun as is at present radiated out in one year, the solar radius must have been four times as great as at present. If the sun's effective thermal capacity could be maintained by shrinkage till 20 million times the present year's amount of heat was radiated away, the sun's radius would be half what it is now. But the density which this would imply, being more than eleven times that of water, was probably too great to allow the free shrinkage to be still continued without obstruction through overcrowding of the molecules. It seemed, therefore, most probable that we could not for the future reckon on more of solar radiation than 20 million times the amount at present radiated out in a year. Also the greatly diminished radiating surface at a much lower temperature would give out annually much less heat than the sun in its present condition. These considerations had led Newcomb to the conclusion that it was hardly likely that the sun could continue to give sufficient heat to support life on the earth—such life as we were acquainted with, at least—for ten millions of years from now. In these calculations the density of the sun had been considered as uniform for the sake of simplicity. In reality, of course, there must be a wide difference between the density at the centre of the sun and the density at the surface; but it did not seem probable that the correction could add more than a few million years to the past of solar heat, and what could be added to the past would have to be deducted from the future. By the light of more recent calculation, and taking into account all possibilities of greater density in the sun's interior, and of greater and less activity of radiation in past ages, it would be rash to assume as probable anything more than 20 million years of the sun's light in the past history of the earth, or to reckon on more than five or six million years of sunlight for the future. As to the early history of the sun, five or ten million years ago it might have been about double its present diameter and an eighth of its present mean density, but we could not with any probability of argument go on continuously much beyond that time. It was impossible to help asking, however, What was the condition of the sun's matter before it came together and became hot? It might have been two cool solid masses which came into collision with the velocity due to mutual gravitation, or, but with enormously less of probability, it might have been two masses coming into collision with velocities considerably greater than those due to gravitation. If two cool solid globes, each of the same mean density as the earth and of half the sun's diameter, were given at rest at a distance asunder equal to twice the earth's distance from the sun, they would fall together in half a year. The collision would last a few hours, and in the course of it the globes would be transformed into a violently agitated incandescent fluid mass, with about 18 million years' heat ready made in it, and swelled out to possibly three or four times the sun's present diameter. If, instead of being initially at rest, two globes had a transverse relative velocity of 1·42 kilomètres a second, they would just escape a collision, and would revolve in equal ellipses round the centre of inertia. If the initial transverse relative velocity were a little less than 1·42 kilomètres a second, there would be a violent grazing collision, and two bright suns would come into existence in a few hours and commence revolving round their common centre of inertia in long elliptic orbits, the eccentricity of which would be diminished. If the initial transverse component relative velocity of the two bodies were just 68 mètres, the moment of momentum would be just equal to that of the solar system, of which 17-18ths was Jupiter's and 1-18th the sun's, the other bodies of the system not being worth considering in the account. Assuming the sun's mass to be composed of portions which were far asunder before the sun was hot, the immediate antecedent to its incandescence must have been either two bodies with details differing only in proportion and densities from the cases considered; or it must have been some number more than two—at the most, the number of atoms in the sun's present mass. The immediate antecedent to incandescence might have been the whole portions in the extreme condition of subdivision; or it might have been any smaller number of groups of atoms making up minute crystals; or it might have been lumps of matter like meteoric stones. For the theory of the sun it was indifferent which of these alternatives was accepted; but we could not but adopt the common opinion which regarded meteorites as fragments broken from larger masses, and we could not be satisfied without trying to imagine what were the antecedents of those masses. Nothing short of atoms seemed admissible as a theory of the primitive condition of things; and it was strange how we were brought back to the theory of Lucretius.

TURNING PULLEYS—LATHE FACE-PLATES.*

By Prof. JOHN E. SWEET.

SOME unfortunate experience in recent attempts to get pulleys that run true leads me to call attention to a method I believe to be the correct one, producing pulleys meeting the general demand that they shall be cheap and good. I mean where a common turning lathe is used for boring and turning. And here it may be pertinent to remark that the pulleys we have had reason to complain



about have been made at places where shaftings and pulleys are a speciality, and presumably finished by special pulley machinery. I will also take this opportunity to remark that I was told by a man who makes a business of the small pulley trade that they, on common lathes, could beat, in quantity and quality, any special pulley machinery he had ever seen, and that he had seen all he had ever heard of. From his statement of the number turned out in a day, I should judge they could. But to the point. Pulleys that wobble from $\frac{1}{8}$in. to $\frac{1}{4}$in. when set upon a ground mandrel and run on dead centres are not good enough, and the system upon which they are made, that renders it possible to make them so, must be wrong.

The plan that seems to me to be right is this: First, all pulleys to have six, or if very large nine, or if small three, arms; second, to have bolted to the face-plate three brackets, projecting out far enough to bring the rim of the pulley 1in. or more from the face-plate, and of such shape at their outer ends as will grasp an arm of the pulley, with set screws to adjust the pulley sideways and to hold it firm, and set screws to set pulley concentric. [The small engraving will represent Prof. Sweet's idea; as shown, it is applied to turning a balance wheel.]

With this system of holding, it is not possible for the latheman to spring the pulley in any way; and—what is of far more consequence—if the casting has any inherent strain, it will take care of itself when the roughing cut is taken off, and no letting up on the straps, after the roughing cut is over, is necessary or possible. Third, everything that is to be done to the pulley, both in the way of boring and turning, can be done at one setting, and if the brackets are set out near the rim, the driving power is the strongest possible; boring the hole too large or tapering is about the only way to make a poor job.

In setting pulleys, hand wheels, and, in fact, all concentric work that is to be turned outside, and not inside, the "truing up" should be done by the inside instead of by the outside, as is the almost universal practice, for the reason that then, when finished, the rim will be a practically uniform thickness. Another point—if there is any question about a piece holding up to size, if when set by the inside it will not then hold up to size, no amount of shifting will help it.

With a face-plate having three radial slots, the brackets can be set out and in to hold different size pulleys, and this brings up the question of face-plate slots, upon which lathe builders may well spend a moment's thought. We have one with fifty-three slots in the outer circle, and it would be a great consolation to us if the maker could be compelled to use it. It never comes right for anything. What there should always be is twelve, or a multiple of twelve, in the larger sizes. This number is always divisible by both three and four, and, when practicable, three should always be used, unless the piece to be treated is so strong as to be beyond the possibility of springing, or so weak that three points will not sufficiently support it; and then, in the first case, four are better, because a piece can usually be more quickly set on four points than any other number, and in the latter case enough points of supports must be used to hold the piece against the cut.

* From the *American Machinist.*

USEFUL AND SCIENTIFIC NOTES.

Carter's Rivet Pitch Calculator.—This instrument has been designed with a view to afford boiler makers, draughtsmen, and engineers generally a simple, accurate, and comprehensive means of finding a theoretically correct pitch for rivets, without the use of cumbrous tables or formulæ. By a simple movement of the instrument may be found at once, without calculation, such a pitch as will give equal strength of plate and rivet; or the pitch being given, the relative percentages of strength of plate and rivet in the joint may be found. It comprises the requirements of the Board of Trade and of Lloyd's Surveys, and is adjustable to any proportions or allowances desired by the designer. The size is about $5\frac{1}{4}$in. by 2in., and we think it will be found of service.

McKellar's Improved Horseshoe.—An improved horseshoe has been designed by Mr. D. McKellar, Nurseryman, of Oxford-gardens, Notting-hill, W., which promises to become of considerable utility. The patent is not yet completed, so that we cannot fully describe it; but the shoe is so made that a frost plate can be readily slipped over it, while the winter shoe can be worn as an ordinary shoe without the frost plates. A modification provides a shoe excellently adapted for cab horses, &c., as it allows of any description of pad being secured to the hoof. A horse shod in this manner is prepared for all kinds of work, as the plates can be worn regularly or be securely attached to the shoes in a few minutes.

The Coal Supply of London.—According to the statistics prepared by Mr. J. B. Scott, Registrar of the London Coal Market, it seems that in 1886, London imported from different parts of the country by sea 4,671,127 tons, as against 4,563,966 tons in 1885; and by railway and canal, 7,128,380 tons in 1886, as against 7,081,488 tons in 1885. After making due allowance for exports, there has been a total increase in the coal trade within the London district during the present year of 150,043 tons. One is struck by the magnitude of the trade, and also by the fact that the price of coal on the London market has been low during the past year, the average price, including dues, being only 16s. 2d. per ton.

ANOTHER new route to Australia will soon be available. The completion of the new Transandine Railway, now in progress, will, it is expected, enable the time occupied in travelling from this country to Australia to be shortened by at least fourteen days; the route being to Buenos Ayres by steamer, thence by rail to Valparaiso, and thence by steamer again to Australia.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE monthly meeting of this Society was held on Wednesday evening, the 19th instant, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. W. Ellis, F.R.A.S., President, in the chair.

Mr. J. Willis-Bund was elected a Fellow of the Society.

The following papers were read:—

(1) "On the Identity of Cloud Forms all over the World; and on the general Principles by which their Indications must be Read," by the Hon. R. Abercromby, F.R.Met.Soc. The author illustrated the fact of the identity of cloud forms by exhibiting 37 photographs of different kinds of clouds which he had taken in various longitudes, and in latitudes ranging from 72° N. to 55° S., including some actually on the Equator. Cumulus was shown to be the commonest cloud in the Tropics; cumulo-stratus and cirro-stratus in the Temperate Zone; and stratus and fog in the Arctic Regions. The author considers that 90 per cent. of the skies all over the world might be described by the seven well-known types of cloud—cumulus, stratus, cirrus, cirro-stratus, cirro-cumulus, cumulo-stratus, and nimbus; if by cirro-cumulus, fleecy-looking clouds are denoted. Although the forms are alike, the prognostic value of the same shape of cloud is not identical everywhere, for while woolly clouds indicate fine weather in England, they denote rain in Italy. The author showed that the form alone of clouds is equivocal, and that the indications of coming weather must be drawn not only from the form but also from the surroundings of a cloud, just as the meaning of many words can only be judged by the context.

This paper was rendered most interesting by the photographs being thrown on the screen by Mr. B. C. Wainwright, F.R.Met.Soc., from a limelight lantern.

(2) "On the Cloud to which the Name 'Roll-Cumulus' has been Applied," by the Hon. R. Abercromby, F.R.Met.Soc. The author thinks that this cloud should be reported as "stratus" or "cumulo-stratus," according as the component masses partake more or less of the character of one or other of these clouds.

After the reading of these papers, the annual general meeting was held, when the report of the Council was read by Dr. Tripe, which showed the Society to be in a satisfactory condition. The number of Fellows was 524.

The President, Mr. W. Ellis, in his address, drew attention to the remarks made by Mr. Hawksley at the meeting of the Royal Meteorological Society on June 16th last, in which, after acknowledging the indebtedness of engineers to meteorologists for the information collected by them concerning floods and rainfall, without which, as he said, it would not be possible for engineers to carry on their work efficiently, proceeded to urge on meteorologists the need of more investigation into the causes of the various phenomena connected with their science. The president suggested that this is just what meteorologists were always endeavouring to do, pointing out how great an amount of labour had already been thus expended, if not always wisely, at any rate with every desire to trace out connections and causes, any want of success being due rather to the difficulties of meteorological inquiry than to any other cause. Referring then to the connection of the physical sciences, and especially those of astronomy, terrestrial magnetism, and meteorology, he drew attention to various contrasts and relations existing between them, mentioning how in astronomy strict mathematical processes may be employed, whilst in meteorology tentative methods have to a great extent to be relied on—a state of development through which astronomy itself had in earlier ages also to pass, giving hope that in the confessedly difficult subject of meteorology we may in time pass from present systems to others more logical. There has already been progress; the preparation of a daily synoptic weather chart, made practicable by the aid of the electric telegraph, would have been impossible not so very many years ago. Again, in astronomy the power of assimilating observations, as it were, is mostly in advance of the observational power, rendering ever greater instrumental means desirable. Not so in meteorology, for the purposes of which instruments can be constructed with accuracy beyond the power of adequately employing them, of which the difficulty of ascertaining the true temperature of the air is an illustration. This, indeed, troubles also the astronomer, the element of air temperature being one that enters into the calculation of astronomical refraction, besides which he has in various other ways to reckon with temperature effects. After referring to some popular notions on weather changes as related to the sun and moon, as well as to more systematic endeavours made to discover relations, in general insignificant, between position and periods of the moon and different meteorological elements, the president remarked that the modern meteorologist had happily found a wider sphere of work, for troubling himself less about cycles and periods, he had seen the necessity of studying, by the aid of synoptic charts, the complex and broad phenomena of the atmosphere in all their varied relations. Passing on to consider some relations between meteorology and terrestrial magnetism, he mentioned some analogies existing between the meteorological element of temperature and the motion of the magnetic needle, as regards their diurnal and yearly variations; proceeding then to discuss to some extent the relation between solar spots, terrestrial magnetism, and meteorology, pointing out that whilst in certain broad features the relation with magnetism was very striking, that with meteorology, so far as we are able to interpret the results obtained, is comparatively uncertain. Some allusion was made also to earth currents as related to magnetic phenomena. Before concluding, the president, viewing the present outlook as regards meteorology, spoke of the new and higher meteorology that, in spite of the difficulties of the subject, is now springing up, and referring to the various international congresses as having promoted uniformity of action and division of labour, and that meteorology now, perhaps more than ever, stood in need of combined action among its workers; and alluding to the idea of federation of which of late so much has been heard, suggested that a permanent federation of the meteorologists of different countries might regulate meteorological action and inquiry throughout the world, and so promote the better elucidation of meteorological laws, whilst also accumulating materials for the future discussion not only of the meteorology of the earth as a whole, but also of any periodical or secular changes, however produced, that might be proceeding thereon.

ROYAL MICROSCOPICAL SOCIETY.

THE fourth meeting of the session was held on the 12th inst. at King's College, Strand, the President (Dr. Dallinger, F.R.S.) in the chair.

Mr. J. Mayall, jun., at the request of the President, directed the attention of the meeting to 11 photo-micrographs which had been sent by Dr. Van Heurck, and which the latter thought showed results of exceptional merit. The one of *Amphipleura pellucida* by transmitted light was rather striking; it showed apparently two series of lines which were resolved into dots, and, so far as he was aware, this was the best of the kind which he had yet seen. But Dr. Van Heurck did not say whether it was taken from a specimen mounted in a dense medium or not, and he thought also that several important questions of technique were omitted which it would have been very useful to have had mentioned. In the pamphlet which accompanied the photographs, Dr. Royston-Pigott was quoted to the effect that they were "quite free from what used to be called 'diffraction spectra,' which now here have no existence whatever"; but, on examination, unless he was much mistaken, they had been painted out, or otherwise blocked out, from the negative, so that Dr. Royston-Pigott, in his remarks upon this supposed fact, had made what the French called a *boulette*. If it was desired to give such photographs a real value, the background should not be interfered with, and a small tablet should be left on which should be written, so as to print with every impression, the particulars as to magnification, mounting, and other data for identifying the object, which it was essential to be in possession of in order to form any reliable opinion. As regarded the longitudinal lines of *Amphipleura pellucida*, as shown in the untouched negatives of these photographs, Dr. Van Heurck said he had submitted them to Prof. Abbe, who replied that as they appeared closer than the diffraction lines, that was a satisfactory demonstration of their existence in the object. Unfortunately, the data which enabled Prof. Abbe to express this judgment did not exist on the prints sent to the Society by Dr. Van Heurck, in consequence of the objectionable process he had adopted of stopping off the natural backgrounds. In lieu of the natural backgrounds, which left the outlines to be seen exactly as photographed, this plan of stopping off the backgrounds left the field white, but at the sacrifice of the natural outlines. This might add somewhat to the mere appearance of the photographs, but must certainly diminish their scientific value. In the case of *P. angulatum*, he thought the photograph rather failed to show the details satisfactorily. It would have been very much better if only a small portion of the valve had been shown, including the fracture. As to the photograph of *P. angulatum* in which a central spot was shown, all who were familiar with the object were aware that they could get the appearance of a central spot or not according to how they looked at it. It was a question of change of focus. *Surirella gemma* he thought was not better shown than in Dr. Woodward's photographs. Then there were photographs of Nobert's lines, which were said to be those of the 18th and 19th bands; but here again there was nothing to enable one to identify them or to say that they were not the 14th or 15th bands.

The President, in thanking Mr. Mayall for his remarks, said it must be obvious to all that it would be of immense advantage to have the data by which alone they could form anything like a correct judgment as to the value of these, or, indeed, any other specimens of photo-micrography. He thought also that it would be of advantage if they could have the opportunity of comparing these with those of Dr. Woodward.

Mr. Crisp also referred to Dr. Royston-Pigott's misunderstanding as to the diffraction spectra of the Abbe theory.

Mr. J. Beck said he had not looked at any of the photographs except that of *Amphipleura*; but he should say that the manipulation which it had gone through had entirely destroyed its value.

Dr. Miller called attention to a photo-micrograph of *P. angulatum* taken by M. Nachet in 1867, which was fully as good as the one now shown.

The President stated that it was proposed by the Council to fill up the vacancy in their list of Honorary Fellows by electing Mr. P. H. Gosse, F.R.S.

Mr. M. Pillischer exhibited his new "Kosmos" microscope, which was described by Mr. J. Mayall, jun., as being made on the Continental model with a short body and a direct-acting screw, the screws being bevelled off and the corners rounded. There was a very symmetrical foot, and the finish given to the instrument made it very nice to touch. The mirror was made with a neat swinging motion, and was of a somewhat shorter focus than those generally in use, and it was claimed that as regarded general finish and capability, it would compare favourably in economy of price with any others.

Mr. T. Charters White read a note on "Tartar from Teeth of the Stone Age," numerous preparations being exhibited in illustration.

Mr. Crisp exhibited a cylinder of glass made at Jena, and described by Prof. Exner in the December No. of the *Journal*, p. 1,065. Though it had plane ends it acted as a concave lens, the reason being that it was of varying density from the centre to the circumference. It solved some of the questions which had been raised, as to the images formed in insect's eyes. Mr. Crisp also explained Prof. Exner's method of preparing similar cylinders from celloidin and gelatin, when the effect of convex lenses was obtained.

Prof. Bell said that in the interests of the particular branch of science to which he was devoted, he might mention that a little knowledge of histology by certain of the observers mentioned would have shown that the cornea was quite flat in the case of the crayfish, which had managed to see very well for a good many years.

Mr. Crisp directed the attention of the meeting to enlargements on the black-board of the figures of enormous microscopes in Schott's "Magia Naturalis," 1657. These had long puzzled microscopists, who were at a loss to understand what could be the object in making microscopes of the large size which was indicated by the comparison with the observers represented as looking through them. Having found in an old book sent to him by Prof. Abbe—Traber's "Nervus Opticus," 1690—what were undoubtedly meant for drawings of the same microscopes, the mystery was solved, for if Schott's figures of whole-length men were rubbed out and single eyes were substituted for them, as Traber did in his drawings, the scale of the microscope represented was, of course, strikingly altered, and it was seen that they were small hand microscopes after all. Schott's draughtsmen probably had too much of an artistic eye.

Mr. J. B. Medland exhibited and described his new portable cabinet for microscopic slides, in which twelve dozen slides were packed in a space 11in. by 5in. by 3½in.

The President thought this was a very simple and practical mode of making a compact cabinet, which would commend itself at once to all who examined it.

Mr. Crisp exhibited Stein's electric microscope.

Mr. A. W. Bennett gave a *résumé* of his paper on "Freshwater Algæ (including Chlorophyllaceous Protophyra) of North Cornwall," with description of six new species, illustrated by coloured diagrams.

The President said they must all feel indebted to Mr. Bennett for his very interesting communication, and they could not fail to note how very much pleasure there must have been added to a holiday in the case of one who had made himself so thoroughly master of this subject. He thought this paper was full of encouragement to others, because every young student had the ditches and ponds open to him, and there was the opportunity for all to add to their physiological knowledge of this interesting and beautiful group.

Mr. J. Mayall, jun., said that since the previous meeting of the society he had availed himself of an opportunity to visit Jena, which Mr. Crisp aptly

termed the "Mecca of microscopists," where during about a fortnight he had been the guest of Prof. Abbe. Every facility had been presented to enable him to follow the technical processes employed in the manufacture of microscopes in Messrs. Zeiss's optical and mechanical workshops, and in the production of optical glass in the Jena Optical Glass Works, and his impression was that it would be hardly possible to overrate the skill in organisation there displayed for the purposes in view. Messrs. Zeiss employed upwards of three hundred assistants in a series of workshops so arranged that those departments where delicate work was being produced —where the vibration of steam machinery would be a serious drawback—were quite separate from the departments where steam-power was employed. Messrs. Zeiss had found it advantageous to make their own brass castings, and hence had established a foundry on their premises. He had seen the various heavy kinds of lathe work and fraising in full operation with steam-power. The parts of the microscope-stands where this and other mechanical work was being executed were usually given out in sets of ten, and in general the system of piecework was in vogue throughout the workshops. With regard to the optical work, only a very small portion was produced by the aid of steam-power; for instance, the plane surfaces of eyepiece lenses, which were worked together in large sets, and the glass-slitting by means of rapidly-revolving iron discs charged on the edges with diamond fragments. The glass slitting machine was largely employed in the preparation of prisms of the different samples of glass for the determination of the refractive and dispersive indices. By means of the glass slitter, the plates of optical glass, as received from the glass works, were cut to the various thicknesses required, and then, by means of ordinary American wheel-cutters, the thin strips were cut into squares of the sizes required. The squares were placed in suitable trays in the storeroom, whence they were given out to the glass-grinders, together with the necessary tools and the gauges belonging to them. The glass-grinders snipped the squares to approximately the disc shape, and then cemented them each on a suitable block, and ground and polished the surfaces, the metal tools being attached to foot-lathes with vertical spindles passing through suitable deep trays, in which the refuse emery, &c., was caught, and the workmen were generally seated. For testing the accuracy of the finished surfaces, Fraunhofer's method was employed, which consisted in providing for each curvature required a pair of highly-finished standard convex and concave surfaces worked in rock-crystal, of which the radii had been accurately determined by means of a spherometer of great precision, the perfection of the curvatures being shown by the symmetrical formation of Newton's rings when the surfaces were pressed in contact. Each surface, as finished, was tested by contact with the corresponding standard surface of rock-crystal, and the polishing was continued until the required degree of accuracy was reached. He (Mr. Mayall) was aware that Fraunhofer had employed this method of testing the accuracy of spherical surfaces for telescopes, using standards made of glass. Prof. Abbe informed him that Dr. Hugo Schroeder had suggested the advisability of making the standards of rock-crystal, instead of glass, for testing microscope lenses, on the ground of its much greater durability where required to be in such constant use. Each workman was also provided with a contact-measurer, by which he was able to determine the thickness of the lenses, and thus approximate to the required thickness within a small fraction of error. An experienced foreman superintended this department, and was responsible for the accuracy of all gauges, &c. Mr. Mayall said he had been much interested to see these methods of precision in regular daily use in Messrs. Zeiss's workshops, the more so from the fact that for much of the optical work lads were employed, who thus obtained admirable training for the more difficult branches on which they entered later on. He had also witnessed the processes of centring the separate lenses, and reducing them to the required diameters; then the cementing into combinations and the mounting in metal cells, with its attendant further process of centring. He had also watched the whole process of manufacturing a front lens for an apochromatic one-eighth homogeneous immersion, from the grinding to the complete mounting in its cell, centring, &c., the lens being somewhat greater than a hemisphere, and the figure being tested in the standard concave of rock-crystal as he had previously described. The rapidity and dexterity shown throughout the execution of this delicate work had most favourably impressed him as to the high character of the training in Messrs. Zeiss's workshop, for it should be noted that the production of such work was not confined to one pair of hands, as generally obtained in England, but was being executed by several—workmen of special aptitude, doubtless, but still such as the system of training there adopted brought to the fore in sufficient number to meet the demand, even in so large an establishment. He had also witnessed with special attention the methods employed for testing the finished objectives; but there, of course, so much depended on the education of the eye and judgment, that he could not venture to criticise, not having himself practised with Prof. Abbe's silvered plate method. He understood, however, from Prof. Abbe that the method enabled the director of that department to give precise instructions as to alterations needed to reach a certain standard of excellence. He must not omit to refer to the photomicrographic department, to which Dr. Roderick Zeiss had given very special attention. A separate building had been erected for these experiments, and massive concrete blocks were provided to support the installation of the electric light and projection apparatus, &c., as free as possible from vibration. Here he had seen a number of images of test objects, &c., projected on a screen by means of an arc lamp of 1,200c.p., using various objectives, from 1in. to $\frac{1}{20}$in. focus. In some instances the higher degree of achromatism attained in the new apochromatic objectives was unquestionably shown, and he had no difficulty in admitting that on the whole the projection images were the best he had ever seen by artificial light. In view, however, of the extreme difficulty—impossibility he might say —of controlling the arc lamp, of maintaining a steady and equal light even for a space of one or two minutes, he thought for purposes of photomicrography it could not be commended, especially not for producing large negatives by direct projection. He had long held the opinion that the best photo-micrographs were obtained by making small negatives by direct projection, negatives just large enough to exhibit the points sought to be demonstrated; if, then, it were desirable to produce a further enlargement, the small negative could be magnified by an ordinary photographic process. In this way the best photo-micrographs by Dr. Van Heurck, of Antwerp, were produced, and the most difficult results were obtained by using sunlight. The main purpose of his visit to Jena, however, was to submit to Prof. Abbe's examination a number of the best English objectives, whence he could accurately estimate the standpoint of excellence from which English microscopists would criticise the new apochromatics produced at Jena. In furtherance of this purpose Mr. Mayall said that the President of the Society (Dr. Dallinger) and the senior secretary (Mr. Frank Crisp) had placed at his disposal the best objectives in their collections. Mr. Nelson had also most courteously requested him to select from his fine collection any objectives which he thought would worthily represent English optical work. From these collections, and sundry examples from his own, Mr. Mayall said he believed he had been able to carry out the intention of his visit to Jena; and he thought Prof. Abbe was now as vividly aware of what was meant in England by "critically good images" as possibly could obtain under the circumstances. He must, of course, mention the fact that he took with him to Jena his large Powell and Lealand microscope and accessory apparatus. If his visit to Jena resulted in inducing Prof. Abbe to withdraw his frequently-expressed depreciation of the value of the achromatic condenser—and he had reason to believe this would be one of the practical results following upon his visit—he (Mr. Mayall) should consider his journey not wholly fruitless in advancing practical microscopy.

Referring to the Jena Optical Glass Works, Mr. Mayall said they were under the management of Dr. Otto Schott, who appeared to have thrown his energy thoroughly into every detail of their organisation, which had so favourably impressed the German Government that large official grants of money had been made in aid of the experiments suggested by him. He understood Dr. Schott to say the experience he had gained in the experiments made with the consent of the Government—experiments which had all been most carefully classified and recorded—enabled him now to undertake to furnish any kind of optical glass according to sample supplied to him. On receiving such a sample, he proceeded to analyse it both optically and chemically, and then, from his registrations of experiments already made, he was able at once to select the elements and conditions required to arrive at the same result. The new kinds of glass employed in Prof. Abbe's apochromatic objectives were produced at these Glass Works, as also the glass employed by Messrs. Powell and Lealand for their new apochromatics. Dr. Schott expressed his conviction that several of his new kinds of glass would be found of great importance in the construction of photographic lenses; he also said that Steinheil, the well-known optician of Munich, had already adopted its use largely. Such a fact ought not in his (Mr. Mayall's) opinion to be neglected by our makers of photographic lenses; for, assuredly, if one of them could succeed in producing lenses with a given ratio of aperture to focal length, but giving a larger and flatter field than had hitherto been seen—and the apochromatic microscope-objectives showed how advance in that direction had been made by means of the new glass—the demand for such improved lenses would be practically unlimited.

The President said he thought the Fellows would agree that their Society was sufficiently mature to be entitled to get the highest possible perfection obtainable with respect to its apparatus and appliances, so that whatever would contribute to the attainment of any increase in this perfection could not fail to be of the greatest interest to them. From what they had just heard, he felt sure that Mr. Mayall's visit to Jena had not been in vain. His communications had been received with appreciation, and would no doubt be cogitated upon, and would give rise to an amount of interest and attention which would be certain to bear fruit at no distant date in the form of still further increase in the perfection of the very admirable work which they were already so familiar with.

Dr. A. C. Stokes's paper on "Some New American Fresh-water Infusoria," was read by Prof. Bell.

Mr. Crisp read the list of nominations for Council and officers for election at the anniversary meeting.

Mr. Hembry and Mr. Vesey were elected auditors of the treasurer's accounts.

SCIENTIFIC NEWS.

ONE of the most famous mechanicians of this or any century has gone to his rest. Sir Joseph Whitworth died at Monte Carlo on the 22nd inst. in the 84th year of his age. Born at Stockport on Dec. 21, 1803, Joseph Whitworth began his business life in his uncle's cotton spinning mill, where he rapidly acquired a complete knowledge of the machines, and became so useful that he was practically the manager long before he had reached his twentieth year. At that age he ran away (his uncle would not part with him), and obtained employment in some of the Manchester shops, migrating subsequently to London. His skill was soon appreciated at Maudslay's, and there, undeterred by the chaff of his bench mates, he constructed his first surface plates, which would alone have sufficed to make his name known, as it is, in every workshop in the world. From Maudslay's Whitworth went to Holtzapffel's, and afterwards joined that distinguished mechanician, Clements, who is said to have taught him how to make a true screw. In 1833 he returned to Manchester, and set up as a "tool maker from London," and that was the commencement of a business which has had an important effect on the mechanical progress of the world. In the Great Exhibition of 1851 Mr. Whitworth was represented by specimens of his true planes and his millionth measuring machine, but he had previously publicly described his method of manufacturing the former in a paper read before the British Association at Glasgow in 1840, and in the following year gave an account of his uniform system of screw-threads at a meeting of the Institution of Civil Engineers. Sir Joseph Whitworth's inventions in rifled small arms and in guns are well known; but he will be best remembered as the first designer of accurate tools and measuring instruments, and as the munificent founder of the Whitworth Scholarships.

The death is also announced of Mr. Edward Livingston Youmans, a well-known American scientific lecturer and writer. He was born at Colymans, New York, in 1821, and suffered all his life from defective vision—so much so that he invented a machine to assist him in writing. Dr. Youmans was the originator of the "International Scientific Series" and the *Popular Science Monthly*, which latter he established in 1872.

According to Circular No. 13 of the Liverpool Astronomical Society, the star referred to in No. 12 (see p. 450) is rapidly decreasing, as on Jan. 22 it was found to be barely 10 mag. by Mr. W. H. St. Q. Gage.

Under the heading "The New Comet," the daily papers publish a telegram from Melbourne, which reads: "The tail of the comet of the first magnitude, which has become visible here, projects 30 deg. above the south-west horizon, and was first observed on the night of the 19th inst. The nucleus is below the horizon, and is supposed to be in the constellation Microscopium in R.A. about 21h. 40m. south, the tail extending to Alpha Toucanæ. The comet is seen nightly. It is not bright, although it is distinctly visible to the

naked eye after twilight. No positions have yet been determined. The comet is probably invisible in Europe."

According to a correspondent of a San Francisco paper, the crown and flint lenses arrived safely at the Lick Observatory on Dec. 27, and were at once unpacked. The glasses were then mounted in a cast-iron cell inlaid with silver, with a space of $6\frac{1}{2}$in. between them. The cell, with its valuable additions, weighing altogether 600lb., was then placed in a vault in the north room, where every precaution had been taken to prevent injury from damp, and there the lenses will remain until the mounting is ready for them. It is probable that the great telescope and the observatory will be handed over to the trustees of the University about the 1st of September next.

At a recent meeting of the Royal Society, a paper by Prof. J. W. Mallet, of the University of Virginia, was read, in which the author gives an account of his investigations of some volcanic ash ejected from Cotopaxi during the eruption of July 22-23, 1885. In the dust he detected silver—a metal previously unrecognised amongst volcanic products. The dust was collected at a point on the Pacific Coast, about 120 miles west of the volcano, where it fell to the depth of several inches. It appears that about one part of silver is present in 83,600 parts of the ash, or two-fifths of an ounce troy per ton. Although this proportion seems insignificant, the mass of ejected ash was so vast that it really represents a large quantity of silver in the total bulk. Lead, which had been found in ash from Cotopaxi in 1878, was not detected in that of 1885.

At the meeting of the Royal Society of Edinburgh last week, Mr. J. Murray read a paper on "The Total Rainfall on Land of the Globe, and its Relation to the Discharge of Rivers." Investigations show that the total amount of rain falling upon the land-surface of the globe is 29,350 cubic miles annually. Of this amount 2,243 cubic miles of rain fell on the inland drainage areas of the globe, which had an area of 11,486,350 square miles, and as no water was discharged from them into the ocean, it followed that all the water which fell as rain must be again returned to the atmosphere by evaporation. Should the water accumulate in these areas into lakes, and these lakes show a slight annual increase in size, then the rainfall must be regarded as greater than the evaporation; but when, as in the case of the great Salt Lake of North America, the size of the lake slowly diminished, the evaporation over the basin must be greater than the rainfall. The total weight of substances carried to the ocean by rivers each year is calculated by Mr. Murray at over five thousand million tons.

According to a telegram from Melbourne, intelligence has been received from Brisbane which states that the latter city was visited by a cyclone on the 20th and 21st inst. which did great damage, rain having fallen to a depth of 20in.!

Last week an experimental trip was made with the Elieson electric locomotive on the tramway which runs from Stratford Church to Manor Park, a distance of about two miles, and if a Bill is passed in the present session of Parliament, it is intended to run electric locomotives alternately with the horse cars. The locomotive carries 80 storage cells, which are charged at the Stratford depot, and is propelled by means of an Elieson electromotor placed under the flooring of the car; the motor itself revolves, instead of being a fixture, as is usual. A prolongation of the spindle of its armature carries a pinion which gears into a circular fixed rack. Motion is transmitted to the road wheels through bevel gearing. The total weight of the locomotive is $6\frac{1}{2}$ tons, and that of the tramcar empty $2\frac{1}{4}$ tons, or with its full complement of 46 passengers 5 tons. But on the occasion of the actual run there were about 60 passengers on the car and engine, so that the total weight moved was in excess of 12 tons. It cannot be long before electricity will be used extensively for propelling tramcars; but it would seem to be cheaper to have self-contained motor cars rather than to employ a locomotive. On this point, however, experience will soon show which is the more economical.

Mr. J. T. Bottomley has, it is said, made a perfect pendulum by suspending a lead shot by a single fibre of cocoon silk in a vacuum produced by a Sprengel pump. The shot, one-sixteenth of an inch in diameter, weighs one-third of a gramme, is suspended by a 2ft. fibre, and is placed in a tube $\frac{3}{4}$in. internal diameter. It has a vibrational range of $\frac{1}{4}$in. on each side of mid-position, the vacuum being equivalent to one-tenth of a millionth of an atmosphere.

The Council of the Royal Geographical Society having communicated with the Vice-Chancellors of Oxford and Cambridge, urging the claims of geography to a further recognition in the universities, and offering to establish or make a contribution towards a geographical chair or readership, the proposal met with a favourable reception, and it is not unlikely that another step will be taken by the council, with the consent of the Education Department—viz., the award of prizes to pupils in Board Schools who reach a certain standard in geographical knowledge.

In the course of the Greenock annual lecture "in honour of the birth of James Watt," Mr. R. Duncan, shipbuilder, expressed the belief that the Queen's reign might see "steamers eight hundred feet long making the Atlantic passage at twenty-five to thirty miles an hour." In his experience as a shipbuilder there was a certain relation of speed to length, and he gave this rule—the minimum length should be "not less in feet than the square of the speed for which she is designed." A vessel to make ten knots should be at least a hundred feet long; and if twenty knots speed be desired the length should be four hundred feet. Torpedo boats are presumably an exception to this rule.

Last week in Glasgow a new train of close-coupled coaches, lighted with gas and warmed with hot-water pipes, made some trips on the Glasgow and Cathcart District, and we understand it is the intention of the Caledonian Railway Company to supply other local lines with services of a similar character.

The citizens of Liverpool appreciate the importance of an engineering laboratory attached to the University College, for Sir A. B. Walker having given £15,000 to the endowment fund, Mr. T. Harrison has followed with £10,000 to endow a chair of engineering, which is at present ably filled by Prof. Hele-Shaw.

The efforts of Sir S. Maryon-Wilson in promoting fish culture in the Sussex rivers have proved successful, for a batch of young Loch Leven trout were turned into the Ouse about seven years ago, and some remarkably fine specimens have recently been seen in the stream near Searles. One was captured and placed in the lake: it measured 30in. and weighed over 10lb.

In a lecture recently delivered by Dr. F. Day' C.I.E., a warning was given to those who think of introducing the Indian cat-fish to British waters, for the doctor placed a specimen in an aquarium, when it rushed at one of the carp, seized it by the middle of the back and shook it as a dog does a rat until it was dead. The cat-fish it seems destroys simply for the sake of killing, not to supply itself with food.

We mentioned some little time ago that the Prince of Monaco had commenced a series of experiments designed to test the velocity of currents in the North Atlantic. Admiral Bouquet de la Grye has recently made a report to the Paris Academy of Sciences, in which he says that, of 500 little caskets or vessels launched in deep sea off Cape Finisterre, 12 arrived on the French coast a little below Arcachon, after an interval which would appear to show a daily rate of travel of about six miles. The temperature of the water was also observed, and the Prince found that in the Bay of Biscay, at a depth of about 500ft., the temperature of the water was lower than at the corresponding depth off the Portuguese coast.

A report on the employment of salicylic acid in food has been presented by M. Vallin to the French Government, in which it is stated that the continuous taking of even small quantities of salicylic acid, or its derivatives, is injurious to health, especially in the case of aged persons and those whose renal and digestive organs are not perfectly sound.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE "NAUTICAL ALMANAC" FOR 1890—THE GREAT LICK OBJECT-GLASS—A NEW FORM OF METEOROLOGICAL FOLIE—GEN. DE LISLE'S GEODESICAL TABLES—THE NORTHUMBERLAND EQUATOREAL—FOCUS OF LENSES—STARS IN DAYLIGHT—THE GNOMONIC PROJECTION.

[26756.]—THE preface of the *Nautical Almanac* for 1890, which has just appeared, characteristically begins with the words, "The contents and arrangement of the *Nautical Almanac and Astronomical Ephemeris* for the year 1890 are the same generally as those of the preceding year." Just so. As I have previously observed, anything more utterly mechanical than the way in which the data for our National Ephemeris are annually ground out it would be difficult to imagine. If Dr. Hind ever condescends to examine the Ephemerides issued by other countries, he might with advantage consult the *American Ephemeris and Nautical Almanac* for 1889, as affording him a model on which he might found some very distinct and appreciable improvements in the work over which he presides. There even such details as those of the orbits of the satellites of Mars, Jupiter, Saturn, Uranus, and Neptune are rendered more useful and intelligible by wood engravings drawn to scale. I mention this as a single illustration of the attention paid to the general usefulness of the publication. For the rest, the old erroneous prediction of the phenomena of Jupiter's satellites are repeated; while the admittedly wrong dimensions of the Saturnian system are perpetuated. Perhaps this last piece of inattention is the less defensible of the two, inasmuch as the correction of the chronically misleading details requires no elaborate theoretical computation. In the case of Jupiter's satellites, it would seem that gravitational astronomy is at such an extremely low ebb in England, that until (what Professor Pritchard generalised as) "some German" gives us more correct tables than the 51-year-old ones of Damoiseau in use in Verulam Buildings, we must be content, "stare super vias antiquas," and to go on in the old dreary, blundering way.

Remembering the old proverb that "there is many a slip between the cup and the lip," I am gratified to read the inclosed telegram in a Californian newspaper kindly sent me by a friend:

"The Lenses of the Lick Telescope.—San Jose, Dec. 27—[Special.]—The great lenses of the Lick Observatory arrived at Mt. Hamilton at 1.30 this afternoon. They were found in fine condition, and were placed in the fireproof vault."

Let us hope that the time is now close at hand when this marvellous specimen of optical skill will be used for the advancement of our knowledge of the visible Universe. It would appear that there were no less than twenty successive failures in the attempts of the Feils, sons and father, to produce the discs from which this colossal object-glass has been formed. The third lens, for converting it into a photographic objective, is still in process of manufacture. Before the star-maps taken with 3ft. of aperture more than 4,000ft. above the sea-level, the hitherto unapproachable efforts of the MM. Henry Frères must fall into insignificance.

"A prophet is not without honour, save in his own country," and it really would appear that my slight want of faith in the absolute infallibility of M. Folie, the Belgian Astronomer Royal, is shared by some of his own countrymen, if I may judge from articles which have appeared in two of the Brussels newspapers, *La Chronique* for January 5, and *La Réforme* for January 10. It would seem that M. Folie has brought forth a brochure entitled "Petite Climatologie de l'Amateur et de l'Agriculteur Belges," which is very much more teleological than scientific. As I have not seen the book myself, I don't know whether the Saints figure in it (as they did in the notorious *Annuaire*,

of the Brussels Observatory for 1886, with its astounding "Commencement des Saisons," and so on), and, if so, which is the watery, which is the hot, and which the flatulent one?

I spoke (in letter 25555, Vol. XLIII. p. 121) in terms of commendation of some excellent tables for geodesical calculators, which had been computed by General De Lisle, R.E., from Col. Clarke's spheroid. I am sincerely pleased to find, from General De Lisle's kindness in forwarding me a few copies, that these have already run into a second edition. In it a very few trivial typographical mistakes (chiefly in the differences between the logs. of ρ) have been corrected, and possessors of the first edition may possibly care to go to the trivial cost of a new copy rather than to hunt through them to correct three or four figures with their pens. To all practical astronomers and geodesists who omitted to supply themselves with these tables originally, I would only say "Procure them as soon as you can." They are indispensable to all who wish to compute the true length of the radius of curvature of the earth in any given latitude, the parallactic angle (needed in so many astronomical calculations), and so on. It may not be wholly useless to note that in reproducing, in old figures, the formula for the logarithm of the earth's radius on the title-page the — mark over the index of the log. of ·0000018975 has dropped out, and it reads 6·27817685. This *is* remediable with a pen, though.

Someone has been writing to one of the morning papers contrasting, inter alia, the attention paid to astronomy at Oxford with the stagnation of that science at Cambridge, adducing as an illustration the fact that on going a short time since to see the Northumberland Equatoreal, he found puddles upon the floor of the room! It strikes me that a dome must either be brand-new or constructed upon some novel principle to keep out such snow as we have had within the last three or four weeks.

In reply to query 61386 (p. 441), the actual focus of a lens is the distance from the centre of the lens to its burning point, and *not* from the back of it. "Back focus" is new to me; it probably signifies the distance between the back of the lens and its focus for parallel rays. "Equivalent focus" is used in connection with two, or more, lenses in combination, which are said to have an equivalent focus to some given single one.

If "Dubitans" (reply 61101, p. 457) waits until the middle of August, he may, knowing her exact position in the sky, see Venus distinctly "in the open" in brilliant sunshine. Malgré his doubt, the cutting off of all extraneous light by a long dark narrow tube, such as is formed by a deep well or high chimney, does enable the observer to perceive a star of the first magnitude by daylight.

Premising that the gnomonic projection is a very bad one for a map of any place of less than about 60° latitude, distorting as it does proportions so terribly towards the margin of the map, I may just say, in reply to "K. E." (query 61487, p. 465), that the meridians are straight lines passing through the projection of the pole, which is, of course, on the line of projection of the principal meridian, and distant by an amount = radius into tan. principal polar distance (in his case 35°). But now comes the difficulty of this species of projection. All circles of latitude whose polar distances are less than the angle between the polar radius and that of the principal point are projected into ellipses; the one which has its polar distance identical with this angle is a parabola, and the rest are all hyperbolas! The projection of the principal meridian is the principal axis of all these curves. Save for a circumpolar map, the game is assuredly not worth the candle.

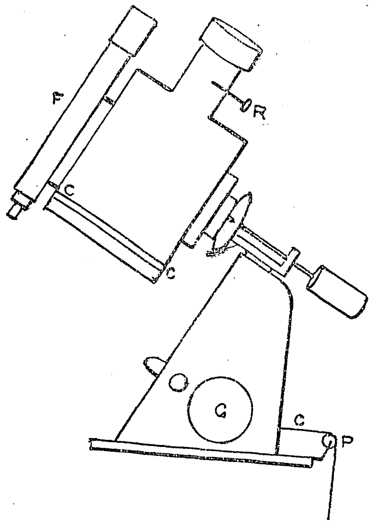
A Fellow of the Royal Astronomical Society.

STELLAR PHOTOGRAPHY—THE LIVERPOOL ASTRONOMICAL SOCIETY'S RESEARCH—DESCRIPTION OF THE STELLAR CAMERA: HOW THE PHOTOS. WERE TAKEN AND REDUCED — EFFECT OF COLOUR — VARYING EXPOSURES.

[26757.]—PERHAPS "F.R.A.S." will allow me to supplement his remarks in letter 61355, p. 420, by giving some account of the research on stellar photography undertaken by me for the "L.A.S." By the time this letter appears I trust that the results will be printed and obtainable by those of "ours" who wish to have them. Lack of funds has put an end to the research, and it must be left to the Americans to carry it out. At the present time Prof. E. C. Pickering, by the generosity of his fellow-countrymen, is doing the same work, and using the same method.

The camera, which was placed at our disposal by Mr. Howard Grubb, was fitted with a lens (compound) of 4½in. aperture. The lens is fitted with the ordinary rack motion for focussing (R, Fig. 1); but in case any of your readers should think of carrying on the work, I wish to point out that the rack-work should be of the strongest kind, as I found the lens liable to slip. Further, the lens should have a greater focal length: ours had only a focal length of a little less than 16in.; consequently, the distortion on any but quarter plates was serious, enlarging the discs of the stars, and so losing the fainter ones. In front of the lens was a wooden cap fitted with cloth, which could be taken off at pleasure. Here, too, I would suggest that the cap might be a simple piece of metal placed in such a way as to rotate at the side of the lens, so covering or uncovering without any actual contact. The accompanying rough drawing will show the position

FIG. 1.

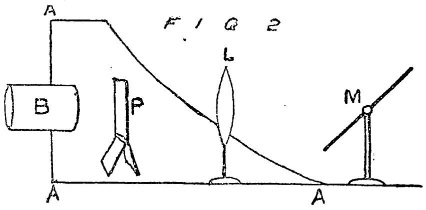


of the finder. This is somewhat in excess of the focal length of the photo. lens. The finder is fixed to the camera in the usual manner. After several arrangements of wires, I found that a simple cross wire worked best, and if a star is placed slightly out of focus and brought behind the wire, it can be followed better than in any other way, as the slightest clock error is shown by the star disc being no longer equally divided by the wire. A fairly high power should be used. The camera is cut from C to C, to allow the plate carrier to be introduced. The plate is introduced into the carrier at the back, and held firmly by a spring, thus preventing slipping, and robbing the L.A.S. of the honour of discovering planetoids in the Orion Nebula. The equatorial stand was of iron. The polar axis turned in V bearings. The iron stand was backed by a thick hollow stand of wood. In this stand, and thus out of the way of any accident, was the clock. The only part appearing on the outside was the large gearing wheel G, working the endless screw which turns the polar axis by means of a smaller wheel. At the back of the stand the cord C carrying the weights came out, and passing over a pulley, P, went down into a wooden box sunk 6ft. into the ground. The stand was fitted with slow motions in R.A. and Decl., and with hour and declination circles.

Let us now proceed to the actual working with the instrument. Throughout the work Wratten and Wainwright's "drop-shutter" plates were used. Other plates were tried, but these were found to give the most satisfactory results. The pyro. developer was tried, but soon gave place to the ferrous oxalate. The latter was obtained by making saturated solutions of ferrous sulphate and oxalate of potassium (neutral). To insure the best action, these solutions were made fresh for each evening. The oxalate of potassium solution was then held up to the light, and the ferrous sulphate added drop by drop till no more could be added. For developing a small outhouse was used. The plate was taken out of the carrier, placed in running water, and then plunged into the developer, care being taken to immerse the whole plate at once. It is a most interesting sight to see star after star come out as a black dot on the white plate. The development was continued till the plate changed from white to grey. The negative was then washed and fixed with hypo. in the usual manner.

Apart from the interest of having a record of the state of the heavens free from all possibilities of error—a record, as it were, self-written—the plates suggested an altogether new line of research—viz., the comparison of actinic magnitudes with those determined by the eye. Here, then, there opened out an entirely new method of photometry—one-sided, indeed, since the record was only of the violet rays of the spectrum, but valuable from the permanency of those records. The question next arose, How can the magnitudes be obtained from the plates? For reasons set forth in the "Catalogue of the Magnitudes of 500 Stars determined by Photography," the stars were made to come out as lines instead of dots, and this method has been adopted by Professor Pickering. Indeed, it seems the only one which nullifies at once all errors due to partial faults in the plate and local mistiness in the sky, &c., while it affords the great advantage of comparing lines together instead of points. Sarting with no previously-beaten track before us, the "solvitur ambulando" was converted not infrequently into "solvitur cadendo." How were we to form a scale? How reduce plate after plate? Such and many other questions were before us. Mr. W. L. Stubbs and myself took a plate, and having fixed upon the brightest and the faintest marking, we called the first 100 and the last 0. We then proceeded independently to assign numbers for the impressions of the rest of the stars. Our results agreed admirably. Then from the D. M. the magnitudes of the stars were taken, and we at once found that it was quite easy to obtain a value which would reduce the stars on the photograph to magnitudes which corresponded in the majority of cases with those in Argelander. The disagreement of the remaining stars was due either to an error in the eye magnitude, or to an abnormal condition of the violet rays in the stars.

Fig. 2 gives a rough idea of the apparatus used



for reducing the magnitudes. The light is reflected from a mirror, M, movable in all directions, and is concentrated by a large lens, L, on the plate P. The plate is viewed through two powerful lenses mounted in a tube B, and fitted with rackwork for focussing. The tube and plate are contained in a box A A A, which shields the plate from all side lights, and the eye from all direct light. If the plate is too transparent a thin piece of paper is placed immediately behind it. By the side of this apparatus was placed the "Atlas of the Northern Heavens," by Argelander; also a notebook, and the volume of the D. M. Certain stars having been selected as comparison stars, the rest of the plate was reduced, the stars being first identified in the atlas, then the photographic magnitude entered in the notebook, and lastly, the number and magnitude in the D.M. Before the work came to an end the first six hours of R.A. in zone + 40° had been photographed on twenty-nine plates, thus allowing the magnitude to be determined for the most part from two, and, in some cases, from three or four plates. Although the stars were allowed to come out as lines, all down to the eighth magnitude are on the plates, while from eighth to ninth nearly 70 per cent. are to be found.

A question that speedily arose from these results was this: Can we fix the star's colour by the difference between the photographic and eye magnitude? The difficulties in the way were considerable, for very little is known about star colours when we come to stars fainter than the sixth magnitude, and the stars above the sixth magnitude are liable to over-exposure on the plates. However, a general examination of every plate taken, not only in zone + 40°, but in other parts of the heavens, yielded the following mean results:—

A red star	decreases	2·5	mag.
An orange-red star...	„	1·9	„
An orange star	„	1·6	„
A yellow-orange star	„	1·3	„
A yellow star	„	0·8	„
A yellow-white star.	„	0·4	„
A white star neither decreases nor increases.			
A bluish-white star	increases	0·5	mag.
A blue star............	„	1·0	„

The largest decrease is in the star B 211 Cancri, which is reduced from 6·5 to 9·4.

Lastly, I must say a word or two as to an interesting attempt made by Mr. Stubbs and myself to determine the least magnitude photographed in a given series of times. To obtain trustworthy results, it was essential to have the same field of stars photographed upon the same plate the same night, the exposure differing each time. A camera with a lens 2½in. aperture was strapped on to the other end of the declination axis of the 17¼ equatorial. Immediately before the carrier was a large piece of cardboard, and in the centre a hole was carefully cut in such a way as to leave only one-fifth of the plate exposed at a time. The carrier was divided outside into five portions. The first division left the first fifth of the plate exposed. After the exposure the carrier was pushed down to the next division. By this means we

eliminated the causes of error, the field being the same, the plate being the same, the exposure alone altering. Several plates were thus taken with exposure of one, two, three minutes, &c., each new plate beginning with the last division of the previous one, and thereby securing an overlapping and continuous record. The stars in this case were allowed to come out as dots, being accurately followed. The great pressure of other work prevented our going into the question as thoroughly as we wished, but the results we obtained, such as they were, were plotted down, and a curve drawn, from which I take the following readings:—

Magnitude. Argelander.	Exposure required. m.	s.
5·0	0	1 ±
6·0		30 ±
7·0	1	15 ±
8·0	6	20 ±
8·5	60	0 ±

Plates taken with the 4½in., but which were not taken for this purpose, gave much the same result, the magnitudes being diminished by about 1·6 mag. Such, then, are some of the interesting results that have been obtained. They are, I think, very encouraging, and open out new fields of research. It is to be hoped that some sturdy English amateur may be found who in friendly rivalry will compete with the Americans. At present we have only a few star-picture makers, who seem incompetent to obtain any results except erroneous ones, while their pictures of nebulæ suggest that the author has sat in a pail of whiting, and then on a black piece of paper.

T. E. Espin.

Liverpool Astron. Society's Observatory, Wolsingham, Darlington, Jan. 21st.

66 CETI.

[26758.]—I AM sorry that, owing to the very unfavourable weather, I have been unable at present to examine 66 Ceti myself; but I hope the following results may be of interest to Mr. Dowsett (letter 26718, p. 451).

66 Ceti is included in Mr. Gore's "Catalogue of Suspected Variable Stars" (Gore, No. 58), on the authority of Taylor, who first seems to have suspected variation, and to have referred to the matter in the "Madras General Catalogue."

The magnitudes in Webb are taken from Smyth, who, as usual, assumed the magnitude of the principal star from Piazzi's second catalogue; the magnitudes in the "Star Guide" are, as I have stated in the preface, almost always taken, as in the case in question, from Dembowski's observations with the 7½in. at Gallarate.

Of 66 Ceti Gould says ("Uranometria Argentina," p. 313): "Taylor designated this star ('Gen. Cat.' 725) as a variable, but I find no evidence in support of this opinion other than the very slight discordance of the recorded values of the magnitude. D'Agelet twice noted it as 7, Lalande, as 6½ and 6; Piazzi, 7; Bessel, 6; Johnson 6·0. It is not in the "Uranometria Nova," and Heis makes it 6⅓. The Albany estimates in 1858 give 5·9; five Cordoba determinations in 1871 and 1874 vary only between 5·7 and 5·9." Gould gives 5·8 as the magnitude in the test, the magnitudes of the components being 6 and 8. Sir W. Herschel gives the magnitudes as "very unequal" on October 13th, 1782, which may indicate a difference of 1½ mags. between them. Piazzi gives 6 and 8 for the mags. of A and B of the pair in his first catalogue, and 7 and 9 in his second. However, as he gives the magnitude of such a star as *o* (Omicron) Cephei, for instance, as 7, though it is really about 5½, his estimations, made with a bright field illumination on a 3in. telescope, are not very trustworthy. Struve gave 6, 9 from four observations with the Dollond transit in the last two months of 1819; and H_2 and So 7, 8 "pretty unequal" on November 23rd, 1822. They remark that "the magnitudes, too, disagree with those of M. Struve (6 and 9)"; and, indeed, H_2 and So's 7 and 8 would probably mean 6½ and 7. Struve again found 6 and 8 with the 10ft. transit in 1821, and 6·2, 8·5 with the circle in 1822, 1823, 1824; while from the micrometrical observations with the 9½in. refractor, from 1829 to 1835, he found 6 and 7·8, the greatest difference being 5·5 and 8 in December, 1830, and the nearest approach to equality between the two components being registered in August, 1835, the magnitudes being respectively 6·5 and 7·5. Dembowski assigned 5·4, 7·5, as his estimates in 1854, the greatest difference being 4·8 and 7·0 in 1854, October 9th. Howe, at Cincinnati, gives 6·0, 8·0 as the result of one evening's observation in 1879, and Engelmann, at Leipzig, 5·6, 7·8 as the result of six evening's observations in 1882, 1883, and 1884. Houzeau gives 66 Ceti as a naked-eye star of the 6th magnitude in August, 1875; but it does not appear to have been photometrically measured by Messrs. Plummer and Jenkins, at Oxford. The Harvard photometrical measures make it 5·64 mag. Mr. Gore estimated it as 5·4 mag. on Nov. 21st, 1884. It seems to me that the *comes* may be slightly variable, and that this variation produces the slight change of light in A that seems to have been noticed by some observers with the maked eye or field-glasses. Both stars are animated by the same common proper motion, which amounts to 0·54″ annually. Though they have passed over nearly a minute of space since the time of Sir W. Herschel, no change seems to have occurred in their relative position angle or distances.

Jan. 24. **H. Sadler.**

A NOVEL FORM OF OBJECT-GLASS.

[26759.]—THE remarks of "our" valued contributor, "F.R.A.S.," in your issue of the 14th inst. will, I hope, draw the attention of practical opticians to the question, whether the errors of a large single lens, can be balanced by the opposite action of a small lens, placed not very distant from the focus of the large one. As regards Dr. Schott's new optical glass, I may say that soon after my query appeared in the "E.M.," some gentlemen very kindly sent me (through you, Sir) a copy of Schott's catalogue. It contains a long list of glasses of very varied character, and very different from any I have hitherto seen. I shall send the list to these columns as soon as I have the opportunity to copy it out, with the requisite explanatory remarks.

In connection with the subject of this letter, I may state that glass No. 1 on the list is a light phosphate crown index for the D ray 1·5159, and giving a difference of refraction between the C and F lines of ·00737. Thus it has a very low dispersive power, considerably less than the English hard crown. The last glass on the list is a flint of very great density, specific gravity 6·33; index of D ray 1·9626; difference of refraction for C and F lines ·04882. Its dispersive power is more than 3½ times that of the first-mentioned crown.

Suppose we take the common approximate formula for achromatising two separated lenses, which is

$$\delta = \frac{(F - s)^2}{F \cdot f}.$$

F being the focus of the positive crown lens, f that of the negative flint, s their distance apart, and δ the ratio of dispersive powers. Now let $s = (F - f)$ and our equation reduces to

$$\delta = \frac{f}{F}$$

which states that the combination will be achromatic when the foci are *inversely* as the dispersive powers. This is exactly the reverse of the condition for contact lenses; for if $s = 0$ in the above formula

$$\delta = \frac{F}{f}$$

which is the ordinary approximate rule.

Now let us inquire what will be the effect of the combination when s has the value $(F - f)$. Evidently a concave lens placed at its own focal length in front of the focus of another convex lens, will annul the positive refraction of the latter, and restore the rays to parallelism. The combination thus forms a simple Galilean telescope; and the reciprocal of the ratio of dispersive powers is the measure of the magnifying power. If the two preceding kinds of glass were used, this would be—

$$\frac{1}{\delta} = \frac{F}{f} = \frac{70}{19 \cdot 7} = 3 \cdot 55.$$

In this position the chromatic aberration would be balanced, and consequently, if the lens were drawn back so as to allow the rays to come to a positive focus, under-correction would result. Let us modify the first formula in order to find if this can be avoided. Instead of s being equal to $(F - f)$, put it $= (F - nf)$, n being a proper fraction. Then we have—

$$\delta = n^2 \frac{f}{F}; \text{ or } \frac{F}{f} = \frac{n^2}{\delta}.$$

If we assume the use of the foregoing glasses, we have (since $1/\delta = 3 \cdot 55$)—

$$\frac{F}{f} = 3 \cdot 55\, n^2.$$

And as n is a proper fraction, whatever value we may give to it will always make the ratio F/f less than 3·55; so that it would seem this is the maximum ratio of foci which can be used in such a combination.

This result is obvious from the fact that if the concave be placed so as to allow under-correction for the sake of obtaining a positive focus, an increase of chromatic negative error is required, which would also increase the negative refraction, and thus destroy the object sought to be attained.

In the course of these remarks I have used only simple approximate formulæ, and the results they give may not altogether be correct; but they are sufficient to convince me that if the new arrangement be perfect, I have much to learn and more to "unlearn."

So far we have considered the corrector as a simple lens; but suppose it to be a compound of crown and flint, will such a one answer the purpose? I believe to a *certain* extent it will; to *what* extent I cannot say.

The reduction in size of the dialyte correctors can no doubt be very considerable, but the limit must be practically determined. To use the ordinary formula of Rogers, which is—

$$f = F \cdot \frac{a^2}{A^2} \cdot \left(\frac{1}{\delta} - 1\right)$$

where f = focus of one corrector (the other of equal opposite focus) F = focus of o.g., a and A the acting semiapertures of corrector and o.g. Suppose the glasses to be the same as above-mentioned, then—

$$f = 2 \cdot 55\, F \cdot \frac{a^2}{A^2}.$$

Let us assume that the aperture of the correctors is $\frac{1}{10}$th that of the o.g., then—

$$f = \cdot 0255\, F;$$

or if F be 100, then $f = 2 \cdot 55$; that is, supposing a single o.g. (crown glass) of 10in. aperture and 100in. focus, it is theoretically achromatised by two crown and flint lenses, each of 2·55in. focus (positive and negative), and 1in. aperture, placed about 10in. in front of the focus of the o.g. I wonder if theory is borne out by practice; I feel rather doubtful. Will our friend "Prismatique" and others say a few words?

In connection with this matter, may I ask "F.R.A.S." if any explanation has been given of the discrepancy between the theoretical star-discs calculated by Airy's undulatory theory, and those measured in practice;—and perhaps also Mr. Sadler, who kindly referred me to M. André's theory, will say if this physicist gives any definite rule or formula for calculating such star-discs, and in what respect it differs from Airy's.

Orderic Vital.

HORIZONTAL WIND POWER.

[26760.]—IN reply to several correspondents in regard to the above, I am unable to refer to Vol. X. In regard to Mr. Raymond Browne's remarks, I am perfectly aware of the many uses to which windmills may be applied, the chief of which, I believe, to be the raising of water, for which purpose, no doubt, intermittent power may answer. There is a 10ft. American mill erected near my house, which pumps sufficient water into elevated tanks to suffice for the watering of a large garden, and the value of such windmills only requires to be more widely known to insure a large demand for them.

Replying to "Gwalia," I was precisely of his opinion till I took out extracts from our local meteorological reports, when I (reluctantly) came to the conclusion previously stated. I thought that one of the 14ft. windmills, shown at Colonial Exhibition, and which were stated to give 2H.P. with 18 miles of wind, would, at any rate, give 1H.P. for twelve hours out of the twenty-four. From the table below, if the Editor will be good enough to print it, as it may prove of some interest in this discussion, it will be seen that the least recorded speed of wind during the 17 weeks was less than one mile per hour; that there were 13 days less than four miles, and 17 under six miles. Even in the week when the speed was greatest, there was one day when it was less than 5½ miles. It must, of course, be borne in mind that, for the purpose of electric lighting, a dynamo must run at not less than a certain speed, and until that speed was attained by the windmill, it would have to be cut out of circuit: otherwise the accumulators would discharge themselves through the dynamo. There seems, therefore, to be considerable difficulty as to the practical application of windmills for electric-lighting purposes. Of course I am referring to such mills as might be erected near one's dwelling without being an eyesore to the neighbourhood.

A friend who is agent for the sale of an American windmill has recently returned from America, and told me what I stated before in regard to the ideas of the ingenious people over on the other side. By the way, Mr. Vallance is mistaken as to a seven-mile wind being ⅗lb. per foot. I think authorities (Molesworth, &c.) state that 10 miles is only ½lb., so that no doubt his calculations of power will be materially altered.

I cannot state what is the speed of the wind in other places than this; but I waited on Mr. Joseph Baxendell, F.R.S., F.R.A.S., who is responsible for the returns here, and he informed me that some time ago, having charge of similar returns for the Manchester Corporation, he had an anemometer in use at Anfield (one of the waterworks stations), which showed a less wind speed (some two to three miles per hour) there than here, though the elevation, of course, is much greater. Mr. Baxendell has since kindly brought me a table showing the mean daily movement of the wind at Southport, from 1872 to 1886; which shows that in the former year it was 311·4 miles, and in the latter 187·1

miles only. How far this may arise through houses being built round the park in which the observatory is situated, I cannot say. I have obtained from Mr. Hartnup, of the Liverpool Observatory on Bidston-hill, results from 1879 to 1883; but as these are daily records, it will take some time to arrive at the mean for the several years; this I will get out and see what difference there is between the two places.

It may be well to note that on the open sea 650 daily observations, taken on cruise of *Challenger*, gave a mean hourly velocity of $17\frac{1}{2}$ miles, whereas 552 observations near land, gave $12\frac{1}{2}$ miles only. At Valentia, Ireland, one of the windiest situations in western Europe, three summer months of '78 gave a mean hourly velocity of 13·3 miles, the minimum 10 to 11 miles, from 9 p.m. to 6 a.m., and maximum exceeding 16 miles, from 11 a.m. to 5 p.m.—("*Meteorology*," *Ency. Brit.*, 9th edition.)

The 17 weeks in the table are not quite consecutive, simply because I failed to find all the reports in the local papers in our newsroom. The anemometer is about 60ft. above the mean sea level.

VELOCITY OF WIND IN MILES, SOUTHPORT.

Week ending.	Total Week.	Day, Greatest.	Day, Least.
1886. June 25	1,994	448	127
July 9	1,081	236	72
„ 23	848	214	37
„ 30	1,289	279	66
August 13	1,356	347	119
„ 20	1,291	404	55
September 3	455	106	41
„ 10	1,086	238	54
„ 17	719	160	73
„ 24	542	142	38
Oct. 1	1,401	359	78
„ 15	1,573	284	141
„ 29	868	156	88
Nov. 5	1,095	345	50
„ 19	1,420	308	104
„ 26	583	124	20
Dec. 3	1,882	406	60

Total...... 19,483

Average about 1,146 miles per week.
„ „ 164 „ day.
„ „ 7 „ hour.

Southport. **Benjamin Boothroyd.**

HORIZONTAL WINDMILL.

[26761.]—I NOTE that in P. Vallance's account of trials with a vertical against his horizontal windmill, that it would seem from this description that the hauling rope was common to both, and, therefore, that that machine which had sails upon it had also, besides doing its legitimate work, to keep the other mill (without its sails) also in a state of revolution. If this were the case, it is obvious that the weighty concern would have a great advantage over the light-weighted opponent; also he does not state whether the vertical, which would run so much faster than a horizontal, was so geared as to make the speed of the ploughs equal in both cases. I feel curious to know "at what part of the revolution, and for what length of time" a more effective surface can be obtained, or even a larger effective area of sail in a horizontal than in a vertical. I also note that he is silent as to the weight and cost of all the metallic parts, which would, I opine, form an important item. **A., Liverpool.**

[26762.]—SEEING the controversy now going on, and being interested in a wind motor for compressing air, I should like your advice as to which is really the best or most powerful. As to the horizontal ones I do not quite understand their action, or how the wind acts on them without their being sheltered on one side from the wind. I have a very light waterwheel made with zinc rim and buckets. Could this be used in any way for a wind motor by, say, concentrating the wind on just one half, and sheltering rest of it? The wheel is 3ft. diameter, with 1ft. wide buckets, 4in. deep. I am situated just now where there is no block for the wind for miles, and when it blows, I get the full force of it. **L. W. D.**

PATENTS AND LAND.

[26763.]—UNDER the heading "Patents and Land" in yours is a letter from our old friend Thomas Moy, than whom no one is better competent to speak about patents and inventions, but whose violent prejudices on the subject of land and landlords spoil the effect of his argument. The subject of inventions and patents is of deep interest to many of your readers, and I hope to be excused in making a few remarks on the subject of Mr. Moy's letter.

The land question is to Mr. Moy what King Charles' head was to one of Dickens's characters—he can't keep it out of his kite. In the case he puts of a landlord reclaiming land from the sea, the landlord *does* create a new combination, a new and useful one too, and, moreover, one that probably lasts for ever after, whilst a patented invention for 14 years is frequently as long as a patent is worth anything—new methods and combinations having superseded the original.

But take the case of a leaseholder of a mine who has it for a short term, and after spending £20,000 may or may not "strike oil," and when he does must pay royalties and taxes, &c. Skill and money have to be employed, and risk taken in either case, and Mr. Moy might find patenting inventions more profitable than either of the above operations.

The inventor, however, has a good case on the merits. Let us compare him with an author: the latter "invents" a book, and for the trifle of five shillings obtains registration of it, and a copyright or monopoly for 42 years. The patentee invents a machine and obtains a monopoly for 14 years only, and the Government exacts from him £154—from the author, nothing at all.

Both on the ground of shortness of term allowed for his invention to fructify and the heavy fees payable, the patentee is unjustly used by the Government. Although 17,000 people chose last year to enter into this bargain with the Government, it does not alter the case. By taking these heavy fees the country is deprived of hundreds of good inventions, which would bring wealth and find employment to many more than at present. Granted the fees are only £4 for the first four years, yet anyone taking up an invention must do so with all these heavy payments in prospect, and numbers of useful inventions come to an untimely end in consequence. The United States are wiser, taking only a few pounds, comparatively, in the first instance and have done with it, granting a patent for 17 years. The States find their account in it by the impetus given to internal trade and manufactures through the inventive faculties of their people being fostered and encouraged, while our system acts in restraint of trade.

I maintain that inventors should be encouraged in every way to bring out new ideas and combinations; should be charged only a few pounds for examining, printing, and registering their patents; we should then be able to hold our own against Germany and the States both; for English mechanics are clever and reflective, and the country would benefit immensely more by extension of trade and manufacturing industries than it ever can by the imposition of high fees on patented inventions. **O. G. Beard.**

NON-FLESH DIET AND HARD WORK.

[26764.]—IT is a great pity that Dr. Allinson, "The Lydney Dispenser," and other enthusiasts cannot be induced to know that all the units of the human race are not exactly alike. Hobbies are all very well in their way, but they get spoiled if they are ridden to death. It stands to reason that men who have been brought up from infancy on oatmeal and teetotalism should do more work on that particular diet. It is part and parcel of their mode of living, and any sudden change of diet would probably upset them in common with other people. Dr. Allinson should also know that it is perfectly absurd for any man or body of men to do hard or heavy work on a full or overloaded stomach. A heavy meal should be taken after work is over (as did the Highlanders); if a heavy meal is necessary at all, and if those Scotchmen had started on a stomach full of oatmeal they would have done as little work as the Englishmen. All this is a matter of personal experience with me, and I can do as much work on one kind of food as another; but I must first get thoroughly accustomed to the change. As a rule I eat no meat, but content myself with fish, and very little of it. Personally, I think that nineteen people out of twenty not only eat too much meat, but too much altogether. I know that at one period of my life I was perfectly incapable of doing anything after a two o'clock dinner. I am now as fresh after dinner as I was before. I did not consider myself a large eater, and don't suppose I ate on the average more than anyone else, and I do not now eat more than half or one-third of what I used to do, and of a much lighter kind of food.

A man who has been used to meat craves for it in much the same way as a drunkard craves for drink. At some workhouses where fish dinners were tried the inmates said they felt as if they had had no dinner at all, and this will be the case with anyone else; but perseverance for a few days or weeks soon relieves that feeling. A friend of mine once, to the surprise of himself and everyone else, won the first prize at a shooting match, and he attributed it to the fact that all the best shots had a heavy luncheon just before; he had none.

I am not a vegetarian; but I take a little animal food, because I feel I cannot do without it. I am not a total abstainer, but I hardly ever touch alcoholic drinks, as I don't think they are good for me; but I don't wish to lay down hard and fast rules for everyone else. Many people live to eighty and ninety years of age on a good supply of meat and alcohol, and many people kill themselves with the same.

The leading idea should be to be temperate in all things, avoid bigotry in every shape and form, and don't imagine that your coat is made to fit everyone else. **Os.**

DOES THE SUN PUT OUT THE FIRE?

[26765.]—"K. E." (letter 26745, p. 454) asserts as a fact that which is disputed by almost everyone who has studied the subject. I am glad, however, to find that he limits the sun's supposed influence in this direction to cases where the fire has been neglected and allowed to get dull, which, I take it, will often be followed by its completely dying out, either with or without the sun's special assistance in doing so. "K. E." goes on to say that in the case supposed the draught ceases, and the fire consequently goes out because the sun's rays warm and rarefy the air of the room as much as the fire warms the air passing over it up the chimney. Does "K. E." wish us to understand from this that the air of the room is only partially warmed by the sun, a special reserve of cold air being left unaffected for the fire alone to act upon? Otherwise, supposing the air of the room to be generally warmed by the sun's direct rays and the ordinary currents that would be set up, which I maintain would be the case, his argument has no foundation, as the action of even a dull fire would always have a tendency, under such circumstances, to create a draught.

I am inclined to believe that the tendency of the sun to dull or put out a fire is strictly limited to its apparent effect in doing this, and that when Jane, after neglecting her fire too long, gives it a gentle stir, draws down the blinds, and soon begins to discover a few red-hot patches which previously appeared to be black, her traditional instincts at once assure her that the fire is beginning to "draw up" because she has shut out the baleful influence of the sun. **W. T. N.**

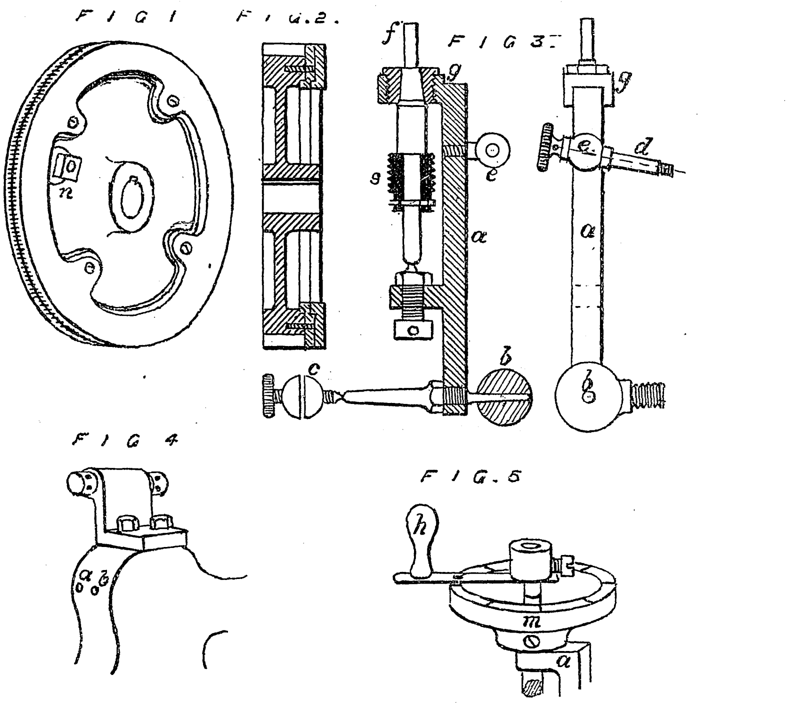
SUGGESTION FOR A SAFETY PARAFFIN LAMP.

[26766.]—ACCORDING to my design, the lamp is to be without having any bowl, so that consequently there could be no explosion of a bowl. My suggestion is that the reservoir for the oil be formed of a coil of metallic tubing, capable in itself of holding a sufficient quantity of oil. One end of the coil would open into a wick-chamber in the centre; the other end would be closed with a screw-stopper having a vent. In case of the upsetting or falling of the lamp, a small quantity only of the oil could be spilled, particularly if regard were paid to this object in the manner of coiling, and, at the same time, there would be no brittle substances like bowls to be broken by the fall. I should suppose that a lamp constructed on this plan would be absolutely incapable of exploding, assuming that the bore of the tubing were sufficiently small. The interposition of so much metallic material among the oil ought to be effectual in preventing explosion, as it is a well-known fact that the intervention of substances, such as powdered glass, sand, &c., will effectually destroy its explosive power. **E. H.**

ROAD REFORM.

[26767.]—THE great question for the country to decide respecting the reform of our common highways is, "Will it pay?" Let us compare the work to be done, with and without reform. For physical work means "expense," whether paid for directly or indirectly, because it means "consumption." If "F.R.A.S." is afraid that in reforming our roads we should cut through park or farm (though country roads generally run through farms) in order to avoid unnecessary road-hills, suppose we reform without altering present positions of roads; then there are hundreds of hills and valleys to be levelled. Will it pay to level a road that has an average daily traffic of, say, 20 tons along it—this means 7,300 tons yearly? This road may have a succession of hills and valleys along its course, let us say five hills and four vales, each hill averaging fifteen yards in altitude; then the yearly work caused by these five hills is 7,300 tons multiplied into 225ft., which equals 1,642,500 tons to be raised one foot annually at public expense; without taking lost time, fatigue, and extra distance into account. Surely it is cowardly to say with "F.R.A.S."—"There the road is, we can only make its surface firm."

Now let us reform this road by levelling it—i.e., by taking off the tops of these hills, and casting them into the vales; then all the earth taken from these hill-tops has simply to be tipped downwards, not raised from the vales to the hill-tops, as our traffic has to be raised. Then, again, the weight of earth taken from the hill-tops has to be shifted but once, whereas the 7,300 tons of traffic has to be raised to the tops of the hills every year. Ten yards taken from a hill-top may raise a vale ten yards; then public traffic gets the double advantage of twenty yards, or 60ft. Then, probably,



the load that now requires four horses will require but two.

I may inform "F.R.A.S." that I am not prepared to pay more road rates, though reform should take place, but rather less; for at the present time if I want a ton of coals brought from the nearest station (seven miles) I must pay a sovereign for them. The coals are 9s. per ton at the station, and yet my house is on a plane with the station; but there are 750ft. to be climbed in the several hills that lay between my house and the station.

The question of road reform is not a parochial but a national one. All our public roads are under the care and protection of the Government. It is the province of the parish simply to repair the surface of its roads for the use of them. The prerogative of real reformation belongs to the Government. Being thus a national question, the work of road reform may be accomplished in a few years; but the entire payments for that work need not be finished for thirty, fifty, or a hundred years.

Norfolk.

DIVIDING APPARATUS.

[26768.]—I THINK your readers may care to see an arrangement I have just finished for dividing for wheel-cutting, &c. I hope, too, it may lead others to send us some account of the work they have done lately.

Mine is a 5in. slide lathe by Milnes. I have also a small $3\frac{1}{2}$in. lathe, which I find very useful for small work, and to save removing and clearing the other in the middle of a job, when a screw or bit of drilling is required. The pulley of the larger lathe was fitted with a brass division plate, having three rows of 180, 144, and 96 holes. This I had taken off, and in its place was fitted a worm-wheel, 7in. diameter, and $\frac{5}{8}$in. thick, divided into about 240 teeth, which teeth come just about 11 to the inch, and so suit the $\frac{5}{8}$ Whitworth thread. The worm-wheel is made as two plates with a circular fitting, and the two halves meet at the middle of the teeth, and are secured to each other by four screws passing through four lugs in the plates, Figs. 1 and 2. This was to enable the two halves to be turned on each other; the screw holes should be rather large to enable the teeth to be adjusted to one another. The number of lugs must, of course, be a divisor of the number of teeth in the worm-wheel. The plate came to me cut in the usual way, but on turning the front part half-round, there appeared inequalities in the correspondence of the teeth, which might amount to $\frac{1}{30}$in. A brass frame was then made (*a*) Fig. 3, and fitted into the ball (*b*, *b*) which takes the index spring; a second screw (*c*) was fixed into sole of headstock, to keep all firm below, and a screw (*d*) with milled head, passing through a ball attached to top of frame (*e*, *e*) was provided, which screw takes into a tapped hole in the headstock near the little hole for point of screw of oval-chuck ring. By turning head of screw *d*, the worm (*s*) is brought up into contact with worm-wheel. When screw *d* is released, frame can be turned down, and when screw *c* is taken out with a screwdriver, the whole frame can be removed, leaving no trace but the two small $\frac{1}{4}$in. tapped holes for *d* and *c*.

To complete the cutting of the worm-wheel, a second screw (*s*) was made, and this was filed like a hub with spiral groves, and hardened; a pulley was fitted on the top of the worm spindle at *f*, and the worm-wheel was then recut in several positions. The front of the worm-wheel was then bored as a division plate, and this will illustrate the use of the apparatus. There were four rows of holes: the first (diameter $6\frac{5}{8}$) contains the numbers 11, 13, 14 and 6, all in one row; 6 was added to save the other rows; 17 and 19 would have clashed, as the holes are rather large. The next row contains 192 holes in a diameter of $6\frac{1}{4}$in.; then come 120 holes in a diameter of $5\frac{7}{8}$, and then 72 large holes which are large enough for segment stops. The holes start from zero marks struck on the plate with the index point. The index point, like the holes, is made to an angle of about 18°, and the point rounded and smoothed, so as not to scratch the plate, as advised by "J. K. P." in back vols.; it has also a short shoulder which fits the larger holes, as these contain multiples of nine, and thus they are useful with the index peg as well as for the segment stops. The stop for these is shown at Fig. 4, fixed on top of the headstock; *a* is the tapped hole for the screw *d*, Fig. 3, and *b* is the counter sunk hole for oval chuck. All the divisions named, which contain every number up to 17, were produced from the 240 worm-wheel, which becomes almost a calculating machine. On the top of the frame at *g*, Fig. 3, will be seen a circular fitting which is true with the worm spindle; on to this was firmly fitted a 3in. wooden collar having circles scribed on it in the lathe. These circles were then divided by the dividers into 4, 7, 11, 13; then on the top of *f* was fitted a small spring crank with handle, which could be brought up accurately to the marks, so as to give two turns (for 120), or $1\frac{1}{4}$ turn (for 192), $18\frac{6}{13}$ turns for 13 divisions, &c. You have simply to divide 240 by the number of divisions you require, and that gives the turns you give the worm-screw between each cut. For example: required 192 holes, $\frac{240}{192} = 1\frac{1}{4}$ turn. I have now in hand some brass collars (see Fig. 5,) which will be divided on the top edge for a little tooth or knob in the spring crank to take into; *h* is handle, *k* the knob, *m* the brass collar, *a* the top of the frame. Had the segment apparatus and worm-wheel been placed behind the pulley as usual, the lock nut *n*, Fig. 1, would have intervened, and if it had been at all loose, all accuracy would have been lost. My few patterns are with Mr. Milnes, and anyone may have castings from them.

F. A. M.

CUTTER BARS, &c.

[26769.]—AS a continuation of letter 26584, will you permit me the following?

Your correspondent "H. O., Glasgow," very kindly forwarded me three pieces of Mushet's steel, which I have used with heavy, and also with light cuts, and at such a speed that made the cutter smoke; under these extra strains it has stood admirably, and I have formed a good opinion of it for all kinds of metal turning.

Can any of "ours" tell your readers its composition? and alongside of it, place the composition of the very best crucible cast-steel, so that readers may study the difference?

I was pleased on opening the magazine yesterday to find the "Willis Haydon Tool-holder" sketched as an advertisement, and hope that every lathe-man will make, or purchase, one that sees it. With this holder and a $\frac{3}{8}$ square rod of Mushet's steel every amateur and every professional turner is equipped for all outside turning. A word of warning is necessary to users of this steel to never put it in water while hot, but after it is forged lay it down to cool. There does not seem any means of filing this steel, but by the aid of an emery stone, a good many shapes of cutters may be formed direct from the rod. When it is hammered it should be fully as hot as crucible steel is made when forged, and by no means hammer it when getting cool.

Jan. 22. **Evod.**

LATHE MATTERS.

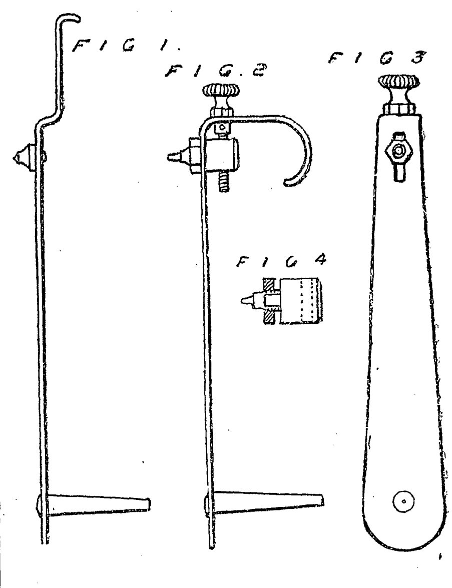
[26770.]—OH, "Vulcan," how could you apply the epithet *thirsty* to such an ardent teetotaller as "F.A.M."? *Hungry* I am for all I can learn about lathes and tools, and send my small contributions in hopes of drawing others to help me. Mr. Jesse Lowe, for instance, could tell us many things about his medallion machine, and other original tools, three-mandrel lathes, and such like.

I do not know where to go for information on the subject, though I believe it is contained in the late Mr. Hartley's unpublished book. Two hundred subscribers for this have sent in their names, and probably the reception of 50 or 100 more would justify its publication.

"W.A.S.B." would find, in Holtzapffel's Vol. IV., some fine patterns of plain turned work, and if he likes to writes to me at 4, Clarence-road, Tunbridge Wells, I will tell him of another source from which he may draw.

As regards A. Gray's question *re* the Edmunds mandrel, I should be well satisfied to adopt it; if I changed anything, it would be to substitute a Whitworth thread for the special thread advocated.

I send the inclosed sketches to show how easily



the plain index, Fig. 1, was altered to the adjustable index, Figs. 2, 3, 4, this being the index used with the division-plate described in my last letter. It may not be perfect, but it is very simple. The old index point was removed, and the top of the spring heated and bent round as seen, the oblong slot filed, the new peg with its nut, Fig. 4, made to fit the coned holes, there being a very short shouldered fitting to go into the larger holes for the segment stops; the adjusting screw completed the work.

F. A. M.

DETERMINATION OF SUGAR IN DIABETIC URINE BY PAVY'S AMMONIACAL CUPRIC SOLUTION.

[26771.]—IN response to the request of "M. O. H." (letter 26633), I now fulfil my promise to give working particulars of the admirable process introduced by Dr. F. W. Pavy, F.R.S.

The *solution* is made by taking—cupric sulphate 4·158 grammes, Rochelle salt 20·400 grammes, potash (caustic) 20·400 grammes, ammonia (sp. gr. 880) 300cc., and making these up to 1 litre; 10cc. of this are equivalent to ·005 gramme of glucose; or, 120cc. of the ordinary Fehling solution, with the addition of 10 grammes of potash and 300cc. of ammonia, may be made up to 1 litre, to form the same fluid. This is one-tenth of the strength of ordinary Fehling solution.

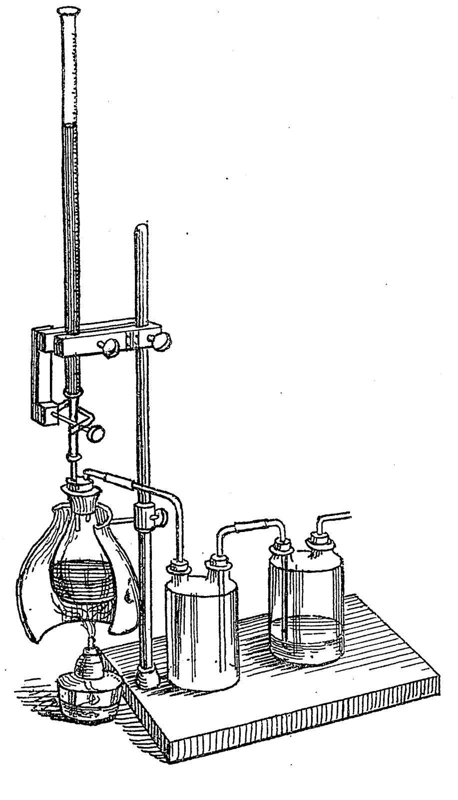
The *apparatus* of the most improved form is that figured here. It consists of a burette, from which is pendent by a short indiarubber tube, a flask of about 150cc. capacity. Flasks known as "carbonic acid flasks" answer capitally. The cork used is of

indiarubber, with two perforations; into one of these fits a short glass tube, connected with the burette by the piece of tubing mentioned above, and dipping a short way into the flask, where it is drawn out to a moderately fine point. The other perforation is fitted with a tube leading off to two Woulffe's bottles, one of which is about one-third filled with water.

The tube between the flask and burette is best compressed by the specially devised screw-tap figured. The ordinary spring-clip brings the fingers too close to the flame to be pleasant; nor does it allow so regular a succession of drops to fall. Behind the flask, to form a white background, is arranged the half of one of the ordinary white, opal gas-globes.

The *process* is as follows:—A preliminary test is made to see if the urine contains sugar at all. This cannot be made by the ammoniated cupric solution, since it is too delicate for that purpose. Into a test-tube place about 5cc. of the suspected urine, and about 3cc. of Fehling solution; boil the mixture for a minute or two. If the blue colour is destroyed and a red precipitate is produced, sugar is present.

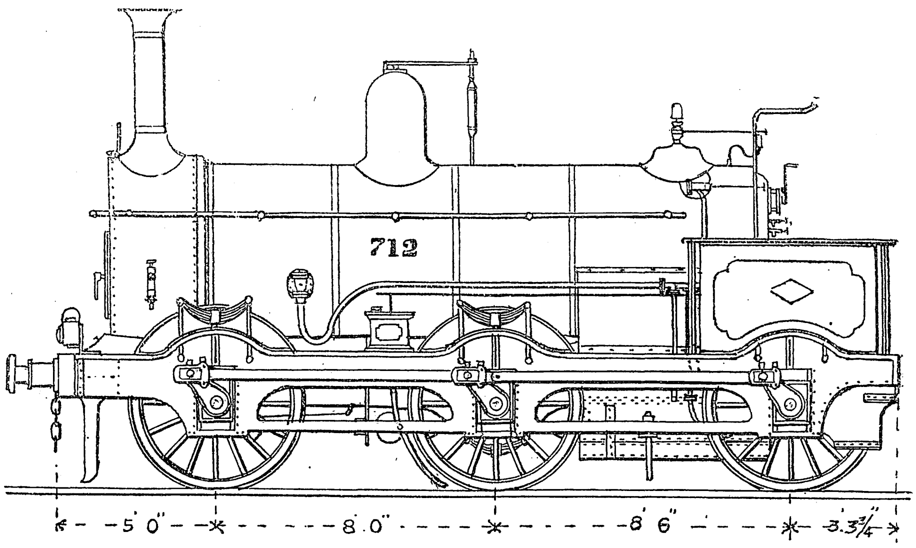
Now, dilute some of the urine to twenty times its volume, fill the burette with this, taking



care that the indiarubber tube and its jet are full too. Into the flask place 20cc. of the dark blue ammoniated cupric solution; attach it to the burette. Light the spirit-lamp or Bunsen burner below. Directly the blue liquid begins to boil, let a rapid succession of drops fall from the burette into it by turning the screw-tap. As the blue colour begins to fade, let the diluted urine flow into it more and more slowly, till the liquid in the flask becomes perfectly colourless. Take care not to let any more run in after the colour disappears. One or two trials will soon show whether you have stopped at the right time. Read off the number of cc. emptied from the burette. The liquid in the flask should now be perfectly colourless and free from any red or other deposit. If an unusually long time has been taken, a red precipitate of oxide of copper will come down, and the experiment must be repeated more rapidly.

The object of the Woulffe's bottles is to absorb the ammonia given off; but little will pass out of the second bottle, and this may, by an indiarubber pipe, be conveyed out of the window or down a sink. The ammonia condensed may be used over again.

Calculation of Results—Suppose 8cc. of the diluted urine decoloured the 20cc. of blue test liquid, and that if all of the urine had been diluted it would have measured 1,000cc. Then, since 20cc. of the blue liquid equal ·01 glucose and 8cc. of the diluted urine equal this 20cc., we have $\frac{\cdot 01 \times 1000}{8} = 1{\cdot}25$, or the whole quantity of urine contains 1·25 gramme of glucose. Urines containing very large quantities of sugar had best be diluted to 40 times their volume. Urines containing very minute quantities of sugar need no dilution.



Interfering Substances.—It is not necessary to precipitate the albumen, phosphates, &c., as in the Fehling method: they do not interfere with the accurate working of this method.

Alkaline tartrates and carbonates, when present, do not "gravely affect the accuracy of the indications," as mistakenly asserted by Mr. Allen from results obtained by Mr. Hehner with quite a different test fluid. Of course, if you vary the constitution of the test liquid, you will also vary the results: this is true also of every other standard solution.

The substances natural to urine that do interfere with the test, causing an over-estimation of sugar, are uric acid and creatinine. The first of these may not only be allowed for, but also be quantitatively estimated by the same test liquid, as was shown by Dr. Pavy in a paper in the *Medico - Chirurgical Transactions*, Vol. LXIII. p. 322. How, I shall be happy to show, if of interest to your readers.

The other substance, creatinine, according to Dr. G. Johnson, F.R.S., in a paper to the *British Medical Journal*, Jan. 8th, 1887, may also be eliminated. The substances equally interfere with the ordinary Fehling solution. They do not, however, seriously affect the *comparative* determination of sugar in urine.

Theory of the process.—This is not definitely settled as yet: all we know is that the boiling caustic potash breaks up the sugar molecules so that they may convert the cupric sulphate into sub-oxide. This sub-oxide would deposit as a red powder were it not for the presence of ammonia, which keeps it in solution. Hence, the reaction with this fluid goes on in an atmosphere of ammonia. If all the ammonia is dissipated, through too slow a titration, the oxide will deposit and spoil the reaction.

Advantages.—The fluid, once made, will keep for an indefinite time; the end of the reaction is sharply marked; there are no muddy red particles floating in a more or less blue liquid to be looked at through a cloud of steam, as in the ordinary Fehling volumetric method; no previous treatment of the urine is needed; it is more speedy, delicate, and accurate than the ordinary methods used. **Alf. W. Stokes, F.C.S.**

Vestry Hall, Paddington-green, W.

BURNT AIR.

[26772.]—IN connection with the warming of the interiors of buildings, we often hear of the injurious effect of burning the air by allowing it to come in contact with surfaces overheated, but not, of course, in combustion; more especially is the injury said to be caused when the overheated surface is of iron. What is the operation of this burning, and what is the explanation of the cause of the injury which is done to the air? Merely to raise its temperature would not, one would imagine, alter its constitution. One explanation is that the evil arises from the decomposition by burning of the dust floating in the air. But although this is generally accepted in the absence of some better theory, it appears to be scarcely sufficient.

Air consists of a mechanical mixture of the gases nitrogen and oxygen with a small quantity of carbonic acid (i.e., carbon and oxygen in chemical combination CO). May it not be that at high temperatures the carbonic acid decomposes and reforms with a larger quantity of oxygen, forming CO_2. or carbonic oxide, thus permeating the air with a more poisonous gas, at the same time robbing it of a portion of its free oxygen?

If neither this theory nor the dust theory be sufficient, does anything proceed from the iron or other overheated surface which poisons the air? **Wm. Archdeacon.**

MIDLAND GOODS ENGINES 700 CLASS.

[26773.]—I NOW beg to forward a drawing I made at Leicester Locomotive Department, 1869, of Midland goods engine No. 712, trusting it will furnish the information for which "Rover," page 442, asks.

The engine illustrated is one of those designed by the late Mr. Kirtley, and constructed by Messrs. Dübs and Co., 1869; the tender being of the same dimensions and weight as the one illustrated on page 412.

Diameter of cylinders	17in.
Length of stroke	24in.
Diameter of wheels..................	5ft. 2in.

The tractive force for each pound of effective pressure on the pistons being, therefore—

$$\frac{17 \times 17 \times 24}{62} = 111{\cdot}870\text{lb}.$$

Heating surface of firebox	103 sq. ft.
Heating surface of 168 tubes ...	993 sq. ft.
Total heating surface...	1,096 sq. ft.
Diameter of tubes outside ...	2in.
Area of firegrate	17 sq. ft.
Pressure of steam	140lb. per sq. in.

Weight in working order—	Tons.	Cwt.
On leading wheels	12	8
On driving wheels	12	13
On trailing wheels	9	12
Total	34	13

The "heating surface" above given is the amount as calculated from my own measurements; the weight was furnished to me by the designer.

Clement E. Stretton,
Consulting Engineer, Amalgamated Society of Railway Servants.
306, City-road, London, E.C., Jan. 21.

FAST TRAINS.

[26774.]—I DO not think that the G. S. and W. of Ireland Co. have any tenders nearly large enough to run without stopping from Dublin to Cork. No stop is mentioned in "Bradshaw," because passengers are not booked to or from any intermediate station. It is only on very rare occasions that the N.E. engines can run right through from Newcastle to Edinburgh—so one of the drivers told me last autumn. The longest run without taking water is made by the Mid. Leeds expresses, which often do not take water at Kettering. On the only occasion I have been in one of these trains—the 3.17 p.m. up from Nottingham—I particularly noticed that the driver took no water at Kettering, though it was rough, wet weather. It was not one of the very largest Mid. tenders; but much larger than any on the North Eastern.

I cannot at all see why it should be impossible for a large-wheeled single engine to attain a speed of over 80 miles per hour. I timed the Mid. Express just alluded to between Luton and St. Albans (10¼ miles), and it took as near as possible 8 min. between the upper ends of the two platforms. The engine No. 1568 has 6ft. 8in. coupled wheels, and 18 by 26in. cylinders, and if that kind of engine could attain a speed of nearly 77 miles per hour in heavy rain, over an undulating portion of the Midland, what is there to prevent the G.W. "Great Britains," attaining a far greater speed between, say, Swindon and Didcot, or Maidenhead and Westbourne Park?

It is quite a mistake to suppose that the "Great Britains," can only go down hill or on the level. I remember, one frosty morning in Nov. 1870, the Prometheus, which had been rebuilt a few

months previously, taking the 9.15 a.m. train from Paddington from Slough to Didcot (35 miles) in 37 minutes, nearly all slightly uphill. The train consisted of 12 old-fashioned B.G. six-wheeled coaches, and was well loaded, as it was a Saturday morning, and the trian took passengers for the Weymouth and South Wales sections, besides being the only good day train to below Plymouth.

Mr. C. Rous Marten seems to be unaware that most of the so-called "old single engines" mentioned in his letter (26651) have been quite recently rebuilt, and are to all intents and purposes, new engines. Probably the oldest single engines doing heavy work are some of the G.W. "Sir Daniel" class (378-387) which came out in 1866. I came with one of these (385) on Dec. 21 from Paddington to Swindon. The 41 miles from Reading to Swindon were easily run in 50 min. with a fairly heavy train (6.20 p.m. from Paddington), though the rails were very slippery from frost. The engine had brought up the 9.35 a.m. from Bristol to London. I know No. 385 and several others have not been rebuilt.

I cannot see why there should be any difficulty with G. W. No. 10 on sharp curves. She is not so long as the G. N. new 7ft. 6in. singles and cannot be longer than the "Great Britains," which have frequently run over the Gloster and Swindon and Maidenhead, Thames, and Oxford sections in days when those sections were B.G.

O. H. P. Scourfield.

EXPRESS TRAINS.—III.

[26775.]—

GREAT NORTHERN RAILWAY.

Grantham—King's Cross, 4.17 p.m. up. The best run, Nov. 24th, 1886.

Miles.	Stations.	Booked Time.	Actual Time.	Speed.
		p.m.	h. m. s.	
	Grantham	4.17	4 17 30	
29	Peterbro' (A) ...		4 52 0	$50\frac{10}{13}$
$17\frac{1}{2}$	Huntingdon		5 10 0	$58\frac{1}{3}$
$26\frac{3}{4}$	Hitchin		5 37 30	$58\frac{4}{11}$
$14\frac{1}{4}$	Hatfield		5 52 0	$58\frac{28}{29}$
5	Potter's Bar		5 57 0	60
$12\frac{3}{4}$	King's Cross......	6.15	6 12 0	51

REMARKS.—(A) Slack through Peterbro' by signal.

Load $8\frac{1}{2}$. Loco. 771. Chief dimensions of loco.:—Cylinders, 18 by 28; bogie wheels, 3ft. 11in.; drivers, 8ft.; trailers, 4ft.; heating surface, 1165 square feet. Water in tender, 2,950 gallons. Coal, $3\frac{1}{2}$ tons. Consumption of coal per mile, 26lb.

GREAT NORTHERN RAILWAY.

Peterbro'—Doncaster, 3.3 p.m. down. The worst run. Nov. 16th, 1886.

Miles.	Stations.	Booked Time.	Actual Time.	Speed.
		p.m.	h. m. s.	
	Peterbro' dep. ...	3.3	3 3 0	
$12\frac{1}{4}$	Essendine		3 20 0	$43\frac{4}{17}$
$11\frac{1}{2}$	Stoke Summit ...		3 36 0	$43\frac{1}{5}$
$5\frac{1}{4}$	Grantham (A) ...		3 43 0	45
$33\frac{1}{4}$	Retford (B)		4 20 0	$53\frac{34}{37}$
$17\frac{1}{4}$	Doncaster	4.37	4 42 30	46

REMARKS.—(A) Slack through Grantham; (B) Slack through Retford.

Load equal to 8. Loco. 707. Dimensions:—Cylinders, $17\frac{1}{2}$ by 26; coupled wheels, 6ft. $7\frac{1}{2}$in.; leading wheels, 4ft.; heating surface, 1,050 square feet. Water in tender, 2,950 gallons. Coal, $3\frac{1}{2}$ tons. Consumption of coal per mile, $29\frac{1}{2}$lb.

French Loco.

ELECTRIC LOCKING FOR RAILWAY SIGNALS.

[26776.]—IF Mr. Spagnoletti (page 452, 26727) will again read my letter, he will see that I do not oppose the system; but in line 5 I remarked, "but there is one most important and vital point which requires to be made clear." Now instead of explaining this matter, my letter is simply called "unpardonable" by Mr. Spagnoletti. He states he "admitted the point raised was an important one," and further that his system does exactly what I say it ought to do.

I am perfectly well aware that a long and somewhat strong discussion is taking place elsewhere between Mr. Spagnoletti and Messrs. Saxby and Farmer with reference to Electric Locking; but it is not my intention, and certainly no part of my duty as consulting engineer to the Amalgamated Society of Railway Servants, to discuss the claims of inventors. I have simply to consider and report upon the mechanical construction and practical working of various appliances and systems which have for their object the safe working of railways.

Nothing was said in my letter about signalmen being "unreliable or careless"; but it is a well-known fact, constantly proved by accidents and Board of Trade reports, that signalmen are liable to, and actually do, make mistakes sometimes, and that to prevent these mistakes resulting in collisions, a safe system of electric locking for signals is absolutely necessary.

The correspondence in your own columns and elsewhere shows that considerable doubt appears to exist as to whether the Spagnoletti system is or is not a safe one, and certainly the inventor's letter, page 452, does not contain any facts to enlighten your readers, nor to clear up this important question. **Clement E. Stretton.**

Consulting Engineer Amalgamated Society of Railway Servants.

40, Saxe Coburg-street, Leicester, Jan. 21.

[26777.]—MR. SPAGNOLETTI (26727) replies to Mr. Stretton (26710) as to his system of electric locking for signals; but we are no wiser than before. Mr. Spagnoletti takes up a great deal of space about "Mr. Stretton being a representative man and adviser to a society," &c.—as if all the railway world did not know that—but never says a word about how he gets over the defect complained of. If the man *does not* put the lever back, how can he lock it? I would refer him to the letter of "Rover," page 452, and ask him to explain. If Mr. Spagnoletti would illustrate and describe his system in the "E.M.," we could then all see for ourselves, and misapprehension would be removed. **J. Dixon.**

THE WIMSHURST MACHINE.

[26778.]—CRISPIN (letter 26736) is right in his suggestion—viz., that wire brushes would answer if substituted for the ordinary collecting combs; but in practice he will find there is difficulty in keeping all the points of the fine wires directed towards or touching the glasses; while if only one of the fine wires should get out of its proper place, it is so highly charged that great loss ensues.

I write after repeated trials, and therefore think he may accept the statement as one of fact.

A length of guttapercha-covered wire, with the end of the wire pointed and brought near to the plate, answers instead of a comb for plates up to about 12in. diameter, while for larger plates two such wires should be used as a substitute for each comb. All the multiple plate machines are so made up, and are so described in your earlier numbers; this cheapens their construction.

For the above-stated reason, and because there is no chafing on the plates, the pointed wires will be found better than brushes when used as substitutes for the ordinary collecting combs.

J. W.

[26779.]—IF "Crispin" (letter 26736, p. 454) will turn back to "E.M." of May 21, 1886, p. 258, as well as to "Original Experiments" No. 8, he will find that I have anticipated him upon the matter. I consider that one point, whether as a point or as a fine wire, is quite sufficient to take all the electricity accumulated upon any sector, and "that it is doubtful if any electricity is given off from the glass lying between each sector," which I think will probably be found upon experiment by building up discs, so that each piece of glass will be no larger than its tinfoil sector; to give at least as much electricity with so much the lighter discs, see No. for Dec. 31st, p. 390. I am also almost come to the conclusion that it is of no advantage to have points or brushes of jars or conductors in connection with both the discs simultaneously: I seem to get equally good results with "one" to each conductor.

January 21st. A., Liverpool.

MICROSCOPICAL—NUMERICAL APERTURE.

[26780.]—THE difficulty mentioned by "J. F. S." is a very natural one which has puzzled many. "J. F. S." says, "Theoretically they (an oil immersion and a water immersion of the same N.A.) should be alike."

Theoretically, a steamer with a screw of 20ft. pitch should advance 20ft. through the water at each revolution. So it would if there was no slip. Also, a dry lens of N.A. 1·0 should theoretically grasp spectra diffracted to as great an extent as those which are only capable of being taken up by an oil immersion of the same N.A. So undoubtedly it would if there was no slip. No one will doubt the superior brilliancy of an oil immersion of N.A. 1·0 to that of a dry lens of the same aperture. The *theoretical* illuminating power $(N.A.)^2$ is, however, the same for both. The amount lost through slip by the dry lens was evidently not taken account of in the *theoretical* formula. There is another element to be considered in addition to slip. Lenses of the same N.A. and power which have media of different refractive indices interposed between the front lens and object have front lenses of different curvatures—*e.g.*, a dry one-sixth of N.A. 1·0 would have a front lens of very deep curvature, while an oil immersion one-sixth of N.A. 1·0 would have one of a comparatively shallow curve.

The deeper the curvature of the front lens, the more difficult it becomes to make it aplanatic and achromatic. It is far more difficult to make a water immersion of N.A. 1·26 than an oil immersion of N.A. 1·27.

"J. F. S." is quite right: there is a great difference in favour of the oil immersion. This is accounted for by slip (loss of light by reflection, &c.) and unavoidable errors in construction.

Edward M. Nelson.

London, Jan. 20.

COAL ECONOMY—GOODS TRAINS AND PARTING COUPLINGS.

[26781.]—B. BAGSHAW (26730) says he does not believe in electricity for signalling; it has failed so often. How does he intend to work the block without? He says, "The plan that I have recommended will be the best to effect the object in view"—viz., safe working. What is the plan; where recommended? Will he kindly illustrate the automatic system he speaks of? Surely the Board of Trade and L. and N.W. Co. did not refuse to patronise so worthy an appliance? Perhaps Mr. Bagshaw will be a little more explicit as to how the ten per cent. is to be made on all railways. I am sure his fortune is made if he can show any board of directors how it can be done. Wages are to increase too! **Rover.**

"THOSE WHO LIVE IN GLASS HOUSES SHOULD NOT THROW STONES."

[26782.]—WHEN your valued correspondent, "A Fellow of the Royal Astronomical Society" (whose communications are, however, too frequently tinged with acid banter), takes upon himself, in letter 26685, to ridicule the "imperfect" knowledge of another, and to stigmatise likewise as "far from perfect" one of the most accurate driving-clocks in existence, he should at least be careful that the reasons assigned for his strictures are themselves correct.

"F. R. A. S.," in the letter alluded to, states that "the mere fact that the mass of star discs upon his negative are elongated in a north and south direction shows that apparently the driving-clock of his equatoreal is far from perfect." Exactly the reverse of this is the case: the elongation of discs in a north and south direction shows that the clock is acting perfectly, and that the irregularity in shape is caused by refraction, which must affect their shape with so long an exposure as 67min., especially upon stars having an altitude of only about 30°.

Perhaps you will permit me to remind your readers, as "F. R. A. S." has forgotten to do so, that the photograph in question, despite the slight defacement occasioned by the "lines" so unfortunately lauded by Sir R. S. Ball, is in itself a remarkable achievement: it is by far the finest taken hitherto of 42 M and the adjacent nebulæ, as it enlarges the limits of the nebulosity to an extent exceeding those of the celebrated photograph of Mr. Common by at least six or seven times.

Many of your readers, I know, would like that the many excellent letters of our friend "F. R. A. S." should contain fewer pungent personalities, which, while they raise a laugh on being read, leave afterwards a sympathetic feeling in our breasts, even sometimes for that greatest of delinquents, the South Kensington Institution.

Another Fellow of the Royal Astronomical Society.

TEMPERING AND DOCTORING STEEL.

[26783.]—HAVING experimented with a compound similar to that of Adam Schaefer (letter 26645, p. 392), I have come to the conclusion that the capabilities of the same are rather exaggerated. I tried wrought iron, Atlas steel, and cast tool steel. On wrought iron the compound had very little effect—only a slight hardening of the skin, and this only after several immersions. The Atlas steel became about as hard as saw temper after three immersions, one immersion producing hardness at the edges only. The fracture was like that of inferior spring steel. In breaking, it first bent and then broke suddenly. On cast tool steel it does not produce any appreciable effect, and can hardly be said to restore burnt cast steel. The mixture I used was composed of rosin 3 parts, charcoal 4 parts, linseed oil 3 parts, glycerine $1\frac{1}{2}$ parts. I tried other proportions, but they did not produce the desired result.

Some months ago I tried the muriatic acid and zinc bath on some small drills, but did not find it had any advantages over mercury.

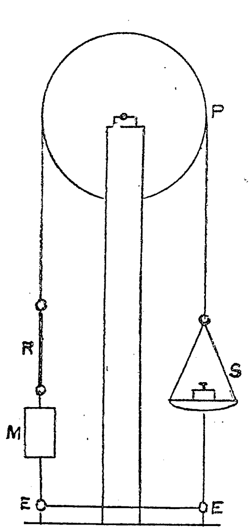
A. F. Shakespear.

Lüttichaustr 14, III., Dresden, Jan. 22.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60744.]—**Question in Dynamics.**—A very simple apparatus will serve to solve this problem experimentally. P is a wooden pulley, with a very



light axle running in two notches cut in bits of sheet brass let into saw-cuts in the tops of a pair of wooden uprights. A silk thread passes over the pulley, and to one end is attached the "monkey" M (mine weighed 7oz.) by means of an india-rubber band, the elasticity of which does duty for the muscular arms of the animal; S*a*, scale pan at the opposite end, is accurately weighted to balance the monkey. E E are the screw-eyes in the base of the apparatus, through which passes a thread attached to both M and S, and by means of it R is stretched 1in. On releasing the string, M rises about $\frac{5}{8}$in., S $\frac{3}{8}$in., the difference being due to the friction and inertia of the pulley. The case is really the same as that of two boats afloat connected by a cord; pulling the cord causes them to approach each other, and any other result is impossible by the 2nd law of motion.—W. A. S. B.

[61101.]—**Stars Visible from Bottom of Well.**—In answer to "Dubitans" permit me to quote the few following lines from Herschel's "Outlines," paragraph 61:—"We have ourselves heard it stated by a celebrated optician, that the earliest circumstance which drew his attention to astronomy was the regular appearance, at a certain hour, for several successive days, of a considerable star, through the shaft of a chimney." "Dubitans" will also find several references of a similar nature in Arago's "Popular Astronomy."—B. A., Handsworth.

[61111.]—**Hand-Saw.**—"T. P." inquires the difference in form and mode of using the hand-saw of a British or Oriental workman, and defines the latter as "having teeth leaning in the opposite direction." I would respectfully remind this correspondent—and it is a lesson which, for our good, requires to be more deeply impressed upon us as a nation—that what is not British is not necessarily Oriental. The British workman is acquainted only with the thrust saw, and not with the pull saw. Now the latter is a most useful and convenient tool to work with, and when only light timbers, not exceeding 3in. thick, have to be dealt with, is very superior to the saw used exclusively at home. It cuts clearly and evenly, less force is required, and you are never troubled with buckling or bending. The blades generally measure 35 centimètres long, seven centimètres broad, and one millimètre thick, and are fitted with an appropriate handle for pulling, the teeth being directed towards the hand, with very little side set. Such saws are made in France, and I have seen them in use there, in the provincial villages of Vaucluse, and along the Mediterranean coast. Here in Cyprus, where I am at present, they are used exclusively, and the saw of the British workman is almost unknown. I have examined a few while writing this, in search of a brand, with the result:—two are unstamped, other three are simply marked "Acier Fondi," while one has an addition, the name, "Peugeot Frères." All are distinctly of French, not Oriental, fabrication. Such tools are largely in use in Eastern countries, and, with other such things as locks with inverted keys, and screws with a left-handed twist, have earned for the Chinese and Japanese the unmerited title of being "upside-down people." In Alexandria I observed itinerant vendors of firewood (brushwood) cutting it up with great celerity into short lengths, suitable for local use. They employ a length of band-saw, placed diagonally in an upright frame, the sides of which form a gauge for the length, and the teeth of the saw being set against the operator, he quickly and easily gets through his work, by rubbing or pulling the wood against the fixed saw.—H. B. F.

[61131.] — **Electric Cautery.** — TO MESSRS. STEWART AND CONRY.—If Dr. Stewart will kindly send me a letter through the Editor of the ENGLISH MECHANIC, I shall be happy to lend him one of my 5s. ammeters, by means of which he can determine for himself the amount of current he requires, and report results. I shall be happy to lend E. Conry one of my instruments, provided he will kindly report on its adaptability for measuring small currents. The 5s. instruments will measure up to 5 ampères, and give trustworthy readings of $\frac{1}{10}$ of an ampère.—S. BOTTONE.

[61131.]—**Electric Cautery.**—My original query addressed to Mr. Conry, which has evoked so many replies, is, I think, most satisfactorily answered by Mr. Conry's last letters. "$\frac{1}{4}$in. platinum wire, No. 30 or 80, brought to a bright red, by three good Leclanchés" which are able also "to keep incandescent lamps going for twenty minutes" is certainly "the most economical and satisfactory" arrangement. Despite "Ohm's" sneers, I am greatly obliged to Mr. Conry for the formula in the Dec. 31 number, which I am perfectly able to use. Allow me to say to "Ohm" that, while I have already thanked him for previous letters, his abuse of me and my profession is quite gratuitous. My query was not addressed to him, and as I am a supporter of "Ours" for the sake of the information therein supplied, and put my query in civil form, there was no justification for his occupying the space he did. I seem to have excited his ire because I gave the resistance and did not at once comply with his request for the diameter of the wire or weight in grains. The reason which I gave, if nothing else, ought to have prevented the display of bad temper, viz., that I had not made the thing, and having had the resistance only given me, I quoted that. "Cautery" has now given him full details about it; but perhaps "Ohm" is one of those who, if a medical man wants a cautery, can supply him with a box at £15 to £20, and who insist on another box—at the same price, of course—being absolutely necessary for every other particular purpose. Is not the exhibition made by electricians in last week's issue, in their replies to 61400 specially, but also to 61399, sufficient to make him blush for *his* profession? A range from $1\frac{1}{4}$ to 4,000H.P. in reply to a simple arithmetical question shows well? May I submit to Mr. Conry that the second portion of my query—"How can the current flowing be accurately measured"—has not yet been fully cleared up?—A. DUNLOP STEWART.

[61131.]—**Electric Cautery.**—In reference to "Iota's" query *re* 5-volt lamp of 10c.p., my comment was general. I think you are quite right—it would take at least 6 ampères to work such a lamp. The incandescent lamps usually spoken of as 20c.p. are, I find, only 16 actual, and the best of them then require 60 watts in actual work. A bichromate battery of 3 cells should easily give 5 volts if all connections are well made; but the plates must be large, say 8in. by 4in., two in each cell with zincs same size between them, and for cautery work they could all be joined up parallel, if the plates are arranged to raise and lower; then if this is done by a spring with a treadle, this last can be worked by the foot, and the plates only partially submerged at first, so as to heat cautery as required, more of the plates being submerged as polarisation sets in. I note your remarks about Bottone's instrument. I have only to-day had a set put into my hands to test, and I shall do so and give results. I am very pleased to see reply from "Cautery." Pity Dr. Stewart did not put the query into this gentleman's hands at first! His No. 22 cautery wire is almost exactly same size as the Pt wire used in my experiment, and as it has been hammered out thin, it should have taken more current. "Cautery," says 12-15—this is rather wide; but as the wire has been filed down, that would reduce the sectional area, and so less current would heat it. I cannot allow "Cautery's" remarks about Sprague's galvanometers to pass without protest: they are neither complicated nor fidgety—whatever this last may mean. I have used his largest instrument with 5 circuits for years, and never worked with an instrument more to my mind. It was made by Mr. Sprague specially to suit work when a great amount of tests had to be got over quickly, and it was always a pleasure to work with; it had a range from ·0001 to 15 ampères, and with one Daniell would measure from 1 ohm to 5,000. Mr. Sprague brought out a galvanometer specially for medical men, which was really a fine instrument. Mr. Conry's remarks should be passed over. It was far from my wish to offend him; but as I have done so, I may just add that I would advise him to read carefully an extract from an essay which the Editor keeps continually before us. He says Dr. Stewart did not inquire about battery cells; yet query 61131 reads: "What is the most economical and most satisfactory arrangement for obtaining the heating of a cautery?" Perhaps the doctor could produce such a battery as Mr. Conry speaks of. Did Mr. Conry read the doctor's reply, p. 395, where he discloses such an array of bichromates as would almost make anyone weep for him? Was it in his reply or the original query that the doctor informed Mr. Conry that he was no novice in electrical science? I still say that the formulæ given, p. 395, could not possibly assist with this query: it would have been quite right had it been required to find the heat developed per second in a wire. The query, however, before us is the current required to maintain a platinum wire at a white heat—say about 1,500° C., and into this question neither specific heat nor weight enters further than the latter determines the diameter. Before Mr. Conry appeals to Mr. Sprague on this point, let him read the latter, 2nd edition, pages 300, &c. Now, *re* my remarks about Leclanchés, "Cautery's" reply shows how he and many others would read Mr. Conry's remarks on this battery—viz., that he recommended it for cautery purposes. I have seen incandescent lamps used off these, yet I am prepared to place any reasonable sum in the Editor's hands to be handed over to Mr. Conry if the latter will produce Leclanché cells which will maintain the current I named, 4·75 ampères, for one-fourth of the time he says he has used these lighting incandescents. I am aware that if the size of cells were increased infinitely, then even the Leclanché might do so; but I refer to the usual sizes to be met with everywhere. I name either Mr. Sprague or Mr. J. Brown to test the cells, and I am sure either of these gentlemen will readily give their time to test such cells. I must apologise for the length of this; but hope the importance of the subject may be my excuse, as it would be a pity that any of our correspondents should be wilfully misled. Having written to "Ours" now for 17 years, most of this time as "Ohm," I shall still continue to do so, Mr. C.'s remarks notwithstanding.—OHM.

[61132.]—**Glazing Pottery Ware (U.Q.)**—"Poor Potter" will find most of the information required on this subject in Spon's "Workshop Receipts," third series. It would take up too much space to reply to his questions.—W. HOLDER, Newport, Mon.

[61134.]—**Electro-Motor (U.Q.)**—This query was addressed to Mr. Bottone or Mr. Bowron; but it probably slipped their notice. Anyhow, in small electro-motors it is not the rule to make the resistance of the armature exactly equal to the resistance of the field-magnets. The winding partly depends on the form of the field-magnets and armature. In the case of Siemens H armature with vertical field-magnets, same as are advertised a lot, the resistance of field-magnets is often made twice that of armature; perhaps using No. 18 wire on armature and No. 16 on field-magnets.—W. HOLDER, Newport, Mon.

[61138.]—**Yacht Steering.**—I should be much obliged if "H. G." would kindly let me know the action of the patent steering gears he mentions. A wheel is just the thing I want to do without if possible, as it would take up a great deal of room on a 4-ton yacht.—G. H. V.

[61145.]—**Does it Boil?**—TO "WEALD."—I write far out of reach of back numbers; but, in any case, I have no wish to insist on any charge of evil intention where misunderstanding is easy and the occasion long past. "Weald's" expression, "natural air" is ambiguous; but certainly I meant that water gives off vapour more rapidly in vacuo than in air at any given temperature. I have just been reading the late Professor Clerk Maxwell's "Theory of Heat," and find his account of the matter particularly luminous, more so certainly than that of "A. E. F." Of course the point I am contending for is that water-gas is the same substance, whether formed above the boiling point or below, and that the amount given off depends on the temperature, and that the evaporative power of air is a question of temperature. A current of warm air will supply the necessary heat as well as any other source of heat. The amount of water-vapour in any space where liquid water is present is, if time be allowed for its diffusion, simply a question of temperature, and not at all of air, natural or artificial.—W. A. S. B.

[61145.]—**Does it Boil?**—So far as I can make out, "Weald" holds (1) that vaporisation is simply solution of aqueous vapour in air, and (2) that the steam produced in boiling differs from all other steam in that it merely "displaces" the air and is not dissolved in it. His first contention is easily disposed of by the fact that vaporisation (not merely ebullition) goes on more rapidly in a partial vacuum than in the open air (the quantity, however, being the same as when allowed to evaporate in a vessel of the same size containing air), whereas his theory would require the evaporation to be less, there being less air present to dissolve the

vapour. When evaporation takes place in the air the aqueous vapour is, in a certain sense, "dissolved" by it (in quantities varying with its temperature and pressure); but this is, so to speak, merely accidental, as the process goes on independently of the presence of air or other gas. If "Weald" has read "A. E. F.'s" admirable account of the scientific explanation of the process, he surely ought to have no further difficulty. I cannot see why "Weald" should hold the "displacement" theory of boiling, when it is so obvious that the vapour *diffuses* itself into the atmosphere just like an ordinary gas. All so-called "true" gases are in reality only vapours—e.g., hydrogen at N.T.P. is the vapour of the liquid hydrogen, which only assumes that form at enormous pressures and low temperature. The term vapour is applied to those gases which at ordinary temperature and pressure assume the liquid form.—REYMOND.

[61145.]—**Does it Boil?**—TO "A. E. F.," MANCHESTER, AND OTHERS.—What, now, is the evidence contributed against the view that vaporisation is a case of "solvent action" by atmo? "W. A. S. B." has objected, p. 438 (and "A. E. F." likewise) that water evaporates faster in rarefied air, whilst the sugar in the cup does *not* dissolve faster when the liquid (say tea) is withdrawn. But the comparison is unjust, because the sugar becomes enveloped in air, which nobody expects to dissolve it! Unfortunately, the density of liquid tea cannot be altered much, and nothing will persuade it to offer double accommodation between its particles as long as it remains liquid; therefore the analogy cannot here be put to the test. What matter if solvent air can perform one more trick than solvent tea can? "A. E. F.'s" explanation, p. 458, amounts to saying that where parboiling takes place, an occasional molecule here and there by a freak of nature has been effectually brought to the boil. This is not unlike the popular view that parboiling is a boiling beginning on the surface, but not yet pervading the whole mass of liquid. However, if "A. E. F." admits that "when a pool abates its level" solution is the case, will he not extend the admission to the cup of cold water which steams in the frosty air? ("Nun. Dor.," p. 353). And if the steaming cup of *cold* water is "solution," why not the steaming cup of *hot* water? And why not also the steaming cauldron on the fire, not yet boiling? Returning to "W. A. S. B.," surely "displacing" vapour is a sound idea, and not a "stumbling-block," p. 458? Boil water in a flask, and if vapour is generated fast enough, and the neck not too wide, the air will soon be be "displaced" from body of flask. Take also case of CO_2 liberated by acid at bottom of a test tube.—WEALD.

[61186.]—**Management of Launch Machinery.**—Is not this query rather too vague to meet with a response? for it seems to me that an answer would involve the writing of a treatise on the management of launch engines and boilers. Should not the querist procure one of the manuals? —though, as a matter of fact, he will find that nothing but practical experience will teach him. He will find much information in Reed's "Engineer's Handbook," published by Reed and Co., Sunderland, and a very useful little work entitled "The Safe Use of Steam," is published by Lockwood and Co.—J. T. M.

[61187.]—**Driving Feed Pump.**—It is not easy to answer such a question; for the advantages and disadvantages must depend on the construction of the engines and the surrounding conditions. As a general rule, it is advisable to keep everything off the shaft, except what must of necessity be put on.—C. K.

[61190.]—**Differential Feed.**—With a screw of four threads to the inch and left-handed, it is clear that to cut the same number of threads also left-handed the screw must be without movement while the bar turns: whereas if required to be right-handed, it must take twice the revolution that the bar does. In the former case, the end is obtained by putting a wrench on tail of screw, and in the latter by putting a wheel on bar twice the number of teeth of that on back shaft. For 3 threads, left-hand, while the bar makes 3 turns, the screw must make 4 − 3 = 1 turn in same direction as bar and wheels in the inverse proportion will do it, as 40 and 120, and if right-hand wanted bar makes 3 turns while screw makes 4 × 3 = turns, or wheels, say, 70 and 30. For ·148 pitch, or, say 3/20, or 20 threads in 3in. bar makes 20 turns while screw makes 12 turns less, or 8 turns, say wheels 80 and 200 for left hand, and (12 × 20) : 20 = 30 : 20, or, say, 130 and 80 for right-hand is very near. To save complication, if you add idle wheels so as to gear, you should add an even number of wheels.—T. C., Bristol.

[61191.]—**Wimshurst Machine.**—This query has been answered many times by anticipation. See back numbers.—VIDEO.

[61193.]—**Poisonous Alkaloids.**—There is no doubt that old flour is deteriorated, no matter how carefully it has been kept; but as to the existence of poisonous alkaloids, that remains to be proved. Fermentation of a kind goes on in the most carefully treated flour, and possibly some of the nitrogenous matters are altered; but what are "poisonous alkaloids"? Is not "poison" something that depends on quantity rather than quality?—BACAN.

[61202.]—**Fret Saws Breaking.**—The breaking of fret saws is somewhat of a mystery, for at times one will last for weeks, and at others a couple or more go without any apparent reason. I think that many are broken by the work getting an unconscious twist while the saw is actually moving through it at high speed. The saw should have as straight a motion as can be imparted to it: that is, straight as regards itself, for it is advantageous, I fancy, for the saws to describe a small arc as regards the line of cut. Some of our friends might turn their attention to this subject by answering the question, Which is the best movement for a fret saw?—SAML. RAY.

[61204.]—**Photographic.**—"Lens" should read up the subject of diaphragms in Capt. Abney's treatise, published by Longmans. The distance the stop or diaphragm should be placed in front of a lens is really a matter for trial.—I. H. J.

[61207.]—**Paper Doors.**—I have heard of a paper piano case, and see no difficulty in making paper doors or even paper houses. It is simply a matter of properly compressing the pulp which might otherwise be made into paper.—NUN. DOR.

[61208.]—**Watch.**—To polish parts of watches use rouge or jeweller's chalk with a brush, and, if necessary, clean off on bread. A bent balance wheel will have a tendency to wobble, and will therefore affect the time-keeping.—D. G.

[61214.]—**Pumping Set.**—A defect in one of the valves—most likely the bucket; but examine both. The bucket should draw practically air-tight, and if the inlet or suction is covered by water, no air ought to get in, even if the clack is defective. —NUN. DOR.

[61225.]—**Ironing Machines.** —There are several patented ironing machines; but none that could be considered "domestic." I believe some are in use by City manufacturers, and others were shown at the Inventions; but labour is cheap, and the gas iron answers all purposes—SAML. RAY.

[61226.]—**Barometer.** —This query is rather confused; but it refers presumably to a wheel barometer, and probably the weight and the tube require cleaning.—T. P.

[61230.]—**Watch Conversion.** — How can anyone tell "Watch Chain" what size lever escapement he will want when he gives only the size of the "top plate"? He might as well give the size of the pocket in which the watch is carried. D. G.

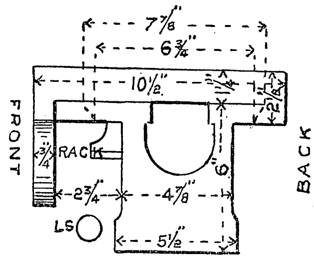
[61234.]—**Hardening Small Circular Saws.** —I find ordinary "pen" steel answers admirably. Float a piece of brown paper on water, make the saw hot carefully over an upright blowpipe, and lay it on the paper; it will be dead hard, and seldom warp. Temper as usual.—A. CLEGG.

[61274.]—**Portable Battery.**—The cells recommended by me are in daily use. Strange to say, they have none of the vices Mr. Conry enumerates; expect this must be due to some warm climate where he is—must be awfully hot. Glad he has given us the recipe for his private yet patented cell. Was this an Irishism?—OHM.

[61307.]—**Occultations.**—In connection with the query of "A. W." (p. 399), I would refer him to Mr. Woodside's graphic method of computing occultations, which he will find in the ENGLISH MECHANIC, Nos. 1075, 1076, 1080, 1083. I have used Shadwell's tables and Pearson's graphical method, but Woodside's is much easier, and quite as correct. I would point out to "A. W.," however, that to avail himself of this method he will require the "Elements" given in the *American Nautical Almanac.* It is to be regretted that the computation of occultations for places at a distance from Greenwich should be so laborious, as the observation of the phenomena is fascinating to amateurs.—J. R.

[61310.] — **Electricity.** — I am very much obliged for all the answers about an electric machine for killing dogs. I now find that the *Electric Review* of the 30th April, 1886, contains the description of such a machine, which was recommended to the Kimberley borough council by Mr. R. L. Cousens. I should much like to know whether this machine is still used, and without danger for the man who works it, and what it did cost to establish? Does Mr. Bottone not think that prussic acid may not kill instantaneously, and is nearly as dangerous for those who employ it as an electric machine? Morphia administered to one of my dogs, a young and vigorous bull-dog, produced a most wretched state of agony, and after sixteen hours of suffering, I was obliged to drown the poor creature.—W. VAN EYS, San Remo.

[61323.]—**Back Shaft for Sliding and Surfacing.**—To "J. H."—Thanking you for promised particulars, I send sectional dimensions. The



lathe is one of Selig's "Victorias," frequently advertised in the "E.M.," with 6ft. gap bed. The rack is in front; teeth ½in. pitch (nearly).—T. C. C.

[61332.]—**Speeding Millstones.**—TO "T. C., BRISTOL," OR "GLATTON."—Thanks for noticing my query. I am not wedded to the particular arrangement I named for driving; but am compelled by circumstances to adopt that method and no other. Would you still recommend 6 to 1 for the first motion? I was in hopes I should have had "Glatton's" opinion as well.—A COUNTRY MILLER

[61333.]—**Air Compression.**—The operation of compressing air is not one that can be carried very far with ease. It would perhaps have been well to explain whether it was only as an experiment, or to be on a scale that would serve some practical use. Some years ago, one of the underground Railway Co.'s, troubled with sulphurous fumes from the locomotive, made some experiments with a view to working engines with compressed air. It was found impossible to accomplish this compression at one operation, and the air was pumped from one vessel to another until the needful pressure was obtained; but the expense was found to be too great for profitable working. If the accounts of these experiments could be referred to, they might give the needful information.— H. C.

[61335.] — **Clark Soap Test.** — Wanklyn's standard soap solution is used in precisely the same manner as Clark's, with which, I presume, you are familiar, only that one cubic centimètre of Wanklyn's will precipitate one grain of carbonate of lime or its equivalent in degrees of hardness. One degree equals one grain of carbonate of lime. The estimation should be made with 70cc., not 100cc., as Clark's; washing soda will not precipitate carbonate of lime. Any further information with pleasure.—KCALBRED NAXELA.

[61366.] — **Super - Elevation of Railway Curves.**—The super-elevation of the outer rail on curves is usually determined by the following formula—

$$W \frac{V^2}{1{\cdot}25\ R} = x$$

Where W = gauge in feet,
V = velocity of train in miles per hour,
R = radius of curve in feet,
x = elevation of outer rail in inches.

Referring to the Portadown accident, the speed was 45 miles an hour, the radius of curves 30 chains or 1,980ft., and the gauge 5ft. 3in. Therefore—

$$\frac{5{\cdot}25 \times 2{,}025}{1{\cdot}25 \times 1{,}980} = 4{\cdot}2945$$

or about 4¼in. It must be specially remembered that the Irish gauge is 5ft. 3in.; and those who have not understood General Hutchinson's figures have doubtless only allowed for a 4ft. 8½in. gauge. —CLEMENT. E. STRETTON.

[61366.] — **Super-Elevation of Railway Curves.**—It is practically impossible to lay the super-elevation to suit the different speeds of trains. If a mean speed is taken, the faster passenger trains will wear the outer rail, and the slow or goods trains will wear the inner rail. The following formula from Molesworth's "Pocket-Book" may be useful to "Platelayer":—

Let E = elevation of outer rail in inches,
W = width of gauge in feet,
V = velocity in miles per hour,
R = radius of curve in feet.

We have $E = W \dfrac{V^2}{1{\cdot}25\ R}$.

Example: A train running 45 miles an hour on a curve of 30 chains, and gauge of 4ft. 8½in.; required the super-elevation of outer rail:—

45 × 45 = 2025
30 × 66ft. = 1980
4ft. 8½in. = 4·708

$$4{\cdot}708 \times \frac{2025}{1{\cdot}25 \times 1980} = 3{\cdot}85\text{in., or, say, } 3\tfrac{7}{8}\text{in. nearly.}$$

—JACOB GEORGE.

[61366.] — **Super-Elevation of Railway Curves.**—The formula for finding the proper elevation of the outer rail of railway curves is as follows:—

Let W = Width of gauge in feet.
V = Velocity in miles per hour.
R = Radius of curve in feet.

Then the super-elevation of the outer rail would be $W \cdot \frac{V^2}{1 \cdot 25\,R}$. In the case quoted, on G. N. of Ireland, it would work out thus—

Gauge (5ft. 3in.) = 5·25ft.
The square of velocity (45 miles) = 2025
Radius of curve (30 chains) = 1980ft.

Then $5 \cdot 25 \times \frac{2025}{1980 \times 1 \cdot 25} = 5 \cdot 25 \times \cdot 81 = 4\frac{1}{4}$in., as given by Board of Trade Inspector. Another practical rule which platelayers generally adopt is as follows:—

Let V = Maximum velocity of trains in feet per second.
G = Gauge of railway in feet.
C = Length of chord whose versed sine will equal the super-elevation.

Then $C = \frac{1}{2}\,V\,\sqrt{G}$. It works out thus for a speed of 45 miles.

Irish gauge (5ft. 3in.)
½ max. speed (66ft. per sec.) = 33
sq. root of gauge = 2·29 appx.
Then 33 × 2·29 = 75·57ft. length of chord.
English gauge (4ft. 8½in.)
½ max. speed (66ft. per sec.) = 33
sq. root of gauge = 2·17
Then 33 × 2·17 = 71·61ft. length of chord.

Stretch the tape on inside of outer rail, the distance from it at the centre to the rail will be the proper elevation in inches for a curve of any radius.—W. M. S.

[61391.]—**Soldering.**—I thank "Regel" for his plain and lucid remarks on the subject of soldering. At the conclusion of his remarks he asks "if any flux is required in coating iron with lead, except the usual preliminary dip in the hot grease bath?" The writer has seen sheet-iron coated with lead with a flux without being passed through grease; and iron also coated with zinc by being passed through a flux without grease. I don't know what the flux is. At the present time it would be very useful to me if any reader could inform me the flux used for this purpose. Would the killed acid mentioned by "Picklock" answer the purpose, if used on the top of the lead when molten, and the sheet-iron passed through it? If not, I should be pleased if he or any other reader could tell me the proper flux to use.—GALEN.

[61396.]—**Stains on Horse's Coat.**—"Under Strapper" does not say what colour his horse is; but I suppose it is a grey or roan. Does he not know that his horse if well strapped will have a beautiful new coat before summer, and at the latest by the end of May? Horses' coats do not grow much after the second or third week in December; the hair ceasing to grow becomes dead, and takes a stain almost as readily as a bit of cotton wool, and nothing, so far as I have been able to find out, will effectually take it out. With live hair it is quite different; use cold-water soap and a horsehair scrubber. The only preventive I know is to oil the quarter on which the horse lies down with neatsfoot or salad oil; but this must be done before the hair begins to stain, and done every night, washing off in the morning.—AN OLD MAN AND UPPER STRAPPER.

[61398.]—**Electric Battery.**—I should recommend a single-fluid cell of the size and plates you mention, and the following composition; but I should make the zincs the 3 and the carbons 2. I should also advise making the cells not less than 6in. by 4in. inside. The battery has no perceptible fumes, metallically, unless short-circuited, which would not happen with any ordinary care. I have found two of the great secrets of comfortable working with single-fluid lighting batteries to be (1) When you lift the plates out, place them all together in water, which if they are fixed to frames you can easily do, so as not to let the solution dry upon them. (2) If the light gets dim, stir the solution about by shifting the plates in it with a few small quick motions, or by stirring with a stick. Unless your 10c.p. lamps, however, are exceptional ones, you will want more than six cells to light them.—EDWARD CONRY.

[61399.]—**Leclanche Batteries.**—The bursting of the inner jars is usually fatal to a Leclanché. If adding sal-ammoniac will not make the batteries ring the bells properly, and they used to do so at one time, it shows the peroxide of manganese in the inner cell is exhausted, and you must either get fresh inner cells or open the old ones and add a small handful of "needle peroxide of manganese" to each, mixing it up well with the compound already there, and seal up again with pitch, leaving a couple of blowholes. This resealing is convenient but not absolutely necessary.—EDWARD CONRY.

[61399.]—**Leclanche Batteries.**—When the porous cell of a Leclanché is burst or cracked, it usually means that the cell will furnish a current so long as it will hold together. The secondary salts, which are formed in the working of the Leclanché battery, crystallise out inside the porous cell, in the space occupied by the loose carbon and oxide of manganese, and also within the pores of the cell itself. In the latter case, the crystals either fill up the pores, adding very considerably to the resistance of the cell, and finally closing the liquid conducting path for practical purposes; or it breaks the cell, thereby lowering the resistance by increasing the area of the conducting liquid. If "Colliery Manager" will communicate with me, I shall be pleased to give him any further information he requires upon the matter.—SYDNEY F. WALKER, 195, Severn-road, Cardiff.

[61400.] — **Electric Light.**—"Lancaster" is evidently entirely at sea in his reply to this query in last week's issue. "Ohm" also seems to be wrong. He wants to divide his result by 10. Evidently he has omitted the decimal point. The power available will be (as per my own reply in last week's issue) 2¾H.P. theoretical, and from 1½ to 2 actual.—J. H. H., Edenfield.

[61400.]—**Electric Light and Water Power.**—Very sorry that in setting down figures for calculation I added a cipher to the tons of water, making this 15,000. Please divide my results by ten. When this is done it reduces your power very much; perhaps, however, you could use 15 to 20 incandescent lights in the workings by day, and about the pit-head by night. If you could keep the dynamo continually at work, then it would well repay your outlay; but not so if you could only use the lights a few hours per day.—OHM.

[61400.]—**Electric Light.**—"J. H. H.", "Lancaster," S. Bottone, and "Ohm." all answer the same query. I pity the fog of the querist. Below I give a tabular statement of the various calculations of H.P. from the *same* fall of water:—

Horse-Power from same Fall of Water Calculated by Four Contributors:—

"J. H. H."	"Lancaster."	S. Bottone.	"Ohm."
Nearly 2¾ theoretical.	4,000 (four thousand).	2½ (about)	28

Is not H.P. always calculated per minute—i.e., so many foot-tons per minute = 1H.P.? Where have the four diverged?—R. S. T.

[61400.]—**Electric Light.**—"Colliery Manager" is, no doubt, somewhat perplexed at the slightly divergent answers given to his question by two contributors; he may take it, however, that the maximum power available will not exceed 1½H.P. If, however, a storage of water can be made, then, of course, a greater amount of power could be obtained for a shorter period. Is this feasible? Some time back I took in hand a matter of this kind, and after going over the ground I came to the conclusion that it would be best to form a pond, and obtain the required fall for the wheel by dropping it down a pit, the slope of the ground enabling the water to get away freely from under the wheel. If "Colliery Manager" sees fit to send me a rough sketch of the ground, and approximate section, I will do my best to put him in possession of the most economical method of dealing with the case, having regard to his requirements.—FRANCIS M. ROGERS, 21, Finsbury-pavement, E.C.

[61405.]—**Liquid Fuels.**—In estimating the thermal value of fuels, take the thermal value and multiply by amount present of each of the constituents contained in the fuel, and add the whole together, which will give you the thermal value of the fuel.

Thermal value per lb.:—
Carbon = 14,500 units.
Hydrogen = 50,000 „

Only the free hydrogen should be calculated, or the amount not combining with the oxygen in the fuel to form water. The hydrogen may be reduced to its equivalent of carbon by multiplying amount by $\frac{50,000}{14,500} = 3 \cdot 45$. Take an oil composed C = ·84, H = ·15, O = ·05; then ·144 = free H × 3·45 = ·497, and ·497 + ·84 = 1·337 = equivalent of fuel in carbon, and 1·337 × 14,500 = 19·387 units.—ELAG.

[61406.]—**Glow Lamp.** — Depends upon the voltage of the lamp, but I should say 7. The terminal attached to the zinc plate is the negative pole, and that attached to the carbon or copper plate, the positive. Connect thus: Join carbon of one cell to zinc of next with wire or other metal connection, and so on right through. You will thus at the finish have a carbon terminal at the end of your line, and a zinc at the beginning whatever be the number of cells.—EDWARD CONRY.

[61407.]—**Glass Spinning.**—A foot in diameter and a mile a minute mean 1,760 revolutions a minute. Does "M.R.C.S." mean such a speed as this? I suppose "M.R.C.S." means soda glass when he says "soft" glass.—R. S. T.

[61407.]—**Glass Spinning.**—1. The wheel should revolve with great speed, and the glass thread quickly thrown over it while at full speed. 2. The softest glass tube is the best for the job, carefully kept at fusing point. 3. The blowpipe-jet should be as near circular as possible, so as to give a long pointed flame.—C. A. W., Emberton, Bucks.

[61407.]—**Glass Spinning, Glass Working.**—In order to work glass with the blowpipe, it is necessary to procure the soft kind of glass, usually sold in long rods or pencils. The common kind of glass would only fly to pieces the moment the flame should be directed on it. If a person cannot procure those rods, he has only to go to one of the fancy shops and buy some glass toys—syringes, miniature bottles, &c.—as those are mostly of soft glass, and can be worked with the blowpipe into all conceivable shapes. From those toys I have myself made needle-caps for magnetic compasses, which answered their purpose extremely well. In spinning glass there are always two blowpipes and two burners employed, the flames being blown in opposite directions, so as to make both flames meet where the glass is to be held. I have no hesitation in saying that glass of the ornamental kind is the most resplendent thing in nature, and that glass thread is the most resplendent thing of its kind. Gems and precious stones, though somewhat of a more brilliant material than glass, are prevented by their smallness of size from offering any comparison with it in dazzling effects.—X.

[61409.] — **Coating Steel Springs.** — If "Tonge" requires his information for manufacturing purposes I fear the replies will not help him. I can give him the American method by which a boy can easily coat two tons of springs daily; but I regret I cannot make this information public. If "Tonge" will advertise his address, I will write him. The cost of coating with copper is nominal.—CANADIAN.

[61414.]—**Electromotor.**—TO MR. BOTTONE AND E. CONRY.—Size you mention would, I think, be almost too small to be useful for a sewing-machine. Should rather recommend you the one I described with drawings a few weeks ago. Yes, several. "Urquhart on Electromotors" is a simple and good book for a beginner, or Mr. Bottone's book if you want constructive details.—EDWARD CONRY.

[61416.]—**Early Railroad History.**—Some differences of opinion seem to exist with reference to the early history of railways, but so far as my researches have extended, it appears that "stone tracks," consisting of long narrow flagstones placed in parallel lines, were introduced about the year 1602; the "wooden way" seems to have been introduced at Newcastle, 1630. The wooden ways were first "plated" with iron to protect them at Whitebaven, 1738, and the first cast-iron plate rails were undoubtedly used at Coalbrookdale, 1767. Some authors unfortunately have considered the "stone tracks" and the "wooden ways" as the same system, and have confounded the "wooden plated ways" with the "cast-iron plate rails": hence the mistakes have crept in.—CLEMENT E. STRETTON, C.E., Leicester, Jan. 22.

[61418.]—**G.W. Engines, &c.**—The B. and E. engines having been reduced, the largest driving-wheel now on the G.W.R. is 8ft. Engine No. 10 is a new narrow-gauge express engine with 7ft. 8in. drivers. With the exception that the eccentrics are inside and all brazings outside, like the 7ft. class, it is the same as No. 9, of which a sketch and full dimensions have appeared in the "E.M."—SPECTATOR.

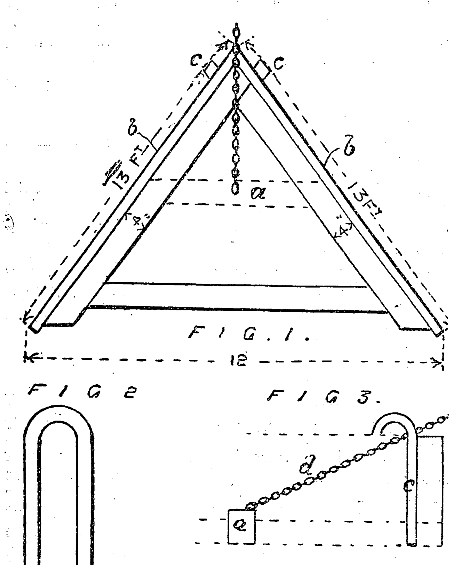
[61420.]—**Loco. Firegrates.**—The heating surface of loco. boilers should be about 80 square feet for each square foot of grate bars, and upon each foot of grate bars about 1cwt. of fuel should be burned per hour. About 240 cubic feet of air is the quantity required for the combustion of a pound of coal. From 8 to 11lb. of coal are consumed in evaporating one cubic foot of water.—AMATEUR.

[61424.]—**Model Steam Engine.**—Does "Angostura" mean that the cylinder is 1in. bore and 2in. long? If this is the case, perhaps I can help him. Why does he say cylinders? Vertical engines possess only on.—AMATEUR.

[61433.]—**Impurities in Gas.**—The tests for detecting impurities in coal-gas are very simple, and consequently merely show that the impurity is present. Quantitative tests require some manipulative skill. For sulphuretted hydrogen, moisten a piece of clean writing-paper with a solution of acetate of lead in distilled water and expose it to a jet of gas (unlighted) for not less than a minute; if the impurity is present the paper will turn brown or black according to degree of impurity. For ammonia, use turmeric paper in the same manner, damping it first in clean water, and if ammonia is present the paper will turn brown.

The paper can be bought ready for use, or made with spirits of wine and turmeric powder. For carbonic acid, pass the gas through clear lime water, and if the acid is present carbonate of lime will be precipitated. Lime water is easily made by shaking some slaked lime and distilled water together and then allowing it to stand for a few hours, when the clear water should be filtered through filtering paper. For sulphur compounds, to detect these, expensive apparatus is necessary, and some care is required in using it; this cannot, therefore, be classed with the above. Nearly all companies are required to see gas free from sulphuretted hydrogen under a penalty for failing to do so; but very few of the smaller ones are bound to free the gas from the other impurities. It is certainly to the interest of a company to take out the ammonia, as this is of value; but to remove the sulphur compounds requires expensive plant, and the smaller companies have therefore been left alone in this respect. The remedy is for the local authority to appoint a proper qualified person to test the gas at the works. Under the 1871 Act companies are to provide the necessary apparatus whenever required. If the local authority fails to appoint a gas examiner, two justices may do so, on the application of not less than five consumers. If the examiner proves to the satisfaction of two justices that on a certain day the gas was impure, the penalty is a fine not exceeding £20.—F. M. E.

[61434.—**Snow Plough.**—I send sketch of one that has been in use for some time and answers very well. First make a frame of 6in. by 4in., oak, as Fig. 1, setting the 6in. way of stuff upright, then bolt a piece across, 3ft. from the point



(as shown by the dotted line a) upon the top of the frame; two $1\frac{1}{2}$ elm boards should now be securely fastened outside the oak frame, as shown by b: these should be 12in. or 14in. deep. A piece of hoop iron should run all round the bottom, outside. A piece of $1\frac{1}{4}$in. by $\frac{1}{2}$in. bar iron must be bent as Fig. 2, and fastened across the point c to form an eye for the driving chain to go through, which must be fastened to the centre of a. Fig. 3 shows the chain d. Planks may be laid across inside and weighted with stones or bricks to keep it down, if necessary.—C. A. W., Emberton, Bucks.

[61435.]—**Storage Cell.**—TO MR. CONRY.—Depends entirely on the volts and ampères your lamp would require when fully lit. Impossible to give any information accurate enough to be useful without knowing these. The lightest form would be the E.P.S.; but as these are patented and strictly protected, you could not make or use them. Besides, it requires a considerable plant to make them successfully, and they are much more trouble when made than the Planté variety, which is free to anybody.—EDWARD CONRY.

[61438.] — **Measuring Cloth.**— The simplest way would be to weigh it, and calculate the length from the ascertained weight of a known length.—A. E. F., Manchester.

[61442.]—**Weight of Moist Air.**—In one sense "L. S. A." would be right in the way he understands the formula which he quotes; but this is not the way in which the author intended it to be understood. To make this plain in general terms, suppose S, S', and S'' to be the specific gravities of moist air, dry air, and saturated vapour respectively, as compared with a gas at the same temperature t, and the same pressure p; and let the corresponding volumes of the moist and dry air and the vapour be V, V', and V''. Then the weight of a cubic foot of the gas being taken as the unit of weight, since the weight of a given quantity of moist gas is equal to the sum of the weights of its constituents, we shall have—

$$V\,S = V'\,S' + V''\,S'' \quad \ldots\ldots\ (1)$$

But by Dalton's law, E being the tension of the vapour, the pressure of the dry air will be $p - E$; and by Boyle's law, since the temperature is the same for both, we shall have the volume of the dry air—

$$V' = \frac{p - E}{p} \,.\, V.$$

Next, considering that the volume of the vapour is to be estimated on the supposition that it is to be reduced to the volume of dry air, we have—

$$V'' = V'.$$

That is, V'' is also equal to—

$$\frac{p - E}{p} \,.\, V.$$

Substituting these values of V' and V'' in (1), we have—

$$V\,S = \frac{p - E}{p} \,.\, (V\,S' + V\,S'')$$

or—

$$S = \frac{p - E}{p} (S' + S'') \quad \ldots\ldots\ (2)$$

Hence, taking the weight of a cubic foot of dry air as the unit of weight, we should have the formula—

Weight of cub. ft. moist air $= \dfrac{p - E}{p}$ (weight cub. ft. dry air + weight cub. ft. sat. vapour). To show in what sense "L. S. A." would be right, take the same equation (1), i.e.—

$$V\,S = V'\,S' + V''\,S''.$$

Let now the specific gravity of the vapour S'' be estimated on the supposition that it belongs to a volume of vapour equal to the whole volume of the moist air, then—

$$V'' = V.$$

But, as before— $V' = \dfrac{p - E}{p} \,.\, V.$

And equation (1) becomes—

$$S\,V = \frac{p - E}{p} \,.\, V\,S' + V\,S''$$

or—

$$S = \frac{p - E}{p} \,.\, S' + S'' \quad \ldots\ldots\ldots\ldots\ (3)$$

Now, taking the weight of a cubic foot of moist air as the unit of weight, we have, in the way understood by "L. S. A."—

Weight cub. ft. moist air $= \left(\dfrac{p - E}{p}\right)$ weight cu. feet dry air + weight cub. ft. vapour.—MILVERTON.

[61444.]—**Dynamo.**—It is impossible for me to specify or localise the fault in your dynamo. That it is something trifling is shown by the sparking at the brushes, which proves that the dynamo works. I can only suggest the following causes. 1. The current leaks off either on the F.M. or armature. 2. The slits in the commutator are not in their proper position as regards the brushes: they should be under the brushes at the moment the flanges of the commutator are opposite the F.M.'s; there should be only two semicircles in the commutator. 3. The amount of wire is disproportionate. 4. Lamps of too high resistance are used in circuit, or too few are used. Why not send it to me?—S. BOTTONE.

[61445.] — **G.W.R. Compound.** — As "Compound" has applied to me I will tell him what I have heard of No. 7 and No. 8 from drivers and others on the G.W.R., although I have never seen either engine. They are four-cylindered compound coupled engines, with 7ft. driving-wheels, and were built last year, but are not in regular work yet. They have been trial trips, and have been back in the factory several times for alterations and improvements. No. 7 is narrow gauge, and No. 8 is broad gauge, but so built as to be capable of easy conversion into narrow. I am told that No. 7 is much cramped for room for cylinders, &c., between the wheels, and that in this respect No. 8 has a great advantage. In do not know on what section of the line between London and Penzance she will work. The following dimensions for No. 7 were given me by an engineman who had driven her:—Diameter of low-pressure cylinder, 23in.; ditto high-pressure, 14in.; pressure of steam in boiler, 180lb. to the inch; ditto low-pressure cylinder, 90lb.; total weight, loaded, 75 tons; 3,000 gallons of water in the boiler. Both pistons are connected to the same crank. He spoke well of her steaming and running powers; but another driver told me he preferred one of the 2,200 class with their new boilers.—T. PERKINS, Shaftesbury.

[61447.]—**Sugar in Boiler.**—I should advise "E. A. B." to discontinue the use of sugar as a scale preventive, and to soften the water by the lime process before putting it into boilers, cleaning out all acid at present in boiler first. There are more boiler accidents due to the use of scale preventive compounds, used in a rule of thumb manner, than what are generally supposed or acknowledged.—KCALBRED NAXELA.

[61449.] — **Dynamo.**—TO MR. BOTTONE.—I cannot speak very highly of wire-ring armatures. Nor do I think that a frame 18in. long, with field-magnets only 1in. in diameter, is at all proportionate. Still, if you can get about 2lb. of No. 18 wire on the armature, and about 10lb. No. 20 on the fields, you may get three or four 20's well lighted by it. Couple it up as a shunt machine, and let me know result.—S. BOTTONE.

[61450.]—**Engine Details.**—Connecting - rod $2\frac{1}{2}$ times the stroke, or, say, 23in. to centre, crank shaft should be $1\frac{1}{2}$in. diameter and crank pin $1\frac{1}{4}$in. diameter, and, say, 1in. to $1\frac{1}{4}$in. between shoulders for brasses. Fly-wheel usually 4 times stroke in diameter, that is, 3ft. and weight varies greatly, but 5 to 6cwt. may suit you.—T. C., Bristol.

[61450.] — **Engine Details.**—(1) Connecting rod, 9in. long; (2) width of crank-pin, $1\frac{5}{16}$in., diam. of ditto, $\frac{7}{8}$in.; (3) diam of fly-wheel, 36in. Weight. —This depends on what the engine is to do and what speed it is to run at for ordinary work with a speed of, say, 200 revs. per minute. I would make the rim weigh 85lb. or 90lb.—A. H. SHAKESPEAR, Lüttichaustr. 14 III., Dresden.

[61452.]—**Electrical Apparatus.**—If you will write to me (see Address column) I will send you diagram of switchboard. Only three batteries of the Upward kind were issued, as, according to a recent notice in one of the electrical papers, Mr. Upward and Messrs. Woodhouse and Rawson had hit upon an important improvement, and were reserving all further issue of the battery until such improvement had been perfected. I should say the best means of lighting your place would be by a cell, as follows: — Outer cell: Sulphuric and water, 1 to 15; inner cell, 8lb. bichromate of potash, 10lb. to 15lb. nitrate of soda, 20 pints sulphuric acid, and 50 pints of water. The above will make 10 gallons of solution, and costs about 5s. It is a good working battery, and on a large scale comes especially cheap, as it is possible to profitably recover more than one of the chemicals from the waste solution after use by electrolysis, precipitation, and crystallisation. E.M.F. slightly less than the Bunsen; about 1·7 and about 16 sq. in. of acting carbon surface required to produce one ampère, when zinc and carbon plates are not further apart than, say, $1\frac{1}{2}$in., this intervening space being occupied by outer and inner solutions of relative lineal thicknesses : : 1 : 2. The probable cost would depend on the lamps you used, and the number you had alight at one time, and the length of time for which you required them.—EDWARD CONRY.

[61454.]—**Hints on Purchasing Lantern.**—Of course, the important part of a lantern is the lenses; the condenser should measure 4in. or $4\frac{1}{2}$in. (the former to be preferred, if large enough) across. The front lens should be one which will give absolute flatness of field, straight lines, and perfect definition from the centre of the picture to its edge. The lantern body should be so as to allow a copious supply of air to the oil lamp (a paraffin one, of the three or four wick, or pamphengos description), and still be such as to keep all light inside when using the limelight. The limelight burner for so large a picture should be what is called a "mixing," or chamber, jet, requiring two gas bags under the same pressure to work it. My experience of lantern microscopes is limited, and I have usually made a lantern-slide of the object, and then thrown it upon the screen by limelight, thereby getting very much greater brilliancy than by any other method. As the lantern is for instructive, and not amusing, purposes, I should certainly not advise a biunial; there would also be a difficulty in fitting oil lamps thereto.—JAMES W. GARBUTT.

[61455.]—**Electric Bells.**—TO MR. CONRY.—I do not see how you can do it without using a relay, which is an arrangement difficult to describe on paper without a diagram, which I will send you if you will write, giving me your address. See Address column.—EDWARD CONRY.

[61456.]—**Caustic Soda Process.**—I saw some little time since in a foreign journal an account of the American torpedo boat *Peacemaker*. It stated that she was driven by means of the Honigman caustic-soda boiler, and further explained that this was an apparatus for generating heat through the agency of the above chemical, which had the property, if once thoroughly heated by a steam jet, of generating steam for itself for a considerable time after. If I remember rightly, the expression used was "generating steam for itself"; but I have an impression that it really so works by the evolving of a powerfully expansive gas, not actual steam.—EDWARD CONRY.

[61458.] — **Circular Saw Shaft.** — As an amateur, I suppose you would prefer making this; if so, have the collar forged on a piece of shaft

2ft. 6in. long. Your next best way is to buy the thing complete. Many tool shops no longer keep them in stock.—T. C., Bristol.

[61458.]—**Circular Saw.**—There would be one great advantage in turning the shaft for your saw in the lathe in which it is to be subsequently used in connection with, and that is, you can rely on it running true between your centres when it is finished, which you can't make sure of if you buy it ready turned. Eighteen inches will be a good limit for the length.—W. HOLDER, Newport, Mon.

[61459.]—**Galvanometer.**—As you have not stated what sort of galvanometer, you had better get hold of a copy of Sprague's "Electricity," which will tell you everything as to construction, winding, resistance, &c., and last, but most important, the why and the wherefore.—W. HOLDER, Newport, Mon.

[61459.]—**Coils for Galvanometer.**—I have an astatic galvanometer, with movable coils, as designed by Mr. Sprague. There are four coils—No. 1 size of wire ·035 = turns 340, R = 1·40w; No. 2 size ·022, turns = 610, R = 8·9w; No. 3 size ·010 = turns 3010, R = 180w; No. 4 size ·0039, turns = 6,000 R = 723w. Then make the instrument suitable for a large range of work.—OHM.

[61463.] — **Propulsion and Weight.** — The power required to propel a given weight differs in all three cases. In air, the amount of resistance depends on size, form, and speed of balloon. On water, the amount of resistance depends on form, speed, and displacement of vessel, and varies nearly as the square of the velocity. In the case of H.M.S. *Devastation* at 13¾ knots, it is ·14lb. per ton. On land, for trains, resistance varies directly as the weight; and where v = velocity, resistance in pounds per ton $= 6 + \cdot009\, v^2$. On tramways it is about 30lb. per ton; on ordinary roads, about 100 to 150lb. If an electric locomotive received its electricity from a conductor running parallel to the track, it might be considerably lighter than a steam locomotive of equal power.—ELAG.

[61464.]—**Iodine.**—Sea-weed thrown up by spring storms is collected, allowed to dry, and burnt in heaps, producing kelp. A certain amount of I is thus lost by volatilisation. The kelp is lixiviated, producing a solution containing alkaline carbonates, chlorides, sulphates, iodides, and bromides. Crystallisation removes the greater part of the first three, leaving I and Br in solution. Excess of H_2SO_4 is added, and liquor heated in iron boilers; the vapour is condensed in a series of aludels, which are of glass or earthenware, fitting end to end. MnO_2 is added little by little during the distillation. The I collects in the aludels. When all the I has come over, more MnO_2 is added, which sets free the Br. Another process is to acidify the liquor with H_2SO_4 and HNO_3 and agitate with petroleum spirit, which dissolves the I. This is shaken with NaHNO, which forms sodium iodide and iodate. From these salts the I is liberated by HCl. The I is purified by washing, drying, mixing with a little KI and sublimation. Any textbook of chemistry will give an illustration of the furnaces and aludels.—A. PERCY SMITH, F.I.C.

[61464.]—**Iodine.**—Sea-water contains an exceedingly small quantity of iodine; but certain plants, especially those growing in deep water, absorb and store up the element in their fronds. The weed is dried and burnt, leaving an ash called kelp, one ton of which yields about 10lb. of iodine. The kelp is lixiviated, and from the solution the carbonates, chlorides, and sulphates are crystallised out as far as possible, leaving a liquor containing chiefly bromides and iodides of the alkalies. There are several ways of obtaining iodine from this liquor. One method is to distil it with sulphuric acid and a little manganese dioxide; whereupon the iodine is liberated thus:

$$\underset{300}{2NaI} + \underset{294}{3H_2SO_4} + \underset{87}{MnO_2} = \underset{254}{I_2} + \underset{240}{2HNaSO_4} + \underset{151}{MnSO_4} + \underset{36}{2H_2O}$$

After obtaining the iodine, more MnO_2 is added, and the distillation continued, whereupon bromine comes over. Another method is to liberate the iodine by sulphuric acid containing nitric acid, and to dissolve out the halogen by petroleum. This solution is next treated with caustic soda, which converts the iodine into sodic iodide and iodate. On adding hydrochloric acid to the solution containing these salts, iodine precipitates thus:

$$\underset{750}{5NaI} + \underset{198}{NaIO_3} + \underset{219}{6HCl} = \underset{762}{I_6} + \underset{351}{6NaCl} + \underset{54}{3H_2O}$$

Iodine occurs in Chili saltpetre $NaNO_3$, and is extracted from the liquor left in refining this salt.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[61465.]—**Sinking Ropes.**— For sinking purposes flat ropes are best to use, because they are not so liable to spin in the shaft. The rule to calculate the strength of flat ropes is as follows:—W idth by thickness in inches, multiplied by 35 for charcoal iron, 55 for crucible steel, and 70 for plough steel, will give the working load in cwts. It is impossible to give size of drum and pulleys, unless the weight of material to be lifted and the probable depth of the shaft be known, whilst there are likewise other matters to be taken into consideration, in determining the kind of rope to use. If "J. O." will write me direct, I will give him what information I can.—J. WORLANDS, Mexborough, near Rotherham.

[61466.]—**Gold Gilding.**—If the surface on which it is put be reasonably smooth, it is sufficient to lay gold leaf on and rub it down smoothly on to the surface by means of a pad and burnisher. A soft, dry, flat camel-hair brush is the most convenient tool to take up the leaf with, first cutting the leaf to the size and shape required by a knife, on a sort of wooden artist's palette, held in the left hand. The brush will take up the pieces of gold leaf more readily if it be sharply rubbed on the coat, or head, or beard at each application—just two or three strokes—as this generates in the hairs of the brush a certain amount of statical electricity which oppositely electrifies the gold leaf, and, as unlike electricities attract one another, the leaf adheres to the brush.—EDWARD CONRY.

[61467.]—**Crayon Drawing.**—Conté crayons are about the best for this, with the little French tortillons for shading. First shade roughly with the point, afterwards blending with stump. I presume "F. H." refers to black and white, not pastel.—G. H. V.

[61468.]—**Brass Surface.**—The following is much used as a dead lustre for clocks; perhaps it may help you:—Water, 5 parts; nitre, 46 parts; salt, 3 parts; and potash alum, 46. Grind it all up together.—W. HOLDER, Newport, Mon.

[61471.]—**Steam - Heating.**—See "Box on Heat," published by Spon.—OHM.

[61471.] — **Steam-Heating.** — If "Ignorant" will give size and number of rooms and passages, temperature required, number of stories, and quantity of window in each room, and purpose each room is used for, I can assist him. If he advertises his name and address, I could assist him better, as the details would take up too much room in the "E.M."—A. GRAY.

[61471.]—**Steam-Heating.**—If you will bear in mind to take your steam to highest point first, and then lay your pipes with an incline to drain away condensed water, you will not have much trouble in laying the pipe to suit the rooms. You can return the condensed water to boiler from all rooms situated above the boiler. If any rooms are below boiler, you must fit a steam trap to end of pipes to economise steam. Boiler had better be fed with a float and usual lever arrangement, as you do not require a high pressure for heating purposes, say, 10lb. to 15lb.—T. C., Bristol.

[61471.]—**Steam-Heating.**—(1) The arrangement of the pipes must be governed by the architecture of the place and where the heat is required, and, therefore, should be settled after actual inspection of the place, and consideration of what is required. (2) If possible, the pipes are all arranged with a slight slope down to the boiler, so that any condensed water may drain back into it. Where this is not possible, drain-cocks are fitted on the pipes here and there, at the points where the condensed water is likely to accumulate, and before the steam is turned on full, these are opened and the pipes "blown out," like the cylinders of an engine before starting running in earnest, buckets, &c., being placed to catch the water. (3) By a donkey-pump or an injector, in the ordinary way. I do not know if there is any such work.—EDWARD CONRY.

[61472.]—**Damp Houses.**—Yes; saturate a circular piece of blotting or filter paper with a solution of cobalt chloride—dry it; this will be blue when dry, and pink when most. It was sold some years ago under the name of "Chameleon barometer"; it is not a barometer, but an hygrometer. When it was first introduced, I compared its action with wet and dry-bulb thermometers. When the thermometers showed saturation of air with moisture I called the tint of paper 0, when the thermometers were 13° apart in temperature the paper was blue, to which I assigned a value 10. I found I could detect a variation in the amount of moisture in the air as well by the change of colour of the paper as by the difference of readings of the thermometers. An account of my experiments may be found in the *Chemical News*, Vol. XXXI. pp. 88, 118.—A. PERCY SMITH.

[61472.]—**Damp Houses.**—I should think a scale might be made by the added weight by which dry plaster of Paris increases in any damp place. It is strongly absorbent of moisture from the atmosphere—increasing in weight and bulk, and turning mouldy. Strong sulphuric acid has also a considerable hygroscopic quality. A glass tube nearly filled with this will slowly fill itself if left exposed to the air. Perhaps something might be done with a graduated glass tube in this direction. Pure nitric acid also weakens rapidly if left exposed to the atmosphere. I believe its specific gravity becomes rapidly less according to the amount of moisture in the air, and, if I am right in this, a hydrometer floating in nitric acid would give evidence at once, as a scale could very easily be made of how much it should sink with each hour or 12 hours in a fairly dry house.—EDWARD CONRY.

[61473.]—**Cell.**—To E. CONRY. — I did not know you had published your address. However, I have given the recipe of the testing cell I referred to in the current number (Jan. 21st) under Replies to Queries (61274). The length of the cell, which I omitted to give, may be 6in. The top of the carbon should project well out of the mixture, so as not to have the brass clamp or leaden top nearer to the surface than about 1½in., in order to avoid "creeping," and if the leaden top be painted with Brunswick black, and also a ½in. of the carbon below it, it will increase the lasting power of the cell, and make it look all the better. One of these cells will ring a bell well, and they can be put up in houses as substitutes for Leclanchés, though for lasting power they are hardly as good in this respect as the glass-jar Leclanché; but they are immensely convenient and handy. If you want any further directions, I am advertising my address this week for one or two others who have written for it.—EDWARD CONRY.

[61474.]—**Silver Cell.**—Try the following: zinc, saturated solution of sal-ammoniac, chloride of silver, and a silver plate, not two or three small heavy portions of silver riveted together, the chloride being about ⅛ thick or more over the silver plate, and separated from the zinc by a thin strip of white flannel; also the zinc and silver plates should be within a ¼in. of each other. With the arrangement you describe, I do not suppose you would get much current out of the affair. The silver plate of Clarke's commercial cell exposes about 15 square inches of surface to the zinc. The soldering fluid you first tried is killed spirits of salts, i.e., hydrochloric acid that has already taken up all the zinc it will hold; it has lost the power of acting on zinc, so that of course you would not get any current.—EDWARD CONRY.

[61476.]—**Brass Foundry.**—If you consult the article referred to, you will see that each of your queries is answered. Fireclay for the bricks, hard coke for fuel, while the furnace itself is fully dimensioned.—J. H.

[61476.]—**Brass Foundry.**—Instead of mortar use fireclay made as soft as mortar, with silicate of soda—i.e., water glass. If you use firebrick, damp the firebrick well, and you will get a better joint. If you do not damp the firebrick, you can start your furnace the minute after it is up.—R. S. T.

[61477.]—**Name of Craft Wanted.**—It is a Chinese house-boat used on the large Chinese rivers by large numbers of the poorer classes who live altogether on the water, getting a living by plying with the boat as a bumboat or cargo boat, or in other capacity. Usually the wife stands at the helm, while the man works or goes on board or ashore, and the son and heir, if there be one, plays about the boat, with an empty air-tight gourd tied between his shoulders as a life-buoy, in case he goes overboard.—EDWARD CONRY.

[61478.]—**Lenses.** — If "B. B." refers to the front page of the issue in which his query appears, he will have little difficulty in finding out where to get the lenses he requires.—VIDEO.

[61479.]—**Medical.**—It is said that watercress has the effect of neutralising tobacco smoke.—F. M. ROGERS.

[61479—61480.]—**Medical.**—To remedy as far as possible foulness of breath, keep the stomach in good order by plenty of exercise, plain food, avoidance of late suppers and alcoholic drinks. To prevent the smell of smoke, do not smoke. To cover the smell of smoke or other foulness, make a weak solution of permanganate of potash, in clean water; one teaspoonful in two quarts will be ample. Rinse the mouth out well with this, but do not swallow it. I should strongly advise you to empty your physic bottles into the sink, unless they have been ordered you by a physician. Both quinine and iron are excellent tonics; but should not be used by those who do not want *toning*.—S. BOTTONE.

[61482.] — **To Loco. Correspondents.** — I extract the following from D. K. Clark's "Locomotive Engine," hoping it may be of some assistance:—"Obviously the firebox heating surface is by far more active for the evaporation of water than the surface of the flue tubes. Mr. Robert Stephenson, from experiment on a small boiler, having six sq. ft. of firebox surface and 40·5 sq. ft. of tube surface, found that while each square foot of the former evaporated 16lb. of water, the same

area of the latter evaporated only 3lb. Mr. Ed. Woods and Mr. J. Dewrance, on testing a modern loco. boiler, found that the first 6in. of tubes evaporated about the same amount of water as an equal area of firebox, the next 12in. of tubes about one-third as much, and the rest of the tubes but a small fraction, the first 6in. of tubes doing more work than the next 60in."—L.B. AND S.C.R.

[61483.]—**Heating Water.**—You describe an impossible experiment, and therefore correct answers cannot be given. Under the conditions given, the water would have no chance of extracting all the heat from the pipe, for the latter would be blown to bits the instant that an attempt was made to fill it with water.—EDWARD CONRY.

[61483.]—**Heat of Water.**—In an open pipe the water could not be raised more than to 212°, a portion of the water being converted to steam until the pipe is reduced to that temperature. Supposing that the pipe weighs 22lb. (neglecting the bottom) the sensible heat lost would be $1050 - 212 = 838°$, that is $838 \times 22 = 18{,}436$ in all. Let x = pounds of water evaporated, then we have the equation $9x\ (966 + 180) + 9\ (6 - x)\ 180 = 18{,}436$, from which x will be found = 1·025lb., leaving 4·975lb. of water at 212° in pipe. The latent heat of steam being 966°—T. C., Bristol.

[61489.]—**Speeding Engine.**—If there are balance levers to the governor, you can simply shift the weights farther out or add heavier weights. Either way will cause the governors to rise at a lower speed; or you may put in fresh gear in the proportion of $\frac{32}{7}$, your present gear being $\frac{32}{8}$. You do not state whether governor works a throttle or a cut-off valve on back of main slide.—T. C., Bristol.

[61490.]—**Acoustic Telephone Construction.**—If you will write me, I will send you a sketch as you ask. My address you will find in the proper column of the number in which this appears. These telephones are much more simple than the others, and will work over long distances. I have put them up so as to work well over more than a quarter of a mile, and have heard that they can be used up to a mile. The same instrument acts as both transmitter and receiver, as in the old Edison telephone.—EDWARD CONRY.

[61491.]—**Copper Castings.**—Copper is not reliable for castings, being spongy below the surface. Occasionally when copper castings have been wanted, as for friction clutch linings and caulking rings, we have got over the difficulty by casting plenty of head, and turning off. The addition of a little zinc will make it cast better; but with copper alone it is impossible to get soundness.—J. H.

[61492.]—**Cells Required for Motor.**—One pint bichromate cell will work your motor; six such cells will cause it to drive a sewing machine.—S. BOTTONE.

[61492.]—**Cells for Motor.**—If your cells are in good condition 3 in series should work it; if not, you will probably require 6 cells connected, 3 in series and 2 in parallel to increase the current.—W. HOLDER, Newport, Mon.

[61493.]—**To Change the Colour of Diamonds.**—Expose them to a good high heat (nearly white hot) in a current of oxygen gas. They will then burn to carbonic acid gas. That will effectually change their colour and value. That is the *only* practical way.—S. BOTTONE.

[61494.]—**Spur-Wheel Query.**—The proper method is the cycloidal, the curves being obtained by means of rolling templet circles. This has been described several times in back numbers. See No. 941, p. 99; No. 943, p. 143; No. 992, p. 84; No. 1,103, p. 242; and others beside. If you have not these numbers, and cannot obtain them, I will reply at length.—J. H.

[61495.]—**Cooling Composition for Hot Neck.**—The following is a valuable formula:—Melt 16lb. of tallow (don't let it boil), and dissolve 2½lb. of lead acetate (white sugar of lead); then add 3lb. of black antimony, and agitate the whole mass until cold.—W. HOLDER, Newport, Mon.

[61499.]—**Storage.**—Power for power, the electric locomotive carrying storage batteries is heavier than the steam-engine locomotive. The utility of the former is for situations where either the steam-engine cannot be employed or its use is undesirable, as for places where there is natural water power but no coals, or for crowded cities, &c., and where there is natural water power, even if coals be present also, the electric locomotive is far cheaper. It is possible that, owing to the better possibility of perfectly softening and annealing a small copper wire than a large one, stranded conductors, composed of several small wires, are for the same bulk of metal of slightly better conductivity than solid conductors; but in the usual employments of copper conductors the only difference recognised is that the stranded conductor, being more flexible, is handier.—EDWARD CONRY.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, W. Holder has replied to 61132, 61134.

60926. Hokey-Pokey and Coker-nut Candy, p. 269.
60931. Bicycle Making, 269.
60946. Locomotives, 270.
60974. Steering Apparatus, 270.
60976. Arithmetical Question, 271.
60980. To Mr. Striffler, 271.

61174. Cane-Splitting Machine, p 355.
61184. Sheep Dip, 355.
61199. Fan, 355.
61201. Range Boiler, 355.
61210. Mean Pressure, 356.
61220. Boxwood, 356.
61221. Cutters, 356.
61229. To Mr. Striffler, 356.

QUERIES.

[61503.]—**Radial Axles.**—Will anyone who knows the G.N.R. say if the new 7ft. 6in. exp. engines have a leading radial-axle box? I see it is stated in the "E. M." that the new G.W. engines, with 9in. less wheel-base, have difficulty in turning sharp curves. If this is so, is not there more difficulty with the G.N. engines, as they have 19ft. 1in. wheel base?—SPECTATOR.

[61504.]—**Double Electric Bells.**—TO MR. R. T. LEWIS.—In Vol. XL. p. 526 of the "E. M.," you gave a sketch of these double-gonged bells. Looking through "The Telephone, &c.," by Prescott, he says on page 383: "In double bells of this kind the line circuit is never broken by the vibrating armature, the effect of this movement being merely to shift the current from one coil to the other. This, in some particular cases, is an advantage of considerable importance." Does Prescott mean by this that three or four of these bells could be connected in series without interfering with each other? It seems to me, by having the armature arranged with a double contact, same as used in the above, two ordinary trembling bells might be made to work satisfactorily in series; so should be glad if you would give a sketch of the connections, supposing it is possible. Please understand I do not doubt two ordinary bells will work together from one push. Thanks to your instructions in back volumes, I have two working in multiple arc at the present moment for telegraphic purposes, though I am told they (the call bells) must be in series, so should be very much obliged for your opinion. By the way, there is a capital short-circuit bell described in this week's (Jan. 14) *Telegraphic Journal*, with an illustration.—M.M.I.SC.S.

[61505.]—**Eyepieces for 3⅛in. Telescope.**—I want three astro. eyepieces for above telescope, and should be glad to know what powers would be most useful. The telescope is 70in. long. Is it any the worse because the focus is so long?—ENQUIRY.

[61506.]—**Compound Engine.**—A compound engine, 18in. stroke, 150 revolutions per minute; boiler pressure, 90lb. per sq. in.; maximum horse-power required, 350. The steam is exhausted into a condenser, the vacuum in which is to be maintained by an independent engine. Will any of your readers inform me what is the readiest method of determining the diameters of the cylinders?—B. PAYNE.

[61507.]—**Condensing Benzoline.**—Chemical friends please reply. In cold weather benzoline condenses in open air at tap to semi-solid. Can it be compressed in this state for use in any place where liquid cannot be had?—T. WOOD.

[61508.]—**German Root Words.**—Will anyone who knows kindly say how a list of roots of the German language might be formed by the aid of a dictionary alone? What are their characteristics, and may each of the irregular verbs be taken to embody a genuine root form?—J. SHIPPAM.

[61509.]—**Syrup for Cordials.**—Will some maker of cordials, as sold by mineral-water makers, tell me how the syrup is made so thick and clear—in fact, as clear as water? I use glucose, as I believe they all do, but I cannot get my syrups bright. Is the glucose boiled, and with what proportion of sugar? Any hints will oblige—COUNTRY MAKER.

[61510.]—**Roller Covering.**—Will someone kindly say if there is a cement for fastening cloth on iron rollers under leather? Is so, what it consists of and how used? We are using white-lead, but it does not answer for our work; and what is the best cement for piecing leather?—W. A. W.

[61511.]—**Dynamo.**—I have a 100c.p. Gramme, its reputed efficiency being 45 volts and 6 ampères at a speed of 1,500 revolutions. The diam. of pulley is 3½in. Will some of our electrical friends kindly inform me the following particulars? (1) How many lamps and voltage this should light? (2) What power gas-engine I require? (3) Will it be necessary to attach a flywheel to dynamo to insure steadiness? (4) What lamps are recommended as giving the best results? (5) What gas-engine is recommended for small cost and economy? My address will be found in your advertisement column for answers to last two queries.—ANXIOUS IMPROVER.

[61512.]—**Magic Lantern.**—Will someone be kind enough to tell me how to fix a kaleidoscope to the lantern, so that when revolved it will show the changes of the screen? My condensers are 3½in. Is it necessary to have the circular glass (holding the coloured glass) of the same size?—J. H.

[61513.]—**Incandescent Lighting.**—TO MR. BOTTONE.—I am now fitting up castings to your directions given Jan. 29, 1886, No. 58666; but with careful winding can only get 2½lb. wire on armature. Please say whether I am to alter quantity of wire on fields. Also, what power lamps will be the best to use, and number of same dynamo will light?—DYNAMO.

[61514.]—**Lining for Accumulators.**—Will any reader of the "E. M." kindly inform me the best substance for lining wood boxes to use as Planté cells, other than lead—any kind of varnish or inexpensive non-conductors not readily acted on by the sc. acid?—VOLT.

[61515.]—**Photographs.**—TO R. A. R. BENNETT, OR OTHERS.—I would be obliged if you could tell me if anything can be done with a very much over-developed negative. It has been developed into a positive.—DUSTY MILLION.

[61516.]—**Gramme Dynamo.**—I have made a Gramme carcase, same as described by Mr. Eaves some time ago (30-lighter), only with one pair of fields. Armature 6in. long, 4⅞in. diam., 16 cogs (sheet-iron rings); channel of pole-pieces, bored 5in. diam.; yokes, 18in. long, 6in. wide, 1in. thick; F.M.'s 3in. diam., 7in. long, best wrought iron, plenty of room to wind F.M. 1½in. deep with wire, making fields when wound 6in. diam. What size and quantity of wire shall I put on A. and F.M.'s? How many 20c.p. Swan lamps should I get? What speed ought it to be run, and what H.P. engine will it require, and what should be the output, volts, amps.? Is there any danger of A. heating with long run? Each ring has about 1-32in. insulation from the next, with air space between each stud which hold ring to spider. Pole-pieces and yokes are cast in one piece.—YOUNG GHAZI.

[61517.]—**Mechanical Piano Playing.**—Can anyone tell me how to construct an apparatus for playing the piano by the use of perforated paper. I have seen an advertisement of an instrument styled the "pianista," which has apparently bellows like a harmonium, a crank is turned, and perforated paper employed. Is there any simple apparatus that can be afixed to the keyboard, and removed when not required?—SM.

[61518.]—**Gas-Engine.**—In a book on this motor, it is said that a hot cylinder lowers the practical efficiency. In another part it states that they are generally worked with cylinders at 100° C. I think these two statements are conflicting. Will some reader kindly explain them?—A. R.

[61519.]—**Lead Cylinder.**—What would be the bursting pressure of a lead cylinder ½in. thick of the following dimensions: Length 2ft., diam. 18in.?—L. W. D.

[61520.]—**Brass.**—I bought a thermometer not long ago, and after a few days, on cleaning it, the brass fittings literally dropped to pieces. On inquiry as to the cause thereof, the optician informed me that brass alway does so when exposed to sudden changes in the atmosphere. The thermometer had only been used for registering the cold on frosty nights. I have noticed the same results with brass that has been much in sea water. What is the nature and the action, and are all alloys similar to brass, such as gun-metal, bell-metal, &c., subject to it? If the zinc in brass is the metal acted on, would a small amount of it in gun-metal cause it to spoil when exposed, and, if not, what would be the largest proportion allowable?—G. M. S.

[61521.]—**Does Iron Fossilise.**—In wandering some time ago in a mountainous district, I happened to pick up a piece of brown stone having imbedded in it a foreign substance, which, to all appearance, was an iron or steel screw, which had become fossilised, the threads of the screw being distinctly visible; I would wish, therefore, to be informed whether iron ever becomes fossilised?—IVONAR.

[61522.]—**Questions as to Evolution.**—Can any of our biological readers inform me if there is any proof that the "pineal gland" of the human brain, which has so long been a riddle to anatomists, may be the remains of an ocular structure, and whether there is in some other animal a more fully developed pineal gland? Also the webbed feet of the Ceylon diving boys: is it known if they are remnants of once more perfect webbed feet, or are they recently appearing?—GERARD SMITH, M.R.C.S.

[61523.]—**Bell Circuit.**—Can earth be used efficiently as a return bell circuit? If so, what is the best way of making earth?—ROSICRUCIAN.

[61524.]—**Universal Cutter Frame.**—TO "J. H."—I have just completed a lathe (described by you in Vol. XXXVIII. "E. M."—a cheap lathe), and am going to put overhead motion to it. Will you kindly give me dimensions of a pattern for cast iron (not malleable) of a cutter frame for grooving taps, &c., suitable for the slide-rest on page 444 of above vol.? Also size of cutter spindle and pulley on same?—W. H. W.

[61525.]—**Racing Canoe.**—I wish to build a small racing canoe (sailing), with fixed false keel instead of centreboard; but wish to be able, with reduced sail area, to use her for cruising; length not to exceed 11ft. over all. Will any of our kind correspondents please give beam and depth suitable for this length, distance of greatest beam from stempost, with, if possible, on a small scale, midship section, distance of steps of masts from bow, height of masts, and length of main and mizen booms and gaffs. Sail plan on the Yankee principle (lugs). Please don't be afraid of putting too much canvas on, as I find that by adopting the Yankee fashion of sitting on deck to windward the craft will stand a lot more canvas than I have seen on any of our Thames canoes.—SHAMROCK.

[61526.]—**Wheel Barometer.**—Will a generous fellow-reader kindly give me a little assistance? My barometer records too high, by 5-10in. How can I rectify? I should also like to know how to re-connect the under pointer with its key spindle. I mean the small hand intended to mark last reading. I could until lately do this by using a key like a large watch key on a spindle below the dial; but now the key turns without moving the hand, the connection, whatever it was (cord or wheels), is severed or out of gear, and I cannot find the way to ascertain what is wrong. I presume the dial must be taken off. To effect this, the large hand must first be removed. This I cannot do. It is quite fast on its spindle; seems riveted. I should add that the door at the back does not give access to the movement I speak of. Please help me.—T. G., Birmingham.

[61527.]—**The Agar-Agar Cell.**—Has the agar-

agar silver chloride cell been described? If not, will someone kindly do so?—A. DUNLOP STEWART.

[61528.]—**Seeds for Microscopic Objects.**—Will some of your readers kindly give me the names of the seeds which are most interesting as microscopic objects, either from beauty of markings or other peculiarities?—LAVANT.

[61529.] — **Mathematical.** — Will some reader kindly give me the formula for obtaining the size of a drum or bobbin to hold a given length of rope of a given diameter, the diameter and length of the barrel of the drum alone being given? Also, when the diams. of the end of the drum and of the barrel are given to find the length it will have to be to hold the given quantity of rope? In both cases, inside measurement is wanted, of course.—E. M.

[61530.]—**Ferrous Oxalate.** — Will Mr. Bottone kindly let me know if ferrous oxalate developer is as efficient for inst. exposure on Eastman's paper as the Eastman's developer?—G. H. V.

[61531.]—**Lantern Transparencies.**—Will someone kindly give me full particulars for taking ¼ transparencies from ½ negatives. I get excellent results by contact printing, but, of course, only get part of the picture. I want to get the whole of a picture contained in a ½ or 1-1 neg. on to a ¼ transparency, but cannot see how it is done.—A. P.

[61532.]—**Varnish for Transparencies.** — In using water-colours, I find it is impossible to spread them on the photo. without coating them with some substance. I have used ordinary negative varnish, but should be glad if someone could recommend something better, if there is nothing made expressly for the purpose.—A. P.

[61533.]—**Speed Wheels.**—Would J. H. Evans, or some other engineering friend, write a book upon speeds of wheels all ready worked out, as I may call it a ready-reckoner, as many of my country friends often ask me if such a book is published? I am sure such a book of the kind would meet with a ready demand.—A COUNTRY MILLWRIGHT.

[61534.]—**Lathe Tools.**—A short time ago I made some lathe tools from square steel, ⅜. When I tried to harden them in water, several cracked. What is the cause of this, and remedy? It is very annoying after spending so much time in shaping them.—TOOL STEEL.

[61535.]—**Fret Saw.**—I have made a fret saw, which bolts down on lathe bed. It has two arms, like the Roger machine, with a wing nut at the back to lighten the saw. During the down stroke, the saw becomes very loose. Have tried to remedy the fault without success Can anyone suggest a remedy?—W. M.

[61536.]—**Organ Blower.**—I propose to blow an American organ (two manuals and pedals) with a small steam motor, working at a pressure of about 40lb. to the sq. in. I should like the opinion of "T. C., Bristol," and others, as to the practicability of the scheme. I intend to raise the steam by gas.—FLOREO.

[61537.]—**Bleaching Silver.** — Will any reader kindly inform me what the solution is composed of for bleaching silver jewellery, and the process of using it?—IMPROVER.

[61538.]—**Straightening Wire.**—Will any of your kind readers practically tell me how to straighten round wire, iron, or brass, from the coil without marking it, say from No. 3 to No. 16 wire gauge? I, having a lot to straighten and to cut into different lengths, should like to know the best possible way to do so.—P. J. W.

[61539.]—**G.W., L. and S.W., and L. and N.W. Locomotives.**—Can anyone give me the dimensions of (1) G.W. 806, 2201, 2211 classes, and the numbers of all the engines in these classes; (2) L. and S.W. 135, 348, 445 classes; (3) L. and N.W. 1678 Airey, and the numbers of similar engines?—V. J. B.

[61540.]—**Portable Engine.**—TO MR. BOTTONE.—I have made a model as above, 15in. long, 9in. high, boiler and firebox of wood, motion work of metal, no cylinder. I wish to drive it by electricity from firebox. Please advise me as to construction, and arrangement of motive power, and battery power required.—ELECTRICITY.

[61541.]—**Polish.**—In No. 1,125 "E. M." is a recipe for brush polish. I made some according to recipe: two parts French polish, and three brown hard varnish. When applied to the work, it was as tacky three weeks after as when laid on. I used brown hard oil varnish. Should it have been spirit varnish?—W. M.

[61542.]—**Clock and Sundial.**—Lockyer's "Astronomy" (Macmillan, 1886), page 197, par. 416, reads: "When the earth is in perihelion, the real sun moves fastest, and therefore will gain on the mean sun, and the dial will be before the clock. When the sun is in apogee, the mean sun will move fastest, and the clock will be before the dial." Is this correct? I always thought the facts were the reverse of this. Will someone kindly explain?—W. GODDEN.

[61543.]—**G.W.R. Locos.**—Can anyone say where No. 378 ("Sir Daniel") G.W.R. was built—runs from Liverpool to London?—C. BAYLEY, Oswestry.

[61544.]—**Darning Machine.**—I have lately got hold of a darning machine, but I cannot make it act. I see by my back volumes of the MECHANIC that an advertisement appeared of it in 1876, and it seems complete by the illustration accompanying the advertisement. It has fourteen needles, which are moved forward by a rack and pinion, which forces them through the work that is held by a clamp moved by a lever from above. Will any of our readers say whether it was a success or not, and how it was intended to act?—F. C. A.

[61545.]—**Railway Coupling.**—What pull is the ordinary screw coupling calculated to exert?—S. O. C. C.

[61546.]—**Harmonium.**—I have a harmonium with one set of reeds. I contemplate adding one half set more (treble), same pitch. Would it be an improvement, and would the bellows be large enough?—JOHN BEGG.

[61547.]—**G. and S.W. Locos.**—I have read with interest in your valuable paper various descriptions and opinions of the locos. of the M., Caledonian, and other railways, but never of the Glasgow and S. Western. Would Mr. Stretton, or others of our correspondents, kindly furnish me with their opinion of our bogie engines?—G. AND S.W. FITTER.

[61548.]—**Shipbuilding.**—Will one of your numerous readers who are experienced in marine engineering and shipbuilding (modern practice) give specific information on the following (accompanied by sketch, if necessary)—viz., method of boring out stern tube and getting the ship ready for launching?—NOVICE.

[61549.]—**Coil.**—Is it a settled fact that cotton-covered fine wire will not do for the seconary of spark coils? Is there any way of treating cotton-covered that will make it equal to silk-covered for spark coils? If not, why is such a wire as No. 40 covered with cotton, and what is it used for? Also, Can I make the ebonite tube for a spark coil by bending a piece of sheet iron round a cylinder and joining it with cement?—COIL MAKER.

[61550.]—**Interest.**—From $P = A\frac{R^n - 1}{R^n}$; when I know P, the principal or loan, A the constant annual payment, and n the number of years in which the loan is redeemed, how can I determine r, the rate of interest which is being charged, by a direct math. process, instead of by guessing and trying? For example, if a society lends me £100 on condition of my paying annually £7 for 40 years as repayment, how can I directly ascertain at what rate I am paying interest on the outstanding balance under such an arrangement? R is for $(1 + r)$; r is one year's int. on £1. Compound interest.—WEALD.

[61551.]—**Flow of Water through Pipes.**—Will any one of your correspondents kindly give me some information on this subject? For instance, I have a 24in. pipe sewer at an inclination of 1 in 100. From the outlet of this pipe I can get an inclination of 1 in 20. What size of pipe should I employ to take the water now coming through the 24in. pipe, of which the length is not known or assumed to be 100 yards? The question is this: Given length, diameter, and inclination (or diam. and inclination only) of pipe, what size of pipe must be used to take the same water at a greater or less inclination?—ST. GEORGE.

[61552.]—**Flat Foot.**—I have lately rather suddenly become lame in my left foot. I have told been it is a flat foot, and incurable. It got so bad from my persistence in walking that it was painful to put to the ground. Rest brings it round; but when I walk for a little time I begin to feel it again. I should like to know if it is really considered incurable, and if there is any means by which a walk of ten miles a day can be gone through, or must I give up employment? What are the causes?—J. C.

[61553.]—**Etching Ground.**—What is the composition of a transparent dark etching ground, such as Rhind's, sold by Winsor and Newton? All the grounds that I have hitherto seen recommended for etching contain wax, which, by assuming a rough surface after being melted upon the plate or deposited from a solution in chloroform, renders the ground somewhat opaque or semi-transparent. Moreover, a ground containing wax is not deposited well and evenly upon the plate from a chloroform solution. I have tried paraffin wax, and also the purest wax, which are very different in their composition. Now Rhind's ground is all that could be desired. It is deposited quite evenly from a solution, and the plate is perfectly visible through it, and is as soft as wax to the needle.—W. HOLDEN.

[61554.]—**To Mr. Bottone.**—Would the above gentleman please answer the following query? I have made one of Mr. Jones's 30c.p. dynamos. The F.M.'s are wound with No. 20 d.c.c. wire, and the armature ought to have been wound with ¼lb. of No. 20; but I wound it with No. 24 by mistake, and only got on ⅛lb. The machine lights one 10c.p. well, but only makes a 20c.p. red hot. If the armature was re-wound with ½ of 20, would I get any better results? Also, what kinds of lamps would suit this machine best—5c.p. or 10c.p.?—THOS. SMITH.

[61555.]—**Muriatic Acid.**—Through an oversight, a lot of iron was left in strong acid. A precipitate, blue crystals, formed on sides of vessel. The acid itself, so far as I can tell by trying with zinc, is neutral. Will someone tell me if it is possible to use it for soldering purposes, and how to make it so suitable?—ROB.

[61556.]—**Substitutes in Photography for Glass.**—Have any correspondents tried substitutes for glass for photographic negatives? I have seen little in the MECHANIC on the subject. I am about getting a camera, and shall be glad to know whether, by the aid of carriers, smaller negatives can be conveniently taken than the full size the back is constructed for?—IRIS.

[61557.]—**Vapour.** — Will any able correspondent kindly inform me what chemical change, if any, is afforded by a substance vaporised? I mean as regards the vapour given off by the heat. Say, for example, oil of sandal wood, or other of the essential oils. What, in fact, is the composition of such vapour in any one or more cases?—NO SIG.

[61558.]—**Metallic Paint.**—I see in last week's issue two correspondents give recipes for coating articles with copper; but Mr. Ray ends by saying that "the simple process of dipping in the sulphate solution gives a coat that will not stand handling." Is there any kind of metallic paint or lacquer of a copper or tin colour with which iron castings can be readily coated, and with a coat that will bear handling?—ORDERIC VITAL.

[61559.]—**Gold Paint.**—Can any kind reader tell me how to put a gloss on Bessemer's gold paint? I believe it can be done with some kind of varnish.—C. S.

[61560.]—**Engineering.**—A sum of £150 was paid to an engineering firm as premium for an articled pupil, to serve two years in fitting shops, two in drawing office, and twelve months in pattern shop, commencing with the fitting shops. The pupil (?) has now been there considerably over one year, and has little else to do but chip, chip, chip, all time. It must certainly be admitted that continuously chipping cast-iron cylinder flanges is scarcely calculated to impress anyone with the beautiful art of fitting. This is not the worst. If a pupil is seen noting the details of anything passing through the works, he is immediately dropped on and asked why he doesn't go on with some work. Now, what I want to know is, whether this is fair to pupils? Why is a premium required when the advantages accruing from it are little better than those obtained by apprentices who pay nothing? Can anything be done? It is a serious thing. I may add that there are several pupils at the work.—DISGUSTED.

[61561.]—**Gravitation.** — Will "F.R.A.S." or any other correspondent kindly state whether it is known what is the velocity of the influence of gravitation? I presume it is not absolutely instantaneous, but would possibly be comparable with that of light or electricity. I have never seen this stated in any work on astronomy or other book with which I am acquainted.—W. T. N.

[61562.]—**Mechanics.**—A particle whose mass is 4, moving with a velocity 12, meets and impinges directly on a particle whose mass is 8 and velocity 4; the co-efficient of restitution is 0·5. Find from first principles their velocities at the end of impact.—S. FORD.

[61563.]—**Torricelli's Theorem.** — A cylindrical vessel with a small hole at the bottom is 4ft. high, and is capable of containing four cubic feet of water. It is kept full, and it is found that four cubic feet of water flow out of the hole in thirty minutes. Find the size of the hole.—S. FORD.

[61564.]—**Instantaneous Exposures.** — TO S. BOTTONE AND "B.SC., PLYMOUTH."—I feel greatly obliged for reply, but will you kindly give the formula you use for this class of work? You say I ought to use the smallest stop; but I have found in using this stop (which is 3-16in. diameter, and lens 11in. focus for whole plates) that an exposure of about five seconds on ordinary plates for a view is correct, and a quick cap on and off with my medium stop, which is ⅝in. in diameter. This last must be much longer than that given with a slow shutter. My plates were certainly under-exposed, for two or three minutes passed after applying the dev. before any image appeared, and nothing but clear glass could be got out of the darker-coloured objects. Besides, I obtained better results with a rapid portrait lens, same aperture, and much shorter focus; but even with this lens my plates were under-exposed. I have had considerable experience in ordinary work, and I think I know what an under-exposed plate is. Something is wrong with my dev., or it requires a plate to be exposed longer than others, and so is not suited for this work. I thought when I began to use a R.R.S. lens I should have no trouble in taking instantaneous pictures; but I was greatly disappointed. Could I add anything to this dev. to get good results from quicker exposures, as I like it so much for ordinary work, that I don't like giving it up?—A. P.

[61565.]—**Daniell's Battery.**—I have an electric bell, which I wish, at a particular hour each day, to keep in action for a length of time. I have been told that Daniell's battery is more suitable for this special purpose than a Leclanché, because more constant though less powerful. I should be glad to have this statement confirmed if correct; or if wrong, to be informed which is the best battery to use. I find also that, in the Daniell's battery which I already possess, the sulphate of copper solution finds its way after a time into the inside of porous cell; cakes of a greenish-blue colour also form round the sides of the copper cylinder, and the top of the porous cell is covered with crystals, and becomes very brittle. If anyone would kindly give me information as to the cause and remedy of these things, I should be obliged. Daniell's cells, I believe, are used in the Post Office Telegraph Department. There must, therefore, be some way of keeping them in order.—LAMBDA.

[61566.]—**To Mr. Bottone.**—Will you oblige me by explaining the difference between series and shunt-wound field magnets, as I think of making a small dynamo, and if you could assist me in explaining how I could make it, so that I could get one or two different powers, say, from a strong physiological to a small electric light current, if I could do it by using different layers on the F.M.? I think of making it with the magnets 4in. high, 3in. wide, and ½in. thick.—A. DAY.

[61567.]—**Strength of Materials.**—Will any one show me a rule to find the proportional strengths of two pieces of square iron or two pieces of flat?—NOVICE.

[61568.]—**Gold.**—I have to set a piece of gold plate about 3in. by 2in. in the centre of a large gold dish. Now, the gold dish is of a rich copper colour, if I may use the term, and, being a young hand at the business, can any of "ours" tell me how I can give my piece of gold the same colour? As a further guide, the dish is something like the case of a genuine gold watch.—DUBLIN.

[61569.]—**Violin Maker.**—I have a violin stamped on the top of back, just under the neck, in old script type, "Grand Gerard." Is this a maker's name? If so, what is the probable age of the instrument? It is rather a flat model, colour orange to brown, has been varnished all over with a rather thin varnish, and has pointed *f* holes similar to those of Guarnerius.—A. B. C.

[61570.]—**Chemical.**—Will some chemist kindly inform me how to test the percentage of oxygen in BaO_2 as manufactured from BaO, by heating it at a certain temperature in oxygen gas? Is there any easy method by which I may test whether the whole of the nitric acid has passed off on converting barium nitrate into the oxide after it has been heated in a crucible to a white heat?—ENQUIRER.

[61571.]—**Organ Accordion.**—Would some correspondent kindly give me instructions how to make the reed pan or soundboard of organ accordion, and a few general instructions concerning the reeds, keys, and framework, and the cost of a set of reeds?—DERFLA.

[61572.]—**Wimshurst Machine.**—TO MR. BOTTONE.—I am making a Wimshurst machine after your directions in the "E. M."; but I am thinking of having two Leyden jars instead of the glass rods. Shall I be right if I put length of brass tube in jars to make metal contact with inside coating, and solder brass ball at proper height to carry the combs, and let discharging terminals fit in top end of brass tube? Will outside coating jars require connecting anyway?—LOUGHBURIAN.

[61573.]—**Microscope Lamp.**—I have a microscope lamp, made after the style of the Nelson-Mayall pattern—viz., a brass oil reservoir, sliding on the usual upright pillar, &c., and a copper chimney, through which the light is only allowed to pass through a narrow slit cut in the side and covered with the usual 3 by 1 glass slip which slides as usual in and out. Now, when I use the glass chimney to it there is no perceptible smell, but when

I slip the copper chimney on, then comes the unpleasant smell I have before alluded to. Now, what can be the cause of this? The burner is well made, and there seems to be plenty of ventilation, and the copper chimney is $1\frac{5}{8}$ wide inside at the bottom, and $7\frac{1}{2}$in. high, and well coated with plaster of Paris. A little advice from some of "ours" would oblige.—NEO-MICROSCOPICUS.

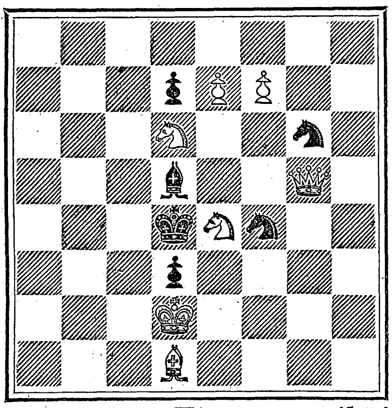
[61574.]—**The Calculus.**—In Ritchie's book on "The Calculus" (2nd edition, p. 12), occurs the following:—"If the side of a square increase uniformly at the rate of 3ft. per second, at what rate is the area increasing when the side becomes 10ft.? $1 : 2x :: 3 : 6x$. Hence the rate of increase is 6×10, or at the rate of 60 square feet per second." What does this mean? The area of a square having an 8ft. side is 64 square feet; that of a square having a 9ft. side is 81 square feet; that of a square having a 10ft. side is 100 square feet. The square with a 9ft. side, in passing into a square having a 10ft. side, has increased in area 19 square foot. How can it be said to be increasing on arriving at that size, at the rate of 60ft. per second? What has time to do with the increase? If the square lengthens its sides from 8ft. to 9ft. and 10ft., the increase of area is the same whether the change takes place in two seconds or in two months. In making the above remarks, I am not questioning the accuracy of the statement. I only wish to state that I cannot understand it, and ask some correspondent to furnish the explanation, which no doubt can be given, but which I have sought for in vain. The same or a similar example to that quoted from Dr. Ritchie's book occurs in at least two other works I have referred to. Hence I do not doubt its accuracy.—TYRO.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXVIII.—BY A. BOLUS.

Black.



White. [7 + 6

White to play and mate in two moves.

SOLUTION TO 1,026.

White.	*Black.*
1. Q takes B P.	1. P takes R (*a*).
2. Q-K 7.	2. Anything.
3. Q or Kt mates.	
	(*a*) 1. Kt takes R (*b*).
2. Q-Kt 6 (ch), &c.	
	(*b*) 1. Kt-Q 4 (*c*).
2. Kt (B 3)-K 2, &c.	
	(*c*) 1. Anything else.
2. Q-Q 6 (ch), &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,026, by Major (very fine and difficult), T. H. Billington (but variation 1. $\overline{\text{Kt-Q 4}}$ omitted), A. Bolus (ditto), and G. A. A. Walker; to 1,025, by Black Pawn, G. T. Stringfellow, Snowdrop, Avon, Hensing, A. Bolus, J. W. Hamill, T. H. Billington, J. J. Spence, Country Boy.

BLACK PAWN and H. Balson are thanked for problem and game.

COUNTRY BOY.—The number of variations is determined not by all the moves Black has at his disposal, but by the different ways White mates.

"THE PROBLEM ART."—This neat little work by Mr. and Mrs. Rowland will be found useful both to composer and solver. Some of the articles in it have been published before in the *Illustrated Science Monthly*. The main subjects are the art of solving and the art of composing. Much will be found here of considerable interest, and the remarks are illustrated by problems by various composers. To the beginner, and even the advanced student, the hints cannot fail to be of assistance in pointing out what to avoid and what to attempt; although practice, after all, is the great thing, and a systematic study of the works of the best masters. We should add that this book can be obtained from the authors, 9, Victoria-terrace, Clontarf, Dublin, and its price is 2s. 6d. The get-up is in Mr. Morgan's usual excellent style.—Simultaneous with the publication of this work is another of much more ambitious design by four of our greatest composers—Messrs. Andrews, Frankenstein, Laws, and Planck. This work, besides containing 400 selected positions by these masters, has seven opening chapters on the Chess Problem by Mr. Planck. Such a treatise as this has long been wanted, as of late years the character of the problem has undergone important changes. As Mr. Planck remarks, a good problem now must contain at least two fine ideas in appropriate form, and some tourney Problems (of which there are several in this volume that have won the highest prizes) contain six distinct themes. Thus the master-problem nowadays is a most elaborate work requiring great skill and patience to compose and, through its complexity, very difficult to solve. Mr. Planck's treatise is intended more for the advanced student, and thus it occupies ground quite distinct from the first book noticed. The steps we have to follow are further up the hill. It is not too much to say that this will become the standard textbook on the subject, and a work of the greatest value. Here again the solver is instructed how to solve—as a rule, to try quiet and apparently weak moves for the key, as such are characteristic of the higher class of problem. The functions of the composer and solver are, of course, to a certain extent opposed, and as the toil of the latter is made easier by exposing the methods of procedure, and taking, as it were, the puzzle to pieces, that of the former is rendered harder. It is like the question of guns and armour over again. What shall we arrive at at last? Mr. Planck remarks, with all the ardour of a devotee to the art: "It is this constant striving for a nearer approach to the impossible which produces such an irresistible charm for the modern problemist. His cry is ever Onward!—towards a goal which he knows he can never reach. . . . There are no bounds to the glorious forward march of the mind, so in his little field of research there is no end to improvement, no limit to everlasting discovery and advance." His observations (p. 79) on marking in problem tourneys are worthy of all consideration. They appear to us to tend towards the view we have always maintained that it is impossible to assign definite marks to a problem as a work of art, either with reference to the "ideal problem" or to others. We can promise the readers of this fine work a rare treat, and no chess library can be complete without it. It is published by Messrs. Cassell, and it is admirable in every respect.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 26, and unacknowledged elsewhere:—

J. LANCASTER AND SON.—M. Glover and Co.—Barnett and Foster.—T. Beecham.—C. P. White.—W. F. Stanley.—Helix.—E. Shearer.—Joe Blain.—A. R.—Jacob George.—Herne.—C. R. O., Devon.—8-Day Clock.—A. Stanley Williams.—Cane Sugar.—W. G. Penny.—Country.—One in a Fix.—Tube.—Cathode.—Acier.—F. R. R.—H. P.—A. Collingridge.—En-Switched.—Another Reader.

CARBON. (See many replies in back numbers. Possibly three cells will answer for such lamps; but it depends on the resistance of the lamps, and that you do not state. See illustration on p. 561, No. 1117.)—NOVICE NO. 1. (It is not easy to make a small machine which will answer both as dynamo and motor satisfactorily; but you will find all necessary details for making either in back volumes. Look through the indices of the last six, say.)—COLLIN. (For directions for making small electro-motors, see pp. 257, 274, 315, Vol. XL., and the indices of recent volumes.)—ALFRED. (Pipeclay will answer, but is scarcely porous enough. Flower-pots are rather too porous. You want a clay that is between the two in degree of porosity. 2. The other questions have been answered many times. They would occupy space, is one reason. The coke and peroxide should be intimately mixed. No one can say. The box must be thoroughly dry, and the glue applied hot.)—IGNORO. (You can use a layer of slag wool or felt between the joists and the wood ceiling, and the usual pugging between the joists. A filling of sawdust would be better than pugging. 2. Spring-heeled Jack has been heard of; but the exact method he adopted of fitting springs to his boots has not been described. You should make some experiments.)—WILLING TO WORK. (You should procure some of the interlinear translations of the Roman authors.)—F. H. R. (We should not use sugar in a steam boiler, for common soda will answer as well; but in the case of your kitchen boiler the best way would be to take out as much of the lime as possible before putting the water into the boiler. You can do that by adding a "cream" of lime and water, and stirring well. See indices.)—AMATEUR ARTIST. (The enamel must be baked or fused on, as frequently described; but for baths you can use varnish paint, cleaning the iron well.)—YOUNG BEGINNER. (What has the circumference to do with it? If not marked, you must test it to ascertain the candle-power. Suitable batteries have been described over and over again.)—THANK YOU. (See answer to "Collin" above.)—JIRK. (Full directions have been given many times. Look over the work again. Perhaps it is not connected up properly. 2. Surely you should procure one of the cheap handbooks of photography. We are afraid you will have to use more than one plate to obtain a "portrait": you certainly will have to use a plate for each single portrait.)—J. S. P. H. (See recent numbers.)—W. H. J. (One coil is enough. Start from centre, and draw it nearly off at each end, returning to centre before stopping current. A short coil of stout wire is sufficient. Hard shear steel. Answered in most of the textbooks, and several times in back volumes.)—A. J. G. (There are several methods of cleaning furs; but perhaps the simplest is to rub in moist bran with a bit of flannel, and afterwards dry bran with a bit of muslin. Then brush well, and finish by wiping down with a rag dipped in benzoline.)—C. KEMP. (Mineral naphtha will dissolve both pitch and guttapercha. The latter is also dissolved by chloroform, benzol, bisulphide of carbon, and rectified turpentine. Chloroform is rather expensive, and there is no cheap sweet-smelling solvent.)—J. W. B. (Almost all the low-priced inks are made without galls. You will find many recipes for inks and writing fluids in back volumes.)—GAUGE. No room for puzzles of that kind. 2. For an epitome of the history of the wire-gauge, see No. 778. We can quite believe that no one seems to know where the original standard B.W.G. is kept. If there ever was one, it has been lost.)—ROBERT PICKLES. (See Hints No. 5. Lacquer; but nothing except frequent applications of "elbow grease" will keep it bright if in use.)—CANALS. (We have not the slightest idea. As so few canals have steamers running on them, it is doubtful whether there is any fixed salary for an engine superintendent.)—ISAAC LEYLAND. (Messrs. Trübner, Ludgate-hill, E.C.; but they do not supply single copies. You must subscribe, we think, for a year. You could try the American Exchange, Charing-cross, W.C.) — IGNORAMUS. (You must either keep it polished, or relacquer. If the latter, better get it done for you.)—A NEW READER OF THE "E.M." (Do you mean French polishing, or simply oil-polishing? Fill in the grain with size, or better, with clean fat and a little whiting stained to suit, and put on some French polish. Or size, and coat with white hard varnish.)—LEAN MAN. (No space for such experiences. Starchy and saccharine foods will aid in the production of fat.)—J. B., London. (See illustrations in back Nos. (986, 989, for instance), or procure one of the manuals—say that issued by Mr. Eldridge, 54, Murray-street, Hoxton. 2. In one form the steam from the wood is condensed by a series of cold-water pipes, and runs into a trough; but if hot dry air is used, that carries away the moisture.)—CYMRO. (If they inherit under the father's will, no probate is required, but succession duty must be paid. If the widow made a will, probate must be taken on that.)—T. M. P. (We do not understand that there is any question of depositing copper on a gelatine mould in the letter referred to. A gelatine photo. is prepared in the well-known way, and a mould is taken from that, the copper being afterwards deposited on the mould. For the other method you must wait and see whether the query will be answered.)—YOUNG ENGINEMAN. (Procure a glass tube, not less than a quarter of an inch internal bore, and 34in. or more long. Close one end in the blowpipe flame, and fill the tube with mercury. Place the thumb on the open end, invert, and immerse in a cistern of mercury before removing the thumb. If both mercury and glass tube are clean, the former will "fall" and stand at the height due to atmospheric pressure.)—X. (Must explain what is meant by "fluid ink eraser." Perhaps it is a solution of chloride of tin.)—GYPSUM. (Much the same as marble. Pumice first, if necessary; then whiting mixed with soap and water, and finally dry flannel. If a high polish is wanted, use a paste of sifted slaked lime and water, and finish with French chalk and putty powder.)—REV. W. MERRELL WHITE. (Cannot be done without an elaborate analysis. See an answer by Mr. A. H. Allen to a similar question in No. 1060, p. 434.)—S. BRIDGETON. (There is nothing to prevent you, or any one else, advertising as a "consulting engineer"—no examination to pass or certificate to obtain.)—A. M. C. (That has always been a difficulty, and it is impossible to advise without details. Sir H. Bessemer's gold paint was kept a secret, and possibly a firm of manufacturers might purchase your secret; but there is always a risk. If a patent is obtained, those who use the process secretly run a great risk of having their proceedings betrayed. What advantage could be gained by inserting such a query?)—YOUNG WIFE. (It is of no use to scrub it; but it may be possible to plane the stains out, though that is doubtful. Why not have it stained a dark colour and polished?)—INKPOT. (No one can do more than guess, and we suspect that the magnet is not near enough to the plates. Any one may make and use a patented invention for experiment; but he must not use it for profit or even for mere amusement.)—E. A. B. (Better buy such varnish; but there are several recipes in back volumes. 2. The 100-ton gun is 32·65ft. long, with a bore 30·25ft. long, and a calibre of 17·72in. Those are the dimensions of the original gun tried at Spezia in 1879. Later examples have slightly different dimensions—notably in the powder chamber, which is of greater calibre than the rest of the bore.)—J. C. H. (You will find something about the subject in recent numbers, and all that can be said about it in back volumes. It is a subject for papers read before learned societies.)—A. P. BOWER. (We do not undertake to deliver any subscription copies, and we fear the Post Office will in no way help to second your benevolent intention.)—V. FALKNER. (Thanks; but we think it is hardly worth engraving, especially as the description has appeared elsewhere so long ago. It is very ingenious; but as you say, others are working in the same field, and we fear your labour will not bring you much reward.)—ACIER. (Better ask the editor of the *Lancet*. We are not responsible for recipes quoted from other journals.)—J. C. D., Liverpool. (Cheaper to buy, by far; write Hill and Co., 46, Essex-street, Strand, W.C.)—ONYX. (It is safer, of course, to wait till the patent is sealed.)

IT has been computed that about 35,000 newspapers are published in the whole world, or one for 28,000 inhabitants. Of this number 16,500 are in English, 7,800 in German, 6,850 in French, 1,600 in Spanish, and 1,450 in Italian.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 4, 1887.

EVANS'S BOOK ON ORNAMENTAL TURNING.

[SECOND NOTICE.]

FURTHER perusal of this volume confirms the high estimate which we formed at our first cursory examination of its contents; consequently we propose in this second notice to enter somewhat more fully into details, adding (by the author's permission) one or two illustrations borrowed from its pages. The first is a new design of universal cutting-frame (Fig. 122), which will probably be acceptable to some of our readers who are adepts at making as well as using lathe apparatus. It will be readily understood that in all such cases as the present cut gears are absolutely indispensable, and the fitting of all revolving spindles must be carried out with such accuracy as to prevent all jar or vibration, which is fatal to good work. The spindle is here forged in one piece with the arm, and bears against a collar $1\frac{5}{8}$ diam. to give greater firmness and solidity. The bearing of the spindle which carries the tool is very similar to that of a drilling instrument, so that all vibration is checked at this part. The tool, when fixed with the spindle in a vertical position, points to the axis of the shaft which passes through the square stem, and when set for work to be cut at the centre is identical with the axis of the lathe mandrel. There is great ingenuity displayed in this design, and many amateurs of known skill in ornamental turning testify to its excellence. The only possible question that can arise as to its efficient working is that which is here answered satisfactorily by those who have given it an extended trial—viz., the possible tremor given to the tool by toothed gearing. Badly cut gears or loose fittings do undoubtedly cause vibration; but this is equally true of all gearing unskilfully manufactured. If well made, and the teeth formed with scientific accuracy, the motion should be perfectly smooth and true, free from backlash and "shake." The vibration of gearing arises, no doubt, from each tooth *striking* that with which it comes in contact, causing, like every other blow, reaction or rebound; and nothing will prevent this but such a form of tooth and close (not tight) fitting as shall cause successive teeth to take up the work of their predecessors before the latter absolutely escape from their labours. True, none but a skilled workman can carry out this; but such alone, we suppose, would undertake the construction of first-class lathe apparatus.

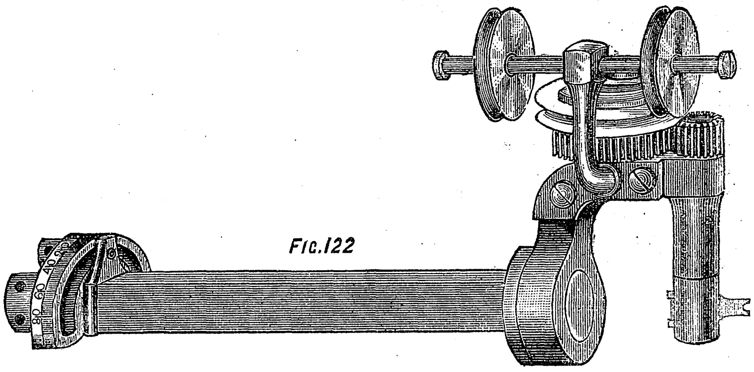


FIG. 122

We reproduce Fig. 169, because it gives an excellent sample of the general engravings; but the reproduction is not, of course, equal to the original, because the latter is executed upon superior paper of polished surface. Ours represents the work-a-day suit, the other the Sunday coat—each, therefore, claiming some merit peculiar to itself. The engraving shows the spiral apparatus as arranged by Mr. Evans, who reverts to its original position at the back of the headstock; but with special fittings, which remove the drawbacks which were inseparable from earlier arrangements. A novel and ingenious dividing apparatus has been introduced by Mr. Evans, for the details of which, however, we must refer the reader to the book itself. It is certainly more convenient to get the radial arm and train of wheels further away from the operator as well as from the chuck and the work. The chuck, moreover, has not to carry the first wheel of the train, and again by means of a very perfect universal joint, the motion can be applied directly to face-work without the usual additional standard and bevel wheels. It is a regrettable fact that we are unable to reproduce the autotype plates; but it is better, and fairer to the author, to refer inquirers to the volume itself. Plate 5, nevertheless, strikes us as a specially beautiful design in drilled work. It is not put forward as a specimen which from the difficulty of reproduction need deter the amateur from attempting to copy it, for, as Mr. Evans says, it is chiefly a question of patience. It is, in fact, simple drilling; but the result is very lovely. The more ambitious amateur, who is better supplied with lathe apparatus, will probably reproduce in preference an elliptic ivory casket, and a magnificent candelabrum of similar material, which will exercise his skill no less than his perseverance. Many a reader will feel like a street arab, however, gazing at the delicacies in the pastry-cook's window, sadly feeling that they are to him forbidden luxuries, the "oof bird" not having hatched for him the needful egg. But here again Mr. Evans comes to the fore with explicit directions how to make several of the simpler appliances for ornamental turning. Indeed, most of the apparatus is explained so as to assist, or completely instruct, a reader who knows how to turn and can use a file; and our own pages have often testified that the author of this book does not belong to that narrow-minded class of skilful operators who selfishly keep their knowledge to themselves.

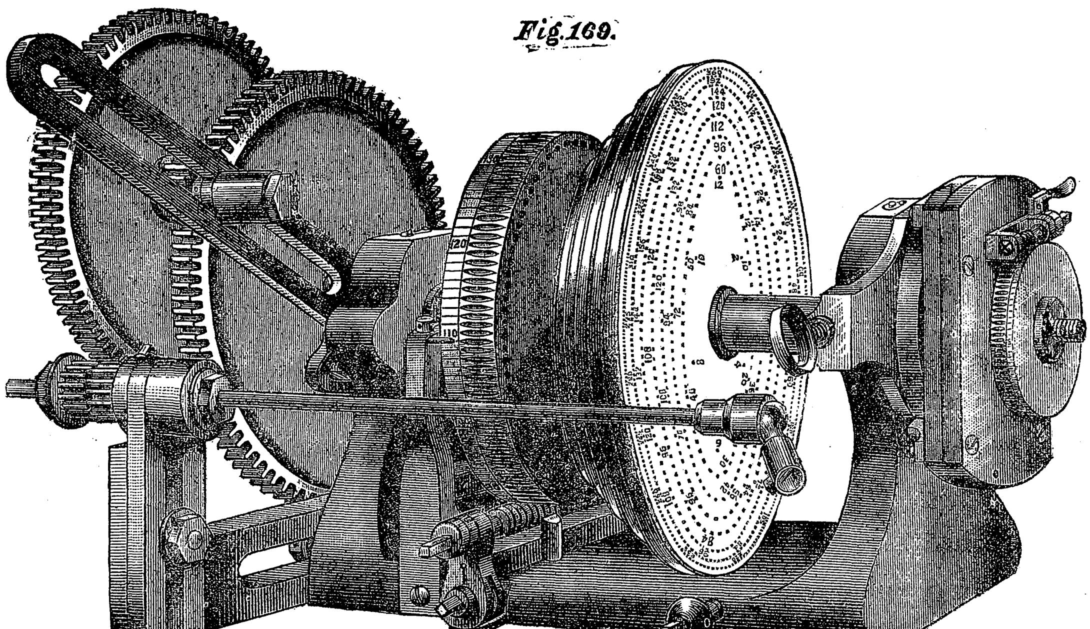


Fig. 169.

We noticed a remark in a letter, that the radial drilling of a division plate on Mr. Evans's plan would only affect the zero points of the several circles. Surely this is not so. If in each row the holes are equidistant, the series started on a curve will so continue, and we might, in fact, take any set as zeros. Mr. Evans, however, gives another plan which appears to us very excellent. The index is pivoted to the top of a pillar on the further side of the headstock, and lies tangential to the circles. The peg which enters the holes is thus close to the operator, and very clearly visible. Here, again, radial

drilling of the holes is successfully carried out. The automatic index is fully described, but we do not feel it necessary to give the illustration; and, indeed, we have already perhaps lingered lovingly, but almost too long, over this admirable book. We observe that subscribers have in some instances failed to see our advertisement, in which the volume is priced by the author at a guinea, with 6d. extra for postage. Autotype plates are costly always, and those contained in this book leave nothing to be desired.

THE THEORY OF MACHINES.—I.

By Francis Campin, C.E.

Modification of Power by Mechanical Elements.

In order to acquire the knowledge necessary to render us competent to design machines that shall give satisfactory results, we must carefully investigate the characteristics of the various phenomena of "force" as elucidated by rational and experimental research, in connection with various mechanical appliances devised to vary the conditions under which they are exhibited.

Into the intrinsic nature of force it is not our business here to inquire; but we may satisfy ourself with the fact that its total quantity is constant, it admits of change from one form to another (as heat to work, electricity, &c., and the converse); but it can neither be created nor destroyed by human means. It may further be laid down as an axiom that matter under all known conditions, whether at rest or in motion, is subject to the action of natural forces.

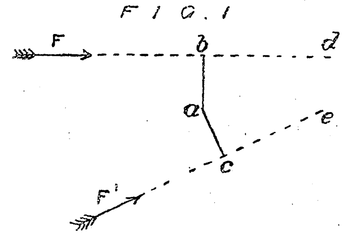
If the forces acting upon a body are in equilibrium—that is, if action and reaction be equal and opposite, the body will be at rest; but if the forces be not in equilibrium, motion will ensue in a straight or curved direction according to the relations of the forces in operation.

By the term "a force or pressure" is indicated a given *intensity* of force acting in the direction of some given straight line, and the action of one such force unopposed will produce motion in a straight line; the concurrent action of two or more forces not in the same straight line may produce motion on a curved line.

A force acting about a point as a centre, multiplied by the least distance of its direction from that point, gives as product the "moment of the force" about such point; thus, if a pressure of 100lb. act on the tooth of a wheel (tangentially to the wheel) 2ft. in radius, the moment will be = 100lb. × 2ft. = 200ft.-lb.

In Fig. 1 let F F′ be two forces acting about a common centre a. Produce the directions of

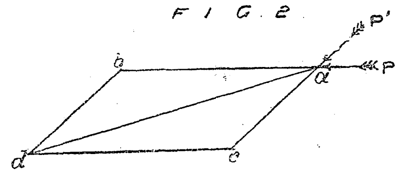
FIG. 1



the forces to d and e respectively, and from the point a draw $a\,b$ and $a\,c$ at right angles to F d and F′ e respectively; then will $a b$ and $a c$ be the least distances from a to the directions of the forces F F′, and the moments of the forces will be F × $a\,b$ and F′ × $a\,c$; if these are in equilibrium, then F × $a\,b$ = F′ × $a\,c$; therefore, $\frac{F}{F'} = \frac{a\,c}{a\,b}$, or the intensities of the forces are inversely as their distances from the centre about which they act. If motion of the points b and c occur, their velocities will be as $a\,b$ to $a\,c$, and therefore inversely as the forces. Hence calling one force the power and the other the resistance, they will be to each other as their virtual velocities, inversely. If motion does occur, "work" is done; thus 50lb. acting against a resistance through 10ft., 500ft.-lb. of work is done, and as work cannot be created, it is evident that that done on a machine must be equal to that expended on the resistances, and the distances passed through in a given time by the driving and working ends of the machine will be (friction omitted) inversely as the intensities of the forces.

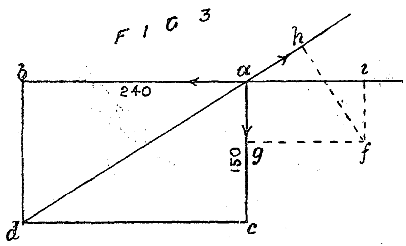
We will now consider the action of two forces at an angle to each other upon a given point. In Fig. 2 let P P′ be two pressures acting at

FIG. 2



the point a in the directions shown by the arrows, produce the lines of direction, making $a\,b$ and $a\,c$ represent the forces P P′. $a\,b$ and $a\,c$ represent the distance through which the forces are each capable of moving a body at a in one second; then the two acting concurrently will move it along $a\,d$, the diagonal of the parallelogram $a\,b\,d\,c$, for if P acted first it would move the body to b, and P′ then acting parallel to its own direction would move the body from b to d, the two forces P and P′ may, therefore, be replaced by a force represented in intensity and direction by $a\,d$, which is termed the resultant of the two forces. The accuracy of this principle of the "parallelogram of forces" may be verified by the principle of moments. In Fig. 3

FIG. 3



$a\,b\,d\,c$ is a parallelogram of forces in which $a\,d$ is the resultant of the forces $a\,b$, $a\,c$. From any convenient point f draw perpendiculars $f\,g$, $f\,h$, and $f\,i$, to the directions of the forces and their resultants; then if the forces $a\,b$, $a\,c$, are equilibrated by $a\,d$, the same should obtain with their moments about f.

The pressures are taken to a scale of 200lb. per inch, and the distances from f are measured in 200ths of an inch; the values are $a\,b$ = 240lb.; $a\,c$ = 150lb., and $a\,d$ = 284lb.; the distances $f\,g$ = 123; $f\,h$ = 118; and $f\,i$ = 63. The moments of the two first forces are 240 × 63 × 150 × 123 = 33,570; and that of the third 284 × 118 = 13,512. Considering the small scale, these figures approximate closely, and so prove the accuracy of the principles involved; but the student should plot examples to a larger scale, using a vernier or a diagonal scale for measuring.

The British units for velocity are feet and seconds, and the measure of force is the momentum it communicates to a body in a unit of time, so a unit of force would be that which, acting upon 1lb. of matter, would produce in one second a velocity of 1ft. per second.

The force of gravity produces in one second a velocity of 32·19ft. per second; but for practical purposes we may take it as 32·2ft. in one second. If, then, a body at rest commences to fall freely, at the end of t seconds its velocity v will be $v = 32{\cdot}2\,t$. The height, h, through which a body will fall in a given time, will be equal to the time multiplied by the mean velocity; if the body be acted on by a *uniformly* accelerating force, commencing with no velocity, then the mean velocity for the whole time of fall will be $\frac{32{\cdot}2\,t}{2}$, and the height fallen through $h = \frac{32\,.\,2\,.\,t}{2} \times t = \frac{1}{2}\,.\,g\,t^2$, where g is used to express 32·2, the value of gravitative attraction. But $v = g\,t$; $\therefore\ t = \frac{v}{g}$ and $h = \frac{1}{2}\,g\,t^2 \times \frac{1}{2}\,.\,g \times \frac{v^2}{g^2} = \frac{v^2}{2g}$ whence, also, $v = \sqrt{2\,.\,g\,h}$.

If the body does not fall freely, but against a resistance, it is capable of doing work equal to its weight W multiplied by the height of its fall, or = W h. If, however, the body does fall freely, the work it is capable of doing will be *accumulated* in it, and will bear a certain relation to its velocity at any point in its fall. Replacing h by its value in the expression W h, and calling A = the accumulated work, A = W h $= W \times \frac{v^2}{2g}$, and thus is found an equation giving the accumulated work in any moving body of which the velocity is known, *regardless of the source of power.*

The work done upon a machine divides itself during its transmission into either two or three parts: the first, that which is absorbed by friction and other useless resistances, known as prejudicial resistances; second, that which is accumulated in accelerating the velocity of the various parts of the machine; and third, that which is expended in doing useful work.

When a machine is started from rest it must, in its various elements, accumulate work until it has attained its normal working velocity, after which, while the velocity and resistance remain uniform, the driving-power will be divided only between the prejudicial and useful resistances. It is evident that there must in every machine be some prejudicial resistances, and therefore, economically speaking, some waste of power.

If a machine is intermittent in its execution of work, then the applied power will be accumulated for some definite period in the moving parts, and subsequently given off at the working end of the machine, so that there will be cycles at the commencement of each, of which the velocity will be the same, and all the power taken up during one cycle will have been divided between the prejudicial and useful resistances at its termination.

The work done by the machine on useful resistances divided by the work absorbed at its driving-end is the co-efficient of efficiency of the machine.

Mechanical inventions are not to be regarded as discoveries, for they consist merely in the arrangement of known elements, according to equally known principles, in such manner as to obtain a specific result, and it is an acquaintance with these principles that will enable an intending designer to expeditiously determine whether or not a proposed end can be attained by means of mechanical contrivances.

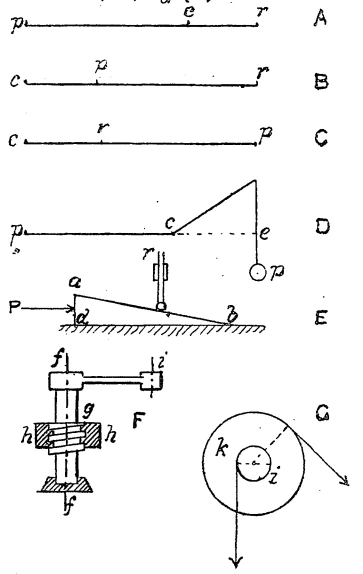
There are movements that cannot be imitated mechanically, such, for instance, as stitching fabrics together. In hand-work, the needle passes *completely through* the two pieces to be joined, re-entering at some other place, whereas in the sewing-machine the needle must return through the opening it has made in entering. Here is a very familiar case where the natural action being unattainable, a mechanical one has been designed which serves as a very good substitute, and from this it may be taken that the designing of an apparatus is not to be given up as hopeless because the movement which has been customarily used is not obtainable.

In the majority of cases an invention will be evolved by the co-operation of two classes of minds: the one finds out what is required to be done, and the other finds out how to do it, and, as a matter of fact, a want must arise for an invention to be of any use. If nothing but a modification of power is required, we have merely to proportion our machines according to the principles previously explained, as will appear from the following examples of simple machines, which, however, we shall here deal with only in regard to the proportions necessary to bring about the required changes, as the determination of sizes necessary to enable the various parts brought into action to resist the bending or breaking strains to which they will be subject is distinct from, though dependent upon, the general dimensions now occupying our attention.

It has been the practice in the older text-books to separate the various simple machines, levers, screws, wheel and axle, inclined plane, &c., to such an extent as to lead the student to the idea that each had a separate theory, and that each theory must be *learnt* independently of the others, and thus the whole matter has been complicated and perplexed; but it will here be seen that the general principles apply indifferently to all of them. For the present, friction will not be taken into consideration.

At Fig. 4 are shown diagrams of the mechanical elements of which most machines are built up. A, B, C, and D are levers, E an inclined plane or wedge, F a screw, and G a wheel and axle. In each case p is the point of application of the power of r the resistance. Let P and R represent the intensities of the power and resistance respectively; c is the fixed centre or fulcrum upon which the lever moves. The pressures are supposed to act at right angles to the length of the levers.

FIG. 4



Now it is evident that in the cases of A, B, and C the relative virtual velocities of the points p and r will be in direct proportion to their distances from c, those distances being the radii of the arcs in which they would move. If, then, the pressures are in equilibrium, it follows that $P \times pc = R \times rc$; so that if any case can be settled by one or other of the expressions, $P = R \times \frac{rc}{pc}$; $R = P \times \frac{pc}{rc}$; $rc = pc \times \frac{P}{R}$; and $pc = rc \times \frac{R}{P}$.

In the case of the bent lever, shown at D, the power does not act at right angles to the arm of the lever upon which it is exerted; draw, therefore, ce at right angles to the direction in which P acts, then by replacing pc in the above expressions by ec, this case may also be solved.

At E is an inclined plane on which the power is applied in a direction parallel to db; da is the vertical height, and ab the upper surface of the plane; the resistance is applied through a rod, r, which is capable of moving only in a direction at right angles to db; the ratio of the velocities will then be as db to da and $P + db = r + da$.

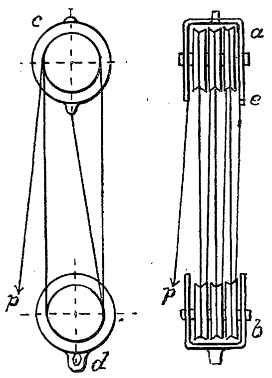
At F is shown a screw, turned by a handle, fi, ff being a line passing through the centre of the screw longitudinally, and i being the point of application of the power P; g is the screw upon which is fitted the nut h, so secured that it cannot revolve with the screw; to this nut $h\,h$ the resistance R is applied. It follows from this arrangement that when the screw is turned the nut will be raised or lowered according to the direction of revolution.

A screw is formed by wrapping an inclined plane around a cylinder with its base at right angles to the axis of the cylinder, the distance measured parallel to the axis, from the centre of the thread to the centre of the next turn is called the pitch of the screw, and is the distance the nut will be raised or lowered by one revolution of the screw Let D = the pitch of the screw, the ratio of D to the circumference of the circle of which fi is the radius will be that of the velocities of i and $h\,h$, hence $P \times 3{\cdot}1416 \times 2fi = R \times D$; $P = \frac{R \times D}{6{\cdot}2832 \times fi}$.

At F is shown a wheel and axle: the power P acts in the direction p upon the periphery of the wheel k, and the resistance acts in the direction r upon the periphery of the axle l; the ratio of the velocities in this case will be that of the radii of the wheel and of the axle; so if x = radius of wheel, and y = radius of axle, $P \times x = R \times y$, which equation can be transposed in like manner with the previous ones to suit any form in which the problem may present itself.

In Fig. 5 is shown another arrangement exhibiting a number of pulleys termed a block and fall, ab is a side, and cd a front view.

FIG. 5



The top block a or c is firmly fixed to some suitable beam or other support, and from it is suspended by chain or rope the fall or bottom block b or d. The pulleys in each block turn freely upon a fixed pin secured to the cheeks of the blocks, and the chain or rope runs freely over them; the power is applied at the free end p of the rope, which, after passing over the pulleys in the top block and under those in the bottom one, is fixed at e to an eye in the top block. The resistance acts at r.

It will be seen by inspection that to raise the lower block 1ft., 6ft. of rope must be pulled over the end top block, so that each of the six lines of rope running between the blocks may be shortened by 1ft.: hence the ratio of the velocities of the points p and r will be represented by the total number of pulleys. Let this number = N, then $P = \frac{R}{N}$; or $N = \frac{R}{P}$.

The above are most of the simple forms of mechanical movements for varying the relations between pressure and velocity in a given quantity of work; but others, and those of more complicated descriptions will be treated in subsequent articles.

THE AMATEUR WORKSHOP.—XXXIII.

Smith's Work.

THOUGH none but a professional smith could hope to undertake elaborate works in wrought iron and steel, yet many simple jobs can be done with a very moderate amount of practice, such as the bending, drawing down, upsetting, shaping, and welding of the plainer kinds of work. I shall, therefore, as I did with the brass-foundry, devote a couple of articles to a condensed description of the various smith's tools and their uses, together with a few practical hints on the management of iron and steel.

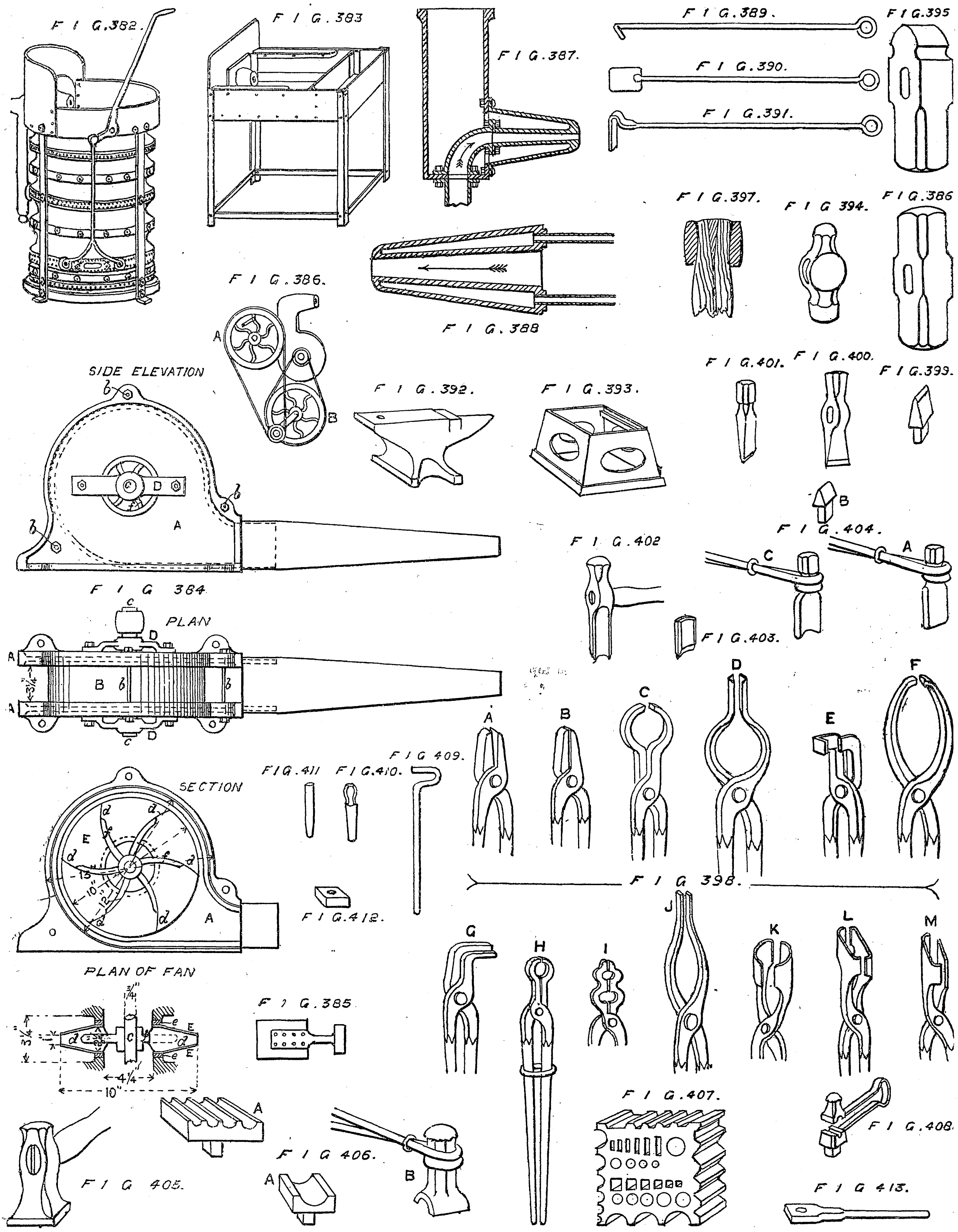
In a small shop an ordinary forge would be rather cumbersome, hence one of the small portable forges would be preferable to a mass of brickwork and iron, if it were not for the difficulty of carrying off the smoke. If the forge is to be in a closed building there must be a hood and chimney; if, on the other hand, it could be placed without the building, protected by a lean-to roof, a portable rivet or similar forge would be lighter and less expensive. The common brickwork type is so well known that I have shown two of the portable types in preference, and these are in keeping also with the amateur appliances and tools already described. The circular bellows in Fig. 382 are either of the single or the double-blast type, the latter giving a continuous current of air, but being also the more expensive of the two. Forges with 16in. bellows are the smallest made, and either these or 18in. would be the handiest for a small shop. A light framework of bar iron supports the circular hearth. The circular bellows are carried beneath, and are worked by the handle, levers, and rocking shaft, the blast being conveyed through the bend pipe into the back of the hearth.

The ordinary fixed forge is built of brick or stone. The hearth bricks simply inclose a hollow space which is filled with cinders, and upon which the fire is laid. The hearth back is of brick or stone, faced at its lower portion with a plate of iron through which the tuyere passes, and pierced at its upper portion with a square hole leading into the chimney. The chimney need not be long, its function not being the production of blast, but only of a sufficiency of draught to lead away the smoke. The face of the hearth for a few inches inwards from the edges is usually covered with a sheet of cast or of wrought iron for the sake of protection to the bricks. Two troughs occupy the front of the forge: a coal bunk, and a slake or water trough, the two often being made in one casting.

About the cheapest forge which can be made is that shown in Fig. 383, and one which any amateur could construct at a low cost, and with very little trouble. It can be employed out of doors, or placed indoors under a hood and against a wall leading into a chimney. Angle irons for the supports, flat bar iron for the horizontal stretchers, and sheets for the hearth and coal bunk are all that are required. The bearing surface of the angle iron will keep the structure from rocking, but if there is any tendency to unsteadiness when working the bellows a diagonal brace on each framing will prevent it. The blast may be taken from long bellows placed underneath, and worked by means of a lever handle, set conveniently behind the hearth back, but keyed to a rocking shaft which moves in bearings bolted to the under side of the hearth plate. The rocking shaft passing thus underneath to the front of the forge actuates a lever and connecting rod, completing the connection with the bottom board of the bellows. Or the blast can be taken from a blower at the back, either with single or multiplying gear. A small forge of this type may measure out and out, 26in. long, 22in. wide, and 30in. high. The angles may measure 1½in. × 1½in. × ¼in., the bar stretchers 1¼in. × ¼in., and the sheets about ⅛in. thick.

The supplying of the blast is effected either by means of bellows of circular or long pear-shaped form or by fans or by blowers, and in these matters the purse and the convenience of the user would be consulted. Bellows are worked by a handle and rocking staff, and attached to the forge, or distinct therefrom, according to convenience. A fan is preferable to bellows, and is worked by hand or foot, or power, but should be driven with multiplying gear to get up the speed. In factories a single fan worked by a belt from the engine supplies blast to a range of forges; a throttle valve under the control of the smith regulating the passage of the blast to each forge. Numbers of small forges are now sold very cheaply fitted with fans, or with Root's blowers, so that the old-fashioned leather bellows seem to be doomed to ultimate extinction. A small fan is shown in Fig. 384. The cheeks A are of cast iron grooved to a bare ⅛in. deep, a, to take the strip of sheet iron or brass B, which is cemented in with white lead and clamped together with bolts b, passing between the sides. The fan spindle c is carried in bridge-like bearings D, bolted to the sides of the cheeks, and the fan itself is composed of dished sides of sheet iron or tin E, between which the vanes d, are soldered. The dished sides are soldered to brass rings, e, which run against the inner faces of the cheeks. The vanes or blades are also soldered to the curved ribs f on the central boss, made of gunmetal. The actual fan requires to be nicely balanced owing to the high speed at which it rotates. The fan sides are each furnished with a central hole to admit the air. Instead of flat cheeks, two castings can be made with curved outlines, and bolted together with a central outside flange in the manner so familiarly known in foundry and other fans; but this means the making of two rather troublesome half patterns. The form of blade used in the common old-fashioned fan is shown in Fig. 385, but it is noisy. It is easy to make, the blades revolving within the outer casing, and as close to the sides without actually touching them as possible.

By multiplying gear, we mean some arrange-



-ment by which the proper speed of a fan can be imparted without excessive labour at the hand wheel. A hand wheel driving direct to the fan pulley will do, but with multiplying gear smaller wheels and less work will effect the same results. The perspective view (Fig. 386) illustrates this gear, the relative positions of the wheels varying as best adapted to the forge itself, and, of course, a treadle can be substituted for the handle. As drawn, the wheel A would be to one side of the forge clear of the hearth, its bearing being bolted to the hearth back, the bearings of the other wheels being bolted to the stretchers underneath the hearth. 10in. would be a good size for the wheels A and B. Bands are preferable to ropes running round grooved pulleys, since the latter properly require tightening gear for alterations in length due to temperature.

There is also the tuyere or tue iron to be considered, its function being the conveying of the blast to the fire. The nose of a tuyere would rapidly burn away, and does inevitably burn in time; but its destruction is retarded by the formation of a water chamber behind and around it, a current of cold water being made to circulate by convection within a conical cylinder through which the blast pipe passes, the whole being attached to a cistern or "water bosh." Fig. 387 shows this, the more modern type, in section, and Fig. 388, a section of the older tue iron, made either in cast or in wrought iron. These are illustrative, however, of the tuyeres used for large forges; but the small forges here figured are not provided with a water tuyere, because they are not subject to so fierce a heat as those of larger dimensions, and they are used intermittently. The nozzle which receives the blast pipe is, therefore, simply thickened up in these cases, and the boss piece is cast in one with a back plate, and thus bolted to the hearth back, so as to be readily renewable as in Fig. 382, 383.

The firing tools are the poker (Fig. 389), the slice (Fig. 390), and the rake (Fig. 391). A ladle is also used for lifting water from the slake trough for the damping down of the fire.

The anvil (Fig. 392) of wrought iron, steel faced, is often supported at its proper height—about 2ft.—on a block of wood, having spikes driven in at the corners to keep the anvil in

place. A much neater and better way is to have a hollow standard of cast iron (Fig. 393) furnished with ledges for the anvil, and with holes at the sides for clearing out the scale and dust. Such a casting is easily made from a pattern by coring out, gives less recoil than wood, and looks neat. Anvils weigh from a few pounds to 4 or 5 cwt., one of 2 cwt. being of suitable size for light work. The conical end is called the "beak" or "bick," the steel top the "face," the body the "core." There is a square hole, or sometimes two square holes, in the face to receive the anvil cutter and the various bottom tools.

There are such a large quantity of tools of different shapes employed by smiths that all I can hope to do is to represent some of the commoner and more typical forms, and briefly note their uses by the way. Those which are in most constant request are the hammers and tongs; after these come the different sets, swages, fullers, and flatters. A smith who works alone is vastly more limited in the number of tools which he can employ than one who has a striker to assist him. When a man is holding his work with the one hand and the hammer with the other, he cannot be holding top swages and flatters and sets as well. But when a two-handed job is required help can usually be obtained; hence I shall describe the usual tools included in a fairly complete set.

Of the hammers there are two principal types, each varying in weight and shape—the hand hammer (Fig. 394) and the sledge (Figs. 395, 396). The former weighs from 1 to 4lb., the latter from about 4 to 14lb. A hand hammer of from 2 to 3lb. weight is useful for general work, the lightest hammer, about 1½lb., being chiefly used by the smith to indicate to his striker at which points to direct his blows, the heavier hammers for drawing down and forging light works. The lighter sledges are used "up-handed"—that is, for lifting and striking in a circular arc simply, over the work; the heavier sledges are swung in a complete circle or "about sledge." The handles of each of these hammers are made of ash, well spoke-shaved, and smoothed with glasspaper, and are wedged with a single wood wedge, as shown in Fig. 397, wedges of wood being less likely to work loose than those of iron.

Taking the various tongs in order (Fig. 398), we have, A and B, the flat bit tongs, having flat parallel jaws, the width of opening of the jaws being greater in the "open mouth" A, than in the "close mouth" B; the former being used for thick, the latter for thin work, but each being similarly used for the purpose of grasping flat iron bars and sheets. The pincer tongs, C, are made in two forms, the first being simply concave in the jaws, the second vee'd as shown, the function of each being the grasping of round, square, or hexagonal bars. The hollow space behind the jaws allows of collars and similar expansions on forged work being inclosed thereby. D are tongs of similar type, but more widely useful because longer and more enlarged behind the jaws. The "crook bit tongs" E, are very common, and are made in various sizes, their peculiar shape permitting of a bar of iron passing down by the handles, while the lip on one jaw serves to retain the bar in place. The "hammer tongs" F, grasp punched work, entering into the punched holes. The "hoop tongs" G, are for holding rings of thin metal; H are "bolt tongs" for grasping bolts or rings of round bar iron; I, J, are two forms of "pliers," the latter being in constant use for general light work, picking up light rods, punches, drifts, hardening and tempering tools, &c.; K are "hollow bit tongs," made in many sizes for holding rods of circular or other section; while L and M are "flat tongs," two of the commoner modifications of the last type, and also made in several sizes for grasping flat bars of different widths and thicknesses. These embrace the principal types of tongs, but like many other tools, they rapidly increase in number, and a single forge will have from twenty to fifty pairs of different sizes and in various modifications.

All tongs are made to grasp their work by means of a "coupler," embracing the handles or reins (Fig. 398, H), and just tapped over with a hammer until they tighten themselves, so that the smith has only to turn the tongs and work about, the coupler maintaining a firm hold of the jaws on the work.

For cutting off bars, rounding edges, and rough dressing of forgings to shape, the chisels or "sets," and the gouges are employed. First there is the anvil cutter (Fig. 399), whose shank drops into the square hole in the anvil, before mentioned. The chisel edge being therefore uppermost, when a bar of cold iron is placed across it and struck with the hammer, the bar being rotated the while, the latter is nicked circularly, and may then be easily broken across the edge of the anvil, the fracture appearing of a crystalline character. The "hot" and "cold" "sets" (Figs. 400, 401) are also chisel-like tools, the difference in these consisting in the angle at which they are ground, the "hot set" being ground thin, the "cold set" relatively thick, and used as their names imply for cutting bars hot or cold. These are handled in a similar fashion to hammers, or on withy rods, or on rods of iron, the sketches indicating both forms, and the modes of handling applying indifferently to either. Tools like Figs. 402, 403 differ only in respect to their width and radii, their edges being curved to various sweeps for cutting corresponding outlines on red-hot iron. These "gouges" or "hollow sets" are struck by the sledge, the smith holding the tool by the withy handles, while the striker directs his blows on the head. The bevel is either inside or outside, and when cutting through a thick mass of iron, it is necessary to withdraw them occasionally, and dip them momentarily in water to prevent the loss of temper and softening.

Besides these there are a large number of non-cutting tools of different forms. Chief among these is the "fuller," used, as its name implies, for "fullering" or drawing down iron in a series of grooves, both for welding, or for obtaining a flat surface, or for producing a starting point from which to bend a bar. A "top fuller" is shown in Fig. 404, A, a "bottom fuller" or "anvil fuller" at B, the latter resting by its shank over the anvil hole, the former being handled hammer-like, or by withes. The top fuller may be used while the bar rests upon the anvil face, or the bar may rest upon the bottom fuller and be struck by the hammer above, or the bar may be drawn down between the top and bottom fullers, the upper one being struck by the sledge while the bar is moved into successive positions until the iron is thinned or tapered by a series of grooves. The "nicking fullers" (Fig. 404) are made in various sweeps, and they fulfil the same purpose for circular shafts and rods that the others do for flat bars.

To finish plane surfaces, the "flatter" (Fig. 405) is employed. This also is struck by the sledge, and finishes or flattens the surface, removing the uneven ridges and indentations left by the hammers and fullering tools.

The "swages" form also a very large family in themselves. They are so termed because by their agency work is "swaged" or drawn down, and made to assume definite outline corresponding with the shapes of the swages. These are, therefore, in principle dies, because the work can only assume the shapes given to the swages. Being also used in pairs, one top, one bottom, they are commonly called "top and bottom tools." Some shapes are given in Fig. 406, A, A, are bottom swages—that is, they fit by their square shanks into the hole in the anvil face; the shape of the corresponding top swages is seen at B. The ordinary shapes are the half-round, the vee'd, and the hexagonal, each being required in different sizes. Fig. 407 represents a swage block for a heavier class of work, the various sectional forms around its edges answering the purpose of bottom swages. It is conveniently laid upon a cast-iron stand, similarly to the anvil, on which stand it can also be laid flat in order that the central holes shall fulfil the functions of "heading tools"—that is, of the type of Fig. 413, for finishing the square shoulders of bolt heads, and similar flat expansions. The top and bottom swages are frequently united in one with a bent rod of iron, which serves to keep them in line, and becomes a convenient handle. They are then termed "spring swages," or "spring tools" (Fig. 408).

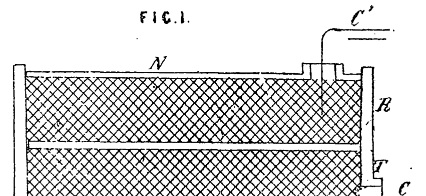
There are three modes of handling tools employed by smiths. The first, just now referred to, of wedging the hammer-head fast in the shaft. The second, that made use of with some of the sets, gouges, fullers, and flatters, in which the handle is simply thrust through an eye in the tool without any attempt at wedging, the reason being that their constant and almost close contact with red-hot iron would cause wedges to work slack almost directly. Hence the smith, previous to using either of these tools, usually strikes the butt-end of the shaft on the anvil to tighten the head. Lastly, there is the method of fixing by hazel-rods. These are straight hazel sticks of about ½in. or ⅝in. in diameter twisted round the necks of the tools (Figs. 404, 406), the elastic wood preventing painful jarring and blistering of the hand of the smith. Before being bent they are soaked in water and steamed over the fire, the operation being alternately repeated until they are sufficiently pliable to bear bending and twisting., but not taking more than a minute or two. The parallel rods are united permanently by a coupler, and are never taken off the tools except when they need renewal. Very often it is the practice to substitute iron rods for those of wood, as being more durable, the rods being bent in the same manner.

A hook wrench (Fig. 409) is used for giving a slight amount of torsion to flat bars while red hot, which have become twisted or winding in the process of forging. Fig. 410 may be taken as a type of the punches which are employed for piercing holes through red-hot iron, and Fig. 411 of the drifts for enlarging and making them parallel, the work being laid upon a bolster (Fig. 412) the while. Fig. 413 is a heading tool, of which there are several sizes used for shouldering the heads of bolts and rivets, or any work provided with collars, though where a collar is welded or otherwise formed on the centre of a bar collar swages are often used in preference.

BAILLY'S PATENT PRIMARY AND SECONDARY BATTERIES.

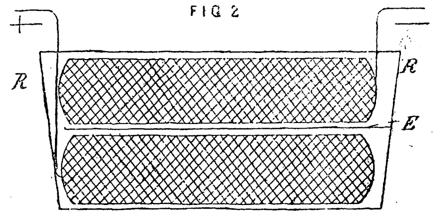
THE use of lead and zinc plates in forming batteries has latterly attracted much attention from several inventors, and amongst them M. Philimond Bailly, of Ermont, Seine-et-Oise, who has recently obtained some patents in this country for his special designs. The object of his latest published invention, so far as relates to lead electrodes or plates, is to arrange the conductors so that they permeate the whole active parts of the electrodes, and unite them without the necessity of the numerous soldered joints which are commonly used to connect the plates of secondary batteries. The lead electrodes are composed of sheets of lead divided

FIG. 1.



into filaments of suitable dimensions, which are interlaced with lead wool, and formed into cakes of any desired form or size. A mass of fine lead wool or spongy lead has been previously used; but it has been found extremely difficult to collect the currents from all parts of the mass without considerable loss, owing to the electrical resistance of the connections between

FIG 2.



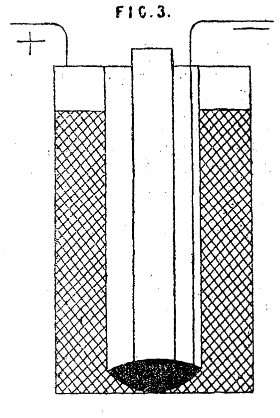
the particles of the lead wool and the conductors. With a view of keeping the resistance as low as possible, M. Bailly cuts the sheets of lead, which also act as the conductor, into coarse filaments or tapes in the manner of a fringe, which he interlaces with the smaller

filaments of the lead wool which compose the electrode. These fringes and conductors thus distribute the electricity throughout the innumerable ramifications of the filaments, and likewise also collect it during discharge, and reunite it in the common conductor. The action may be compared to the arteries and veins which permeate the human body. With this arrangement of conductor he is able to do away with the numerous joints necessary where the electrodes consist of a number of plates, also to minimise the action which takes place at the surface of the liquids, and which causes the rods or conductors to wear out or break off at the level of the liquid. That danger is in proportion to the number of electrodes, and as in his system of accumulators there is only a single conductor per electrode, the danger is reduced to a minimum.

The conductor is formed out of the same lead plate as is used for the electrode, and it can be brought out laterally or through the bottom of the jar or recipient. This arrangement is shown by Fig. 1, in which R is the jar, N the level of the exciting liquid, C[1] the conductor of the negative electrode, which, not being subject to the same danger as the positive, can be put in as usual, or, if found more convenient, can be brought out laterally. The positive conductor C, as shown, is brought out laterally by an opening, T, made tubular or otherwise, which can easily be closed with an indiarubber plug, or by cement.

Electrodes made from a mass of filaments combined with the fringes and conductors can be used for the purpose of a secondary battery in various ways. In order to obviate any chance of a short circuit they can be placed in suitable receivers, cylindrical or of any other

FIG. 3.

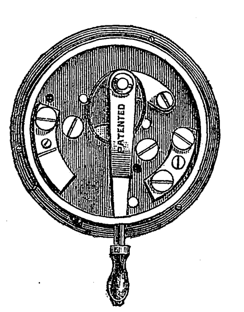


form, and separated from the electrodes of opposite polarity by some porous substance, such as felt, terracotta, or any other suitable material. The arrangement of apparatus thus made may be infinitely varied according to the requirements; thus the positive and negative element can be put indifferently either inside or outside the porous vase, or the electrodes can be put horizontally one above the other. The latter of these arrangements is shown by Fig. 2, in which R R is the receiver, — negative electrode, + positive, E porous partition of paper or other suitable material. This arrangement is especially applicable to large industrial and stationary installations, and has the advantages of cheapness and simplicity of working and construction and permanence of the active material, or the positive electrode. If desired the electrodes can be inclined so as to facilitate the easy release of the gases which are formed during the working, and the horizontal arrangement can be modified in different ways. Where it is desirable to employ an electrode of zinc, instead of using ordinary zinc, which would be attacked by the exciting fluid of the battery, the patentee makes a special amalgam of zinc and mercury, which can be run, moulded, or pressed into cylinders, plates, or any other form which it may be desirable to use. It is most important to have the zinc thoroughly amalgamated. The patentee, therefore, takes powder, filings, or fragments of zinc, and grinds and mixes them with mercury in proper proportions, in the presence of a pickling agent, if necessary, and thus forms a zinc amalgam to which any shape can be given either by casting or moulding, and pressing, and thereby squeezing out the excess of mercury. The zinc electrode can be employed in various ways: is can be placed in a vertical porous pot which is surrounded by one of the lead electrodes. The arrangement is shown by Fig. 3. In some instances holes are made in the porous partitions at the places and in the number most suitable so as to allow the issue of the liquid most saturated with the salts of the electrode, and thus prevent the increase of the resistance and the diminution of the chemical action.

If desired the zinc electrode can be placed below the lead, or it can rest above the inclined porous partition, and be either single or double or multiple, and inclined so as to allow the release of the gases, and so arranged as to have a lower part in which mercury can be placed to insure the constant amalgamation of the electrode, and receive the liquid most strongly saturated with the salts, so as not to increase the resistance on the whole surface. These arrangements can be modified in several ways. Great difficulty has been experienced in making the receivers of primary and secondary batteries water-tight: the patentee, therefore, forms them of two vessels of wood, slate, or any other suitable material, and places one inside the other in such a manner that there is a space between the two which is filled up with a material not attacked by the liquid contained in the inner vessel, and sufficiently resisting and plastic for it not to disintegrate if jarred.

THORPE'S NEW ELECTRIC-LIGHT SWITCH.

In designing this switch one of the principal features has been to put the whole of the work in the face, so that at any time a defect or alteration to wires can easily be effected.



The spring has a direct action on the lever, or has no tendency to pull it over on one side, as is the case with many now in the market, and the action is very quick in either direction. The switches are all arranged to take a fusible wire, and they can be made with either wood or porcelain covers, and owing to the simplicity of construction they can be made at a low price.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—XIX.

By an Analytical Chemist.

Colza Oil.

(249.) *Sp. Grav.*—The percentages obtained at the following gravities are:—

·9135 to ·9139	....	6 per cent.
·914	....	37 „ „
·915	....	25 „ „
·916	....	12 „ „
·917	....	18 „ „
Above ·917	....	2 „ „

A gravity of ·917 is too high, and the samples of that density, although amounting to 18 per cent. of the total number, were an exceptional lot. Most of them were submitted at the same time by the same merchant, and they were found to be genuine, but of abnormal gravity. The table shows that the greater part of the oils lies between ·914 and ·915; well refined oils may fall as low as ·9135 (the lowest figures obtained), and cruder oils may rise as high as ·916.

(250.) *Rise of Temperature with Sulphuric.*—The figures obtained by the following specialists are:—

Allen	91° to 108° F
Maumené	104°
Archbutt	106°
Baynes	108° to 165°.

The latter are probably too high; my own experience, or, so far as I know, that of any other analyst, does not confirm them. Three samples specially obtained and kept as standards gave three sets of figures: the first (described as "Best refined oil") gave a rise of 85° Fahr. and a gravity of ·9137; the second, which had been practically tested for illumination on a large scale and had given complete satisfaction, gave a rise of 96° Fahr. and a gravity of ·9147; while a third gave a rise of 102° Fahr. The results obtained from commercial samples vary considerably; but general experience tends towards fixing a temperature about 100° Fahr. as the standard for genuine colza oils.

(251.) *Cooling.*—Fat begins to deposit at about 24° to 21° Fahr.

(252.) *Drying Properties.*—Oxidises when exposed; but cannot be said to dry at ordinary temperatures.

The elaïdin test gives in about 20 hours a solid of the consistence of butter, and of an orange colour.

(253.) In oil required for burning in lamps the percentage of free acid should be low. (See Art. 230, *d*).

(254.) A drop of sulphuric acid let fall on twenty drops of the oil, as described in Art. 230 *e*, gives a characteristic colour. A yellowish brown spot forms the centre of a gradually extending purplish slate-coloured circle.

(255.) The viscosity test is of particular importance. Glycerine of sp. gr. 1·226 and genuine rape oil have the same viscosity; glycerine serves, therefore, as a useful standard in the absence of a sample of guaranteed purity.

(256.) Colza oil is so little soluble in acetic acid that this is a valuable distinctive test.

(257.) Colza is usually of a light yellow colour, and when well refined almost odourless. Rape oil has a brownish colour, and a characteristic odour; in other respects it so closely resembles colza that they may be regarded as practically identical.

(258.) When colza oil is specially examined to determine its value as an illuminant, a measured quantity of oil is burnt in a particular lamp. When all the oil is burnt the lamp goes out, or it may go out before if the oil is of bad quality. The time the lamp continued lighting is noted; also the condition of the wick after the experiment. An equal measure of a standard oil is burnt in the same lamp under precisely similar conditions, especially as to length and thickness of wick. Good oils burn longer and char the wick less. This is a useful practical test.

Castor-Oil.

(259.) *Sp. Gr.*—·962 to ·963.

(260.) *Rise of Temp.*—Maumené and Archbutt give 84° to 82° Fahr., Allen as high as 117° Fahr. My own results agree with those of Maumené.

(261.) Castor-oil usually becomes cloudy in the ice-chest, although when cooled to 14° Fahr. it does not deposit fat. At this latter temperature it is very thick. It solidifies at 0° Fahr.

(262.) *The Elaidin Test* yields a semi-solid mass of a greenish or more usually a yellow tinge.

(263.) *Colour Test.*—With a drop of sulphuric to 20 of oil, a yellowish orange spot is produced.

(264.) *Solubility in Alcohol, &c.*—Readily soluble in hot or cold alcohol (65 o.p.).

It is also very soluble in glacial acetic acid, but insoluble in petroleum spirit. The latter is a good distinctive test.

(265.) "Cold-drawn" oil is colourless, or straw yellow; lower qualities are darker coloured, with a tendency to darken more and to become rancid. The taste and odour of castor oil are particularly disagreeable to some persons.

Ordinary adulterants may be detected by the above tests.

The viscosity of this oil is greater than that of any other fixed oil.

Niger-Seed Oil.

Not often met with commercially.

(266.) Sp. gr. ·926.

(267.) The rise of temperature with sulphuric was only 119° F., which is considerably below that usually stated.

(268.) *Colour Test.*—One drop of sulphuric to 20 of oil produced a yellow spot, turning to dark red, then dirty brown, with a violet tinge.

Cocoanut Oil.

(269.) The sp. gr. at 100° F. is almost uniformly ·910 to ·911.
(270.) The melting point is 70° to 71° F.
(271.) *Free Acid.*—Frequently considerable.
(272.) It is of the consistence of butter, of a white colour, and peculiar odour and taste. It is much used for marine soaps.

Cottonseed Oil (Refined).

(273.) Sp. gr. ·922.
(274.) *Colour Test.*—With sulphuric acid the colour produced is nearly the same as that from olive oil; it can, however, be distinguished from the latter by other tests.
(275.) The reactions for this oil are only of importance in detecting its use in the adulteration of olive and other high-priced oils. A recent decision given in Glasgow against two grocers puts this question on a higher level. This decision declares olive oil to be an article of food, and the addition to it of cottonseed oil an offence under the Foods and Drugs Act.

(*To be continued.*)

PHOTOGRAPHIC LENSES.*

By J. TRAILL TAYLOR.

WHILE there are few lenses which cannot, in some way or other, be made to conduce to the formation of a photographic image, yet does the photographic objective differ *per se* from all others in certain characteristics. Arriving at a definition of what forms a photographic lens by contrasting it with the object-glass of a telescope, we find that, whereas the function of the latter is to produce an image of objects which are transmitted axially, or in near approximation to the axis, the former must not only do this, but more, for it has to take account of rays transmitted also at considerable obliquity to the axis, and, after such transmission, has to project these oblique rays to distances proportionately greater than axial ones ere they come to a focus, in order to supply the condition of a flat field. Hence the greater the obliquity of the pencils, the more elongated must be the converging beam, in order that this indispensable condition be fulfilled.

It not unfrequently happens that in a photographic lens corrected perfectly to work to focus in the centre of the field the photographic definition towards the margin will be found to be of a higher class than the visual image. From this we may deduce the fact that a formula by which direct or axial rays are achromatised does not include the case of oblique rays otherwise than as an approximation.

It was reserved for the genius of Professor Petzval, of Vienna, to make the grand discovery of the portrait lens. A year after Daguerre's discovery, the late Voigtlander, when calling upon Professor von Ettingshausen, was asked by that gentleman whether he could determine the refracting and dispersing power of different descriptions of crown and flint glass, because Professor Petzval who was at that time filling the mathematical chair in the University at Vienna, had made the calculation of a photographic lens which could not be executed in consequence of the qualities of the glass to be employed not being then in existence. Voigtlander, intimating his ability to do this, was asked to call immediately on Petzval, and the portrait lens was issued about 1841. Of all lenses extant, it is the one possessing the greatest angular aperture, by which term is understood the diameter of the lens in relation to its focus. In former times, when processes were less rapid than they now are, it is easy to conceive of the impetus given to portrait photography by the discovery of Petzval.

If a plano-convex lens, or one nearly of this form, be inserted in a camera and directed to the light, it will be observed that if the convex side be turned towards the view, an image more or less sharp will be formed at the focus, but that the area of sharpness will be exceedingly limited. By reversing the position of the lens, turning the flatter side out, the opposite result is obtained—there is no sharpness anywhere, but a generally better and more uniform image all over the focussing screen. This arises from spherical aberration, the margin of the lens when thus placed bringing the rays to a focus anterior to that effected by the central portions.

The condition for reducing this confused definition to sharpness is that a diaphragm shall be inserted in front of the lens under such circumstances that the centre of the picture shall be formed only by the centre of the lens, no rays finding admission to the margin of the lens but those which come from the side of the view to be delineated, and thus fall upon the surface in a more or less oblique manner. This diaphragm is therefore absolutely necessary with a lens of the nature described, in order to secure flatness of field, with good marginal as well as central definition. It is, therefore, necessary that the diaphragm be situated a little distance in front of the lens, because it is only when thus placed that rays are allowed access to to the lens, subject to the conditions mentioned, those which would mar the sharpness being thus excluded. It must not, however, be imagined that the same effect would be produced by reducing the diameter to the size of the aperture in the diaphragm, for in such a case, while the centre would be sharp as before, the sides would be badly defined.

What has been said of the plano-convex lens is also true of the meniscus. This latter lends itself, by its form, so well to the transmission of rays possessing a great degree of obliquity to the axis, that all lenses which are intended to embrace a wide angle of subject must be of this form; but the spherical aberration being greater in a deep meniscus than in a flat lens, a stop somewhat smaller is requisite, in order to its reduction.

Aplanatism is a somewhat ideal term, and cannot with strict accuracy be applied to photographic lenses. It was originally employed in 1791 by a Scotch *savant*, Dr. Bird, to denote lenses free from spherical aberration, in like manner as achromatism signifies freedom from chromatic aberration. Popularly it is held to designate an objective which gives sharp central definition with its full aperture, no diaphragm being employed. But this even an imperfectly corrected lens will do, provided its diameter be sufficiently reduced. We can, therefore, only talk in this connection by degrees of aplanatism, which would be the better understood if we had a zero from which to start the scale. This zero might be made to equal $\frac{f}{1}$, or a diameter equalling the focus; but at any rate, the term as it at present exists has not a sufficiently definite meaning. With this by way of protest against the mythical expression, I observe that of all photographic lenses extant, the old portrait combination is that in which the property of aplanatism, or maximum angular aperture, is greatest. As is the relation of aperture to focus, so is the intensity of the illumination. While a large angular aperture conduces to rapidity, in the same degree is it adverse to penetration, or the property of presenting on a plane surface, and with a degree of definition which satisfies the requirements of the artist, objects situated at various distances. This property of penetration, or depth of defining—unthinkingly called "depth of focus"—is a power of great value to the photographer, and is induced by means hereinafter described.

The Optical and Focal Centre.

It is in many instances desirable that one should be able to know where the optical centre of a lens is situated. It is a property of this centre that any ray refracted by the lens which passes through it emerges in a direction parallel to its incidence. It is from a point near to, although not quite at, the optical centre of a lens, or combination of lenses, that the focus must be measured. To find this centre draw two parallel radial lines, one from the centre of each curvature, and both being oblique to the axis; then connect the points at which they touch the curved surface by a line, which, in the case of a meniscus, must be prolonged till it meet the axis. The point at which this junction-line touches the axis is the optical centre. In class books on optics the following rule is given: "Multiply the thickness of the lens by the radius of one surface, and divide the product by the sum of the radii, and the quotient is the distance of the centre from the vertex of that surface."

In a *combination* of lenses there is no fixed point which can be termed the optical centre. The mistake is frequently made of assigning it to a position near the diaphragm which has not necessarily any relation to that of the centre, which can only have its position determined upon knowing the precise circumstances under which the combination is to be used, for it has strict relation to the conjugate foci. What is commonly termed the optical centre in a combination is in reality the centre of conjugate foci, and this is determined by the conjugates, which may change with nearly every change of picture taken.

The *equivalent focus* of a lens is so termed from an image formed by it equalling in dimensions that made by a single lens. It has no relation to the misleading term "back-focus," so frequently employed. It is not difficult to conceive of an objective, the back-focus of which—that is, the distance between the posterior surface and the ground glass of the camera—may be 4in., while the real or equivalent focus is 8in. As it is of great importance that photographers know precisely the foci of their lenses, I shall describe methods by which this may be ascertained. Let me first of all observe that, although it has been taught by some that the focus must be measured from the optical centre, this is not quite correct. In every lens or combination there are two nodal points, which are centres of admission and emission. They are sometimes designated the Gauss points, from the fact of Gauss having communicated an investigation of their properties to the Royal Society of Göttingen in 1840. In the case of a simple bi-convex lens these points are situated between the optical centre and the surface, while in a meniscus lens it is outside of the lens, and a little within the optical centre. It is the back nodal point which concerns us at present, as that is the one from which the focus is measured. In a rectilinear combination this posterior focal centre is situated between the diaphragm and the back lens. Opticians interested in this are referred to Secretan's treatise on the true point from which the focus should be measured, or to Gauss's memoir.

It has often been recommended to determine the true focus of a lens of this nature by focussing the camera upon an object, so that the image and the object shall be of precisely the same size, and divide the distance apart of the two by four, the quotient expressing the true equivalent focus of the lens. This is altogether misleading as applied to the combination lens in common use, the focus thus obtained being greater than the true focus by nearly one-fourth of the distance at which the lenses are separated in the mount.

Out of several methods by which the equivalent focus may be ascertained, I shall mention only a few. Select a very thin spectacle glass which, after trial is found to give an image on the focussing-screen of the same dimensions as that given by the photographic objective; and the distance of that glass from the focussing-screen, less one-fourth its thickness, is the focus. Or, having marked upon the ground-glass the precise spots upon which two well-defined objects depict their images near the margin on opposite sides of the screen, unscrew the lenses from the mount, and insert a pinhole diaphragm made in a thin metal plate. Rack the camera in or out until the images made by the pinhole correspond with that of the lens in dimensions. As before, the distance between the ground-glass and diaphragm is the focus.

The way which I prefer is Grubb's, on account of the ease with which it may be carried into operation and the accuracy of the result. On the ground-glass of the camera make two pencil marks at either end, each being a distance of an inch or so from the margin, although this is not material provided both are alike as regards distance. Having brought up a table to the window, spread upon it a sheet of paper, and upon this place the camera. Focus upon a distant scene, and rotate camera until a well-marked object in the scene—such as a chimney or spire—is superposed on one of the lines drawn on the ground-glass. Now using the side of the camera as a ruler, draw a pencil line upon the sheet of paper upon which the camera is placed, and rotate the camera so as to superpose the same object upon the other mark on the ground-glass, and again draw a line upon the paper. Having removed the camera, for which there is no more use, continue by aid of a flat rule these two angular lines until they meet at a point, then connect them by a line as in the capital letter A, which line must equal in length the distance between the two marks made on the ground-glass, and with a foot-rule measure the junction of the angular lines to the centre of the cross line, and you have the true focus of the lens.

Schroeder's method is also simple and excellent, although it implies the possession of a camera capable of extending to about twice the focus of the lens. Extend the camera until the dimensions of the image on the ground-glass and of the object in front are alike. Having marked the position of the camera back in relation to its baseboard, slide or rack it in until a distant object is in focus, and again mark the position of the back. The distance between the two positions, or that through which the camera-back was made to travel from the first focussing to the second, gives the equivalent focus to the lens. In a rectilinear symmetrical doublet of wide-angular aperture which I possess, having an equivalent focus of 13¼in., a reputed focus of 13in., and a back focus of 10⅝in., I find that the focal point or posterior nodal, is situated ·3in. back of the mechanical centre of the lens. This is a matter that greatly concerns those who have to make copies to scale, and who have the sides of their cameras graduated in order to facilitate accuracy and speed.

The earliest form of objective was the plano-convex, or slightly curved meniscus. For reasons already given, it has a diaphragm, or stop, in front. In order that it should work with a larger aperture, the late Mr. Grubb reversed the relative positions of flint and crown, by which he was enabled to bring the diaphragm rather closer to the lens. Still later, the late Mr. Dallmeyer modified it by placing the flint between two crowns, for which further advantages

* Abstract of a paper read before the Society of Arts.

were claimed. By recent improvements in the selection of glass, and curvature, this old objective (which in all its various forms is still much employed) is now made with such a large fixed diaphragm, as to render it capable of being employed in portraiture. This, of course, is owing to the minimising of the spherical aberration. Whilst admirable in other respects, it is unsuitable for copying or for architectural purposes on account of its refracting the lateral rays in a greater proportion than the central ones. This distortion does not show near the middle of a picture, but becomes apparent when the included angle is moderately wide. From the nature of its construction it cannot supply the condition of orthographic projection—viz., that a ray shall emerge in a direction parallel to that at which it enters. To this end the ray would have to pass through the optical centre, which in such a lens cannot be done.

The Petzval portrait lens consists of a nearly plano-convex achromatised lens in front, with a double convex posterior lens at the other end of the tube. This latter is composed of a bi-convex crown and a concavo-convex of flint glass, the inner curves not being concentric, and the two are separated to a slight extent. This back combination fulfils a two-fold function: it shortens the focus and thus intensifies the illumination, and as it possesses a large degree of negative spherical aberration, it counteracts the positive aberration of the front lens, and thus with a large aperture it brings rays to a sharp focus over a field quite large enough for single portraits. Some years ago, Dallmeyer introduced a modification of the back lens, reversing the relative position of its element, as Grubb had done with the landscape lens, the requisite negative aberrations being obtained, as in the Petzval back, by the inner surfaces not being concentric. This form of back lens lends itself to the lowering of definition, when such is desired, as in the case of large faces in which the rugosities of the skin are not always desirable.

An American optician, Morrison, makes some of his portrait lenses—especially those for taking a large standing figure with full aperture—with an uncemented front lens and a Petzval back, the inner surfaces of the front lens having non-concentric lenses.

The most recently introduced lens of the portrait class owes its inception to Steinheil, and is constructed on lines quite different from all others. The front is a cemented positive combination, and consists of a convex crown and a concave flint. The back combination is composed of a bi-concave flint and a bi-convex crown, these being separated to some considerable extent. Each combination exhibits chromatic and spherical aberration to a large extent, but in an opposite sense, so that the two combinations correct each other.

(*To be concluded.*)

STANDARD SCREW THREADS.*

By JOSHUA ROSE.

THE angle of the sides, one to the other, of the United States Standard, of the common V, and of the steam and gas thread, is said to be that of 60°; but it can be shown that a thread can only have a standard angle upon one diameter of bolt or work, and that for this one diameter the angle of the thread is different from that of the tool that cuts it. This in no way detracts from the value of a standard, because it is by means of the standard that we are enabled to originate threads,

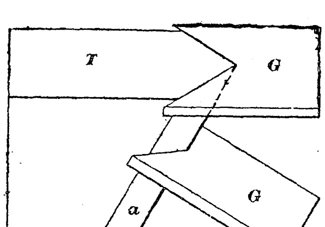


Fig. 1

and be sure that all those of a given pitch will fit, let the diameter of the work be what it may, and the actual angles of the threads vary as they may, upon different diameters of work.

Let it be supposed that a thread is to be originated, its sides to have an angle of 60°, and there at once arises the complicated problem as to what shape the cutting tool must be to produce threads having that angle, for the angle of the tool differs from the thread it produces. This fact may be stated in another way, inasmuch as that the angle of the cutting edges of a tool differs from the

* From the *American Machinist.*

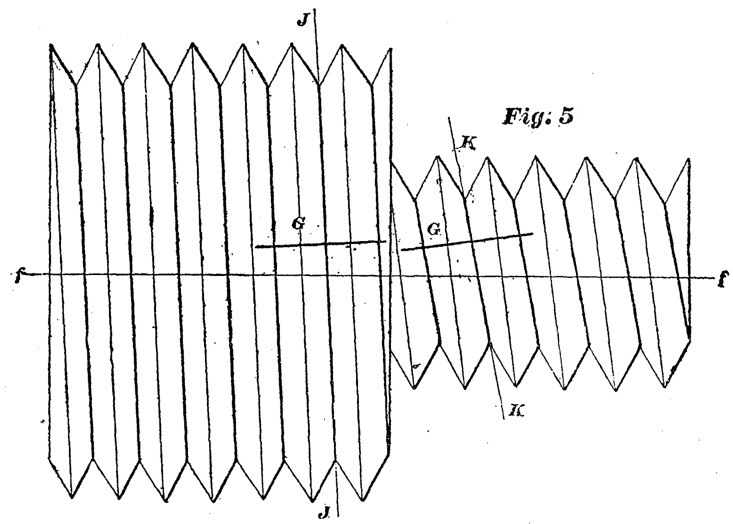


Fig. 5

Fig. 3

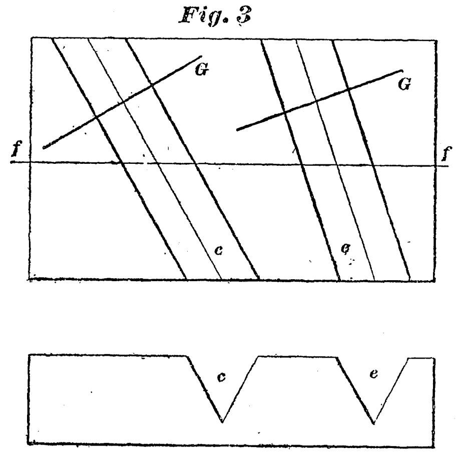
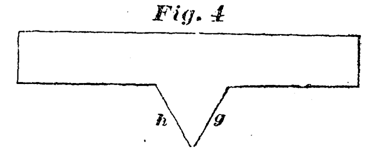


Fig. 4



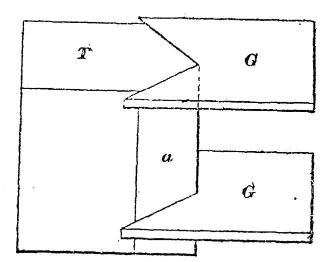


Fig. 2

angles of the two clearance faces, which are factors in producing the cutting edge. This is shown in Fig. 1, where T is a tool, and G a gauge of an angle of 60°. By grinding the end faces *a* of the tool at such an angle that the gauge fits the cutting edges of the tool, the cutting edges will obviously have an angle of 60°, measured on the plane of the top face of the tool; but if we apply the gauge to the clearance faces, as *a*, we must hold it at a right angle to those faces, as at G', and it will then no longer fit, and it is clear that the production of cutting edges at an angle of 60° can, in a tool of this kind, only be obtained by grinding the end faces *a* (these being the only ones that are ground in resharpening the tool) to some other angle, and and that this latter angle depends upon the amount of clearance given to the tool may be shown as follows:—Suppose the tool is given no clearance, as in Fig. 2, and the gauge may be applied parallel to the top face of the tool, and at any part of the tool depth, and will still show the same result; or, in other words, if it fits the tool in position G, it will also do so in G'. But the tool must have a certain amount of clearance on its end faces *a*, in order to enable it to cut, and it follows that for every variation in the amount of clearance the end faces *a* must be ground to some angle other than that of 60° in order to produce cutting edges that shall be at an angle of 60°.

In the practice of the ordinary workshop this has a minor importance, because, so long as the tool is ground so that it fits the gauge when applied in position G in the figures, the workman need not concern himself with what particular angle or amount of clearance he has given to the tool in order to obtain correct cutting edges, all that he needs to insure being that the cutting edges are at the correct angle, and that the amount of clearance is suitable for the diameter of the work the tool is to operate upon, and the pitch of the thread the tool is to cut. But in the manufacture of threading tools it assumes great importance, because the fit-and-try process is too expensive; hence a definite degree of clearance is adopted, and with it such an angle of end face as will produce cutting edges of the correct angle, when the gauge is applied parallel to the upper face of the tool.

When we come to apply a thread gauge to the work we are met with new considerations arising from the angle of the thread to the axis of the work, every varying angle giving in reality a different form of thread, although all the threads may be cut by the same tool, and furthermore, although all the threads may appear correct when tested by a gauge applied parallel to the axis of the work.

But the actual angle of the threads cannot be measured in this way, as may be seen in Fig. 3, in which a rectangular piece of work is represented as having two V grooves, *c* and *e*, cut in it at a different angle to the line *f f*, which may be taken to represent the axis of the work.

Suppose it was required to produce by hand a number of such pieces of work in which the grooves were to be exactly alike, and a male gauge such as in Fig. 4 must be made to test the grooves, the sides *g h* being at an angle of 60° one to the other.

In applying this gauge to the work it must obviously be held at a right angle to the length of the grooves, as at G for groove for *e*, and at G' for groove *c*, and when so applied the grooves fitted to it will have their sides at an angle of 60°, let their angle to the line *f f* be what it may.

But if we then apply the gauge on the line F F, neither of the grooves would appear to be correct, nor would any groove, unless the centre line of its length were at a right angle to the line *f f*.

That a screw thread must, in order that its sides be at an angle of 60°, be measured in the same way is obvious, from Fig. 5, which represents two screw threads having the same pitch, but upon different diameters of work. Line *f' f'* is the axial line of the work, and corresponds to line *f f* in Fig. 3. Line J J is the centre line of a thread groove, G represents the gauge applied, as at G in Fig. 3, at a right angle to J J, and G' the gauge applied at a right angle to centre line K K of thread groove, hence if the sides of both grooves were at equal angle the gauge would fit equally to both. But in cutting the thread, the plane of the cutting edges is parallel to the axis *f f*, and in gauging it the gauge is also applied parallel to the axis; hence the angle of the thread varies upon every different diameter of the work, and can only be a standard angle when a certain thread pitch is considered with relation to a definite diameter of work, as in the case of the United States standard.

But so long as the tool and the gauge are both applied parallel to the axis, work threads of equal diameter and pitch will fit together correctly, notwithstanding that the thread angles may vary with the work diameter. Hence, it is to be considered which is the most convenient method of cutting and of gauging the thread.

THE Manhattan Elevated Railway Co. is adopting solid brass driving boxes for its locomotives.

STEAM-PROPELLED TORPEDOES.

THERE is at the present time undergoing consideration by the Admiralty authorities a system of propelling travelling torpedoes by means of steam instead of by compressed air, devised by Mr. Edward C. Peck, who is engaged in the constructive department of Messrs. Yarrow and Co.'s torpedo boat-yard at Poplar. The torpedo is of the usual Admiralty pattern outside, the dimensions being 14ft. long by 14in. diameter, and it will carry in the forward part an explosive charge of 100lb. of guncotton together with the firing apparatus. The shell will be constructed of metal, and will be sufficiently strong to resist the external pressure of the water and atmosphere when a vacuum is formed within it. At about the centre is a hot-water reservoir 4ft. long and 11½in. internal diameter, and capable of withstanding a given pressure. This reservoir will be surrounded by a coating of non-conducting material ⅝in. thick, and between the outside of this and the skin of the torpedo will be a space of ⅜in. The reservoir is to be charged with about 160lb. of hot water taken from the main boiler of the torpedo boat or other vessel from which the weapon is to be discharged. The water will be transferred very rapidly at a pressure of about 400lb. per square inch by means of a tube fitted with the necessary inlet and outlet valves, and there will be means for raising the temperature of the water, if necessary, during its transfer from the boiler of the boat to the reservoir of the torpedo. The charging operation will not occupy more than half a minute, and it is calculated that the torpedo will keep steam at the pressure necessary for driving her engines for at least an hour after it has been charged. The quantity of water carried will possess sufficient sensible heat to supply the propelling engines with steam of a slowly decreasing pressure during the run of the torpedo. The space between the reservoir and the skin of the torpedo, as also a portion of the space in the body of the torpedo not otherwise occupied, is utilised as a surface condenser for the steam after it has done its work in the engines. By this means the weight of the torpedo will be precisely the same at the close as at the commencement of the run. The torpedo will be fitted with engines of 60 H.P. indicated, and capable of propelling it through the water at a speed of 32 knots an hour. It will be fitted with the usual fins, rudders, and regulating apparatus to insure its travelling at any required depth and in any desired direction. The advantages of a steam-driven torpedo would appear to be very considerable. In the first place weight is saved in the torpedo itself, and, the pressure being only about one-fourth of that in the Whitehead torpedo using compressed air, there will be no difficulty in keeping all the joints and connections tight. In the next place, compressed air will only give a three-quarter minute run, while it is calculated that steam will give a run of a minute and three-quarters. The speed with compressed air is 24 knots, and the average range 600 yards, while with steam Mr. Peck reckons on a speed of 32 knots and a range of 1,800 yards.

A NEW MICROSCOPE.*

I HAVE much pleasure in bringing before you to-night a new microscope made by Mr. C. Baker, which I think you will all admit begins a new era in the progress of "microscopy." You have before you for the first time in the history of the microscope a thoroughly sound full-sized instrument at the same price as a student's microscope. I must say that we are all greatly indebted for the construction of this instrument to the energy and perseverance of Mr. Charles Lees Curties. I will, if you will allow me, just go over some of the points adopted in this new microscope. I say adopted, for in a new microscope there must of necessity be much that is old in design, &c. All that can be expected is that some of the points are to be new. This therefore will be found to be an aggregation of late improvements with some new excrescences added. Let us begin with the foot (a most important part.) All microscope feet may be classified under four heads:—1st. The simple tripod, illustrated by the Powell form. 2nd. The plate and uprights. A flat plate with pillar or pillars, as in the Beck model, and a plate with flat uprights in the Andw. Ross. 3rd. The bent claw, a very common and bad form, used by many makers. 4th. The heavy horseshoe, the usual Continental model. The plate and uprights is a good form, but was not adopted because it is too heavy and expensive. The bent claw is a bad form. It is surprising that it has not disappeared long ago. It is heavy, easily capsized, and while seemingly a tripod, often rocks on four points. The heavy horseshoe which, until lately, was always fitted to students' microscopes, has nothing to recommend it. A designer must indeed be hard up for resources who can only obtain steadiness by weight. There can be no question but that the tripod in its simplest form is the best. Of all the ways of utilising it, that adopted by Messrs. Powell and Lealand is the most efficient—viz., of hanging the microscope in a horseshoe, supported by three legs; but that for this class of instrument was quite out of the question, for cost immediately puts it outside the category of students' microscopes. There is a great difference between the steadiness of a microscope perched up on the top of its trunnions, and one that is hung in a tripod. This microscope is placed in a kind of stirrup hanging from the trunnions, a most ingenious device of Mr. Curties. The body is large enough to take Zeiss full-sized eyepiece—viz., 1⅜in., and is 10in. long when the draw-tube is pulled out to a mark. When the draw-tube is pushed home the length is 6·3in., or Continental gauge. It, therefore, will suit both kinds of apochromatics. The optic axis of the instrument, when in a horizontal position, is 8½in. from the table. It has rackwork, coarse adjustment, and Campbell's fine adjustment. It is to this fine adjustment that the instrument owes its origin. The moment Mr. Campbell explained to me the principle of his fine adjustment, I foresaw the construction of an efficient student's microscope. The direct-acting screw is only suitable for low powers and small apertures. I will put it even stronger: delicate work with high powers and wide apertures is not possible with any microscope having a direct-acting screw fine adjustment. The stage is of the cut horseshoe form, which I had the honour of bringing before you some little time back. The principal object of it is to enable you to feel your working distance. Let me point out a great improvement in the sliding bar. Its guiding lugs are stowed away underneath the stage; I have no hesitation in saying that next to a perfect mechanical stage this is the best. Most of the mechanical stages are so defective in design, and so scamped in their workmanship, as to be worse than useless. The substage is fitted with a tube, having a spiral slot for focussing, which I will pass over, having described it here on a former occasion. There is a novel feature about the stops for dark ground illumination—viz., there is a three-legged carrier which holds them all. This carrier has a pin in the centre of it on which the various sized discs fit. The stops, diaphragms, &c., have a separate tube-fitting for them, so that it is unnecessary to move your condenser when changing either a stop or a diaphragm. This substage will carry either of Prof. Abbé's condensers, or a cheap condenser made especially for this microscope. The weight of the microscope is 7lb. complete. **Edward M. Nelson.**

* Read before the Quekett Microscopical Club, Jan. 28th, 1887.

Nickel Crucibles.—Pure nickel is one of the toughest of metals, it fuses only at very high temperatures, and has a fine grain susceptible of of high polish. These qualities have led to its being used for chemical crucibles and evaporating dishes. For many purposes they are quite as serviceable as platinum ones; and cost only one-tenth the price of platinum. They stand alkalis well, Mr. Wanklyn having found that there was no alteration of weight in the crucible after caustic potash was fused in it. Hydrochloric acid, dilute or concentrated, may be used in the cold to clean them, so also cold vitriol, but concentrated nitric acid attacks them. They can be used for taking water residues.

Locomotive Crank-Axles.—The failure of crank-axles is one of the most important questions that requires the attention of locomotive engineers, and some particulars of breakages on the Northern Railway of France, which are quoted in the current volume of the *Proceedings* of the Institution of Civil Engineers, will be read with interest. The details are taken from the *Annales des Mines*, vol. ix. page 335. The period embraced extends over the five years between 1881 and 1885, during which time there were 58 cases of breakages; one in the bearings, five through the webs, and fifty-two through crank-pins. During the same period 100 axles were condemned. These figures show the crank-pin to be in general the weak spot, and this is of course in accordance with ordinary experience. It is suggested that by drilling an axial hole 2⅜in. in diameter through each crank-pin it would be weakened to a very slight extent, while the insertion of a bolt would add enormously to its safety. Such a bolt would be subject only to sheering strain, and its full area would therefore be efficient. This plan would necessitate no extra room, which is an important point, for though the crank-pins might be increased in diameter the practice would be inconvenient on account of the additional size of big ends that would be required, and the consequent raising of the boiler. It is said that the cost of drilling and bolting two crank-pins would be £1 12s. The cost of shrinking four hoops on to the crank webs to strengthen those parts is set down at £5.—*Engineering.*

SCIENTIFIC NEWS.

THREE new comets were discovered in the last half of January. The great comet announced by telegram from Melbourne was, it appears, discovered by Dr. J. M. Thome, of Cordoba, on January 18th, and was duly circulated by Prof. Krueger from Kiel. According to the Dun Echt Circular, No. 133, Prof. Krueger subsequently telegraphed that the head of the great comet had been observed at Melbourne on Jan. 23, Melbourne M.T. 8h., in R.A. 21h. 20m. 28s.; S. Dec. 44° 17′; daily motion plus 10m. 24s.; 51′ south. In physical appearance it resembles the great Southern comet of 1880, and is expected to become very brilliant. A telegram from Melbourne dated Jan. 31 says that the comet has ceased to be visible there. Dun Echt Circular, No. 132, announces the discovery of a faint comet by Mr. W. R. Brooks, of the Red House Observatory, Phelps, New York, on Jan. 22, at 6h. 54m. local time. It was observed at Strasburg on Jan. 25, the position at 8 p.m. (local time presumably), being R.A. 18h. 29m. 15s.; N. Dec. 74° 19′. It was faint, and moving slowly in an easterly direction. The third comet was discovered by Mr. E. E. Barnard, of Nashville, Tennessee, on Jan. 24, and the following position is given from an observation at Harvard College, Cambridge M.T., Jan. 24, 17h. 55·7m., R.A. 19h. 10m. 17·4s.; N. Dec. 25° 57′ 45″. Daily motion plus 2m. 36s., 75′ north. This comet is also described as faint.

The *Annuaire de L'Observatoire Royal de Bruxelles* for 1887 contains, besides a variety of information of more or less interest, M. Lancaster's useful general list of observatories and astronomers.

The death is announced of Mr. Hilborne L. Roosevelt, the most famous of the organ builders of America, at the early age of thirty-six. We described the large instrument he built for the cathedral in Garden City, Long Island, in Vol. XXX. p. 525, and Walcker's electro-pneumatic movement in No. 1130.

The deaths are also announced of M. Feil, the well-known maker of optical glass; of Prof. Trasenster, Liège University; of M. Mercadier, professor of physics in the Paris Polytechnic; and of M. Fontannes, the French geologist.

It is proposed to hold the first meeting of the Australasian Association for the Advancement of Science in 1888, the hundredth anniversary of the colonies of Australia and New Zealand. The rules are based on those of the British Association, and the aims and objects of the new society will be much the same as those of the old.

At a recent meeting of the Linnean Society, Prof. Bayley Balfour exhibited specimens and microscope slides of the "gingerbeer plant," and pointed out that although well known to many as an agent in the manufacture of an acid drink from sugar, water, and ginger, very little had been published in connection with its life-history. It has the appearance of a white Nostoc, and is composed of a bacterium (passing through all forms of rods, coils, and filaments) which apparently constitute its greater part, and associated with this is a sprouting fungus. Judging from descriptions and figures by Kern of the "kephir" used in the Caucasus to induce fermentation in milk, the gingerbeer plant closely resembles that, though there are many points of difference. It is said that its introduction into Britain was by soldiers from the Crimea. Prof. Balfour will be glad to have specimens of the plant from different localities, and any notes which serve to throw light on its life-history.

A new food for cattle has been patented in Germany, which shows to what lengths food reform may ultimately extend. It is stated to consist of wood sawdust mixed with certain chemicals and "other matter," the composition forming a "very nourishing and wholesome" food for pigs, cattle, and horses.

A consignment consisting of one million and a half of whitefish ova (*Coregonus albus*) was received by the National Fish Culture Association the other day from the American Government, and laid down in the hatchery at Delaford Park. The United States Fish Commissioners

desire especially the introduction of this valuable Transatlantic food fish to the waters of the United Kingdom, especially Scotland, whose lakes are best adapted to its natural necessities. The aquarium erected by the executive of the Fisheries Exhibition at South Kensington was sold at auction for about £100. It was hoped that it would be maintained as part of the Buckland Museum, especially as it was the only one in London worthy of note.

In his inaugural address as president of the Manchester Association of Engineers, Alderman W. H. Bailey spoke of the chief mechanical inventors of Lancashire, and gave an interesting epitome of what they had done. At the time of delivering the address Sir Joseph Whitworth was still alive; but Alderman Bailey said he intended to treat upon Whitworth's contribution to the utility of mechanical tools and to workshop law at another time.

An improved method of producing sodium has been devised and carried out in practice by Mr. Castner, of Belvedere-road, Lambeth, and a full account will be given in a paper to be read before the Society of Chemical Industry on March 7. A compound is prepared by coking iron and pitch together, and that is used as the reducing agent in large steel crucibles. It is stated that from a quantity of caustic soda, which will cost fourpence, a pound of sodium can be obtained at an expense of a shilling when the process is worked on the large scale.

Cheap sodium means cheaper aluminium, but we shall probably obtain that from the Cowles' electric process, as we learn that works are to be erected in this country shortly, and Messrs. Crompton have already been instructed to build a dynamo fifty per cent. larger than the "Colossus" made by the Brush Co., and now running at Lockport, New York. Two other dynamos, each of which is to have a minimum working capacity of more than half a million watts are being contracted for. They will each require over 800H.P., and altogether the plant will involve the erection of engines capable of yielding 3,000H.P.

At a recent meeting of the Physical Society, Mr. C. V. Boys directed attention to some excellent photographs of the solar spectrum just received from Johns Hopkins University. They had been obtained with the assistance of Prof. Rowland's gratings.

It is stated that Messrs. Siemens and Halske, of Berlin, have introduced a compact and portable apparatus, consisting of a "metre bridge," in which the wire is bent into a circle and the galvanometer is replaced by a telephone.

Mr. Magnus Maclean, M.A., the official assistant to the professor of natural philosophy in Glasgow university, has issued (James Maclehose and Sons) "Examples of Exercises," given in the class from 1865-1885, with "indications how to answer them." The little book will be welcomed by all students, more especially by those who are unable to appeal to a teacher for assistance in thinking out a problem. It will be understood that answers are not supplied to all the questions; but "indications" are afforded which will help the really earnest student to do his work well.

It is stated that the specimens of clay from the Royal Society's borings in the Nile delta have not at present yielded any but "derived" fossils; but beds of gravel found at a depth of 120ft. show that the whole surface was formerly 120ft. higher, and was that of an ordinary river valley.

In a memoir on various phenomena presented by the artesian wells recently sunk in Algeria, laid before the Paris Academy of Sciences, M. de Lesseps described the results of some remarkably successful operations carried out in 1885 and last year in the Shotts, where one well, yielding as much as 8,000 litres (1,760 gallons) per minute of pure water, at a temperature of 77° Fahr., had already produced a lake over 32ft. deep, by means of which about 1,800 acres of waste land had been reclaimed. Similar results have been obtained in other parts of Algeria.

The Royal Microscopical Society will hold their anniversary meeting on Wednesday next, February 9th, 8 p.m., at their rooms in King's College, Strand, when an address will be given by the president, Rev. Dr. Dallinger, F.R.S., the subject being "Recent Optical Improvements in the Microscope, and Investigations on the Operation of the Darwinian Law amongst the Minutest Organisms." The address will be fully illustrated by the oxyhydrogen lantern.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of he* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE COMPANION OF RIGEL—ERRATA.

[26784.]—IN 1871 Mr. Burnham discovered the duplicity of H's *comes* to Rigel with his 6in. refractor, the elongation noted being estimated to be in about the direction of 180°. He remarks: "The star was examined subsequently many times with the same aperture, and although there was always a peculiar appearance about the vertical diameter, I could not satisfy myself that it was really double." While examining this star on March 15, 1875, with my 6½in. Calver (being at the time unaware of Mr. Burnham's discovery) I noticed a distinct elongation in the disc of the companion, the direction of the elongation being in 170°—180°, as estimated from a diagram made at the time. Mr. Burnham examined it carefully in 1877 with the 18½in. refractor at Chicago, and was able to measure it on three nights with that instrument in the early part of 1878. The highest power, 925, only gave a small elongation; but that, Mr. Burnham observes, appeared to be well defined and certain. The results of the measures were:

160·3° : : 1878·09 (1 night).
179 0° : [0·35″] : 1878·16 (2 nights).

The central distance was certainly less than 0·2″. From 4 nights' measures with the 6in. refractor at Mt. Hamilton in the autumn of the following year he found,

125·9° : : 1879·68 (4 nights),

noting that "the measures given do not agree with the prior observations, but the slight elongation seemed to be real, and I cannot think there is any mistake." Mr. H. C. Russell appears to have measured the object with the Sydney refractor of 11·3in. aperture; but the observed angles differ very materially from Mr. Burnham's, as Mr. Russell found—

45° ± : 0·25″ ± : 1878·79 (1 night).
64° ± : : 1878·80 (1 night).

He states that when best seen the stars were clearly divided, powers magnifying 600 and 800 times being employed. Professor O. Stone succeeded in obtaining one set of measures in 1879, on a night of magnificent definition, the star appearing "pear-shaped" with a power of 920 on the 11in. refractor. Prof. Stone's results are—

158·7° : [0·42″] : 1879·76 (1 night).

Mr. Burnham examined the star many times in the years 1880, 1881, and 1882 with the Chicago refractor; but could come to no definite result as to its elongation. M. Henry informs me that he has never been able to see the stars divided with the 15in. at Paris; but that the distance is certainly below 0·3″, the mean of three nights' measures in 1884 giving for the position angle—

178·0° : : 1884·14 (3 nights).

In view of the remarkable discrepancies in the observed position angles quoted above, it is desirable that this very interesting object should be examined carefully with such telescopes as the Nice, Washington, and McCormick refractors. M. Henry also informs me that he has succeeded in obtaining photographs of the satellite of Sirius with an exposure of 4 seconds.

In letter 26654, page 410, the R.A. of β 163 should be 21h. 13m. 7·3s., and not 20h. 13m. 7·3s. as printed. In letter 26758, page 476, for "magnitude in the test," read "magnitude in the text."

H. Sadler.

66 CETI (Σ 231) AND Σ 274.

[26785.]—IN my inquiry about the magnitudes of 66 Ceti (letter 26718, p. 451) I find I have made an inexcusable error, and while I offer my best thanks to Mr. Sadler for his kind reply and valuable information concerning it, I must beg him to accept my sincere apologies for the trouble I have unwittingly given him.

The error arose from my mistaking Σ 274 for 66 Ceti (Σ 231). In looking for the latter I inadvertently set the finder on δ Ceti to guide me to it, instead of setting it on Mira. 66 Ceti is 1½° W. of Mira, and Σ 274 is a trifle more on the W. of δ.

The position-angles and distances of these two pairs are not very dissimilar, though a glance will show the disparity in their magnitudes.

While looking at Σ 274, and thinking all the while I had 66 Ceti in view, I was not unnaturally surprised at what I took to be the discordance of magnitudes with those given in "Celestial Objects" and the "Star Guide," and I thought it might be worth a query. Again I express my regret for the mistake.

The particulars given of 66 Ceti in the "Star Guide," page 4, so far as recent observation enables me to judge, seem the refinement of accuracy.

Jan. 28. **H. Dowsett.**

OCCULTATION OF ALDEBARAN.

[26786.]—I HAVE computed the occultation of Aldebaran on January 6 last for latitude 54° 44′ 23″ N. long., 1° 48′ 43″ W., by the partially graphic process of the late Mr. Pearson, and make it 12h. 10m. 38sec. local time for disappearance, and 12h. 57m. 8sec. for reappearance. This is pretty near Mr. Slade's observed time, and although not assumed to be an exact and strictly accurate calculation, yet near enough, as the late Mr. Pearson intended, for a good approximation in aid of actual observation. I make the angles the same as Mr. Slade. **John Bone.**

St. Thomas' Vicarage, Lancaster, Jan. 26.

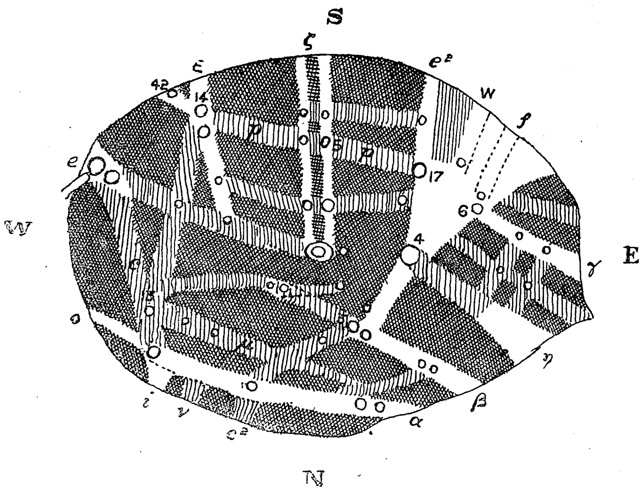
THE MARKINGS ON THE FLOOR OF PLATO.

[26787.]—PROBABLY no portion of the moon's surface has received more assiduous and searching scrutiny than the floor of the walled-plain Plato, a surface roughly circular of about 60 miles in diameter, though from its position it appears to us in the form of an ellipse, and it might, therefore, be thought that the discovery of additional features upon it would be infrequent and confined chiefly to instruments of greater size and power than those which had hitherto been employed upon the object. However, in the course of three nights in the present month with a 6½in. Calver reflector I have succeeded in detecting at least 23 *new* objects—namely, 11 light spots and 12 light streaks—and this notwithstanding that it was rather early in the luni-solar day for securing the best results, and that the weather never remained fine sufficiently long to make an exhaustive examination of the whole of the floor. In addition to the new features, several objects which have been unobserved for years were seen again.

The inclosed drawing of Plato was made on January 8th last between 12h. 30m. and 14h. 0m., with a power of about 170 on the 6½in. Calver. It shows 43 spots and about 32 light streaks. Some parts of the floor, however, received little attention, and this was especially the case with the western quarter. Several of the new features give promise of being rather interesting objects. Thus on the southern portion of the floor will be noticed a plain streak running east and west between spots No. 14 and 17. In the British Association Report, 1872, p. 243, Birt remarked of this streak:—"The observations had proceeded with great care during a period of more than twelve months, when a new streak made its appearance between spots Nos. 5 and 14. Some months afterwards a continuation of this streak eastward of No. 5 was observed, and very lately it has been seen between Nos. 14 and 22." Now immediately south of, and nearly parallel to, this streak, p, between streaks ζ and e^2 a fresh streak will be seen, which on the night in question proved an easy object. It would be interesting if, in a similar manner to p itself, this new streak should afterwards be found between ζ and ε. There is not the slightest trace of any continuation in that direction at present.

Just above the large, bright, central crater will be found two spots lying close together. The easternmost is No. 9, an old and bright spot. The westernmost is a new and by no means difficult object. As it has now been seen on three separate nights, and there is, therefore, no doubt as to its existence and situation, it has been numbered 59.

Between the bright streaks γ and η in the north-east corner, instead of the single streak, b^2, connecting them there are now *two* streaks; whilst also between the two former streaks, and running parallel thereto, is a new streak, which is a plain and easy object.



A continuation of the bright streak β in a westerly direction extends to two spots close together a little N.W. of the central crater. The easternmost of these two spots is No. 0, the westernmost is new. The streak forming the continuation of β has likewise not been seen before. It forms the connecting link between the streak λ (not shown in the drawing) and β. On Jan. 15th, 1870, Mr. Gledhill with the 9½in. refractor of the Bermerside Observatory saw this streak λ, but was unable to see β and λ in the form of one continuous streak.

South of a, o on the north-western portion of the floor the streak μ was a conspicuous object, and could be seen much further east than it has been before, tapering gradually away. On it are at least two spots. The bright streak ζ, south of the central crater, has hitherto only been described as single. It is really, however, composed of two narrow, pretty bright streaks running parallel to each other. As before stated, the western part of the floor was not closely examined, owing to want of time. The interesting streak g^2 extending from spot 13 to 14 was, however, seen to consist of two narrow, parallel streaks close together, somewhat resembling ζ. **A. Stanley Williams.**

"F.R.A.S." AND THE DISCOVERER OF THE ORION PLANETOIDS.

[26788.]—WE all feel sincere compassion for the probably direful fate of our valued correspondent "F.R.A.S." since he has dared to attack Mr. Roberts, of Maghull. The letter of "Another F.R.A.S.," and the prospect of another attack from Mr. R. himself, are so appalling, that it is in fear and trembling that I take up my pen to reply.

Now, Sir, no one will deny that "F.R.A.S." deals hard blows; but they are dealt against either incompetency or humbug, and for my own part I am ready to offer my back at any time should I be guilty of the first—of the latter I trust I never may be guilty.

Now let us see on what grounds Mr. Roberts's knowledge is stigmatised, and justly stigmatised, as imperfect. Mr. Roberts was discovered as a planetoid of the first magnitude in a paper read before the L.A.S. on February 18th, 1884. Although he has never had the courtesy to acknowledge it, his first experiments in photography were made under the guidance of Mr. W. L. Stubbs, who was detached from West Kirby, and taught him the method of developing his plates. Before this time I don't think anybody had ever heard of Mr. Roberts in the astronomical line. At this time he budded in the L.A.S.; two years later he blossomed, to the misfortune of that society, as its president. The results of that session need no comment. The *Journal* speaks for itself. Having been ejected by a majority of votes, he departs to the R.A.S. Mr. Roberts's career, as far as the general public is concerned, dates from 1884 to the present time. He is, therefore, a three-year-old. In such a short time, it is impossible to get any idea of practicable observational work, so that on that ground alone "F. R. A. S." is amply justified in declaring Mr. R.'s knowledge imperfect. But when, in addition to this, a F. R. A. S. makes a learned society and astronomy in England a laughing-stock to the world by discovering a pleasure party of planetoids travelling some 25° from the Ecliptic in the midst of a nebula, I think the word "imperfect" is the very mildest that can be used.

Mr. Roberts' driving clock is perhaps a new one. The one I saw in his observatory caused the tube to jerk perceptibly under a pretty high power.

As regards the actual photographs, it would be interesting to see one of a first-magnitude star, Sirius or Vega. My impression is, they would be found to have as fine a nebula round them as the Pleiades.

In conclusion, I think, Sir, the "E.M." is to be congratulated in having correspondents like "F.R.A.S.," who prevent the public being gulled in the way they otherwise would be; and as to "Another F.R.A.S.," let him persuade Mr. Roberts to obtain the assistance of a competent astronomer for his observatory, and let him do the work while Mr. R. sits smoking his pipe and finding the funds, and by his absence benefiting astronomy in general more than he otherwise ever will do.

A Third F.R.A.S.

FIREBALL — U CYGNI — V CYGNI — COMES TO POLARIS—MARE SERENITATIS — STAR COLOURS AS SEEN WITH DIFFERENT EYES — THE LUNAR RAY SYSTEMS—66 CETI.

[26789.]—ON the evening of the 17th Nov., at 11h. 30m. p.m., I saw an exceedingly fine fireball. It was not well placed for my determining its exact path; but it passed from near θ Ceti, I think, into Lupus—a course extending from about 15°—10° to about 80°—20°. In magnitude it was equal to a first mag. star. Its colour was bluish-white, something like the electric light. It increased in size till it became about one-third of the moon's apparent size. At this point the bluish-white light died out, and was succeeded by a dull glowing red. It did not disappear, but remained visible as a dull red ball. As it passed it varied in brightness, but continued to lose colour. Finally it disappeared, at the same time throwing out a number of dull red sparks.

I am very much obliged to Mr. Tarrant for taking so much trouble *re* U Cygni, more especially for measuring it. I did not expect to find that there would be many measures of it in existence, but I hoped to ascertain whether it was known to exhibit c.p.m., and I am obliged to Mr. Tarrant for the information he has given on this point. There seems to be something specially interesting about the colour of the blue star. I was reminded of this while observing the star on the 22nd Dec., when this was my entry: "A, the richest ruby; equal B; blue of B not very plain, at moments star appeared almost reddish." This brought to mind that Birmingham twice speaks of the blue star as appearing reddish. Under date 1875, Nov. 21, he says, "the blue seems turning reddish," and in the observation immediately following — "1876, Jan. 21 . . . (the blue turned reddish; 8·4)." He says nothing about the blue star in the next observation; but in the next again, April 24, same year, says, "The blue has regained its former colour." Now we learn from what Mr. Tarrant says (p. 368) that Dr. Copeland on one occasion found the star "white," but "blue" just nine days afterwards. Then, again, while we have Mr. Tarrant saying that the "colours were noted in brilliant contrast," and that "with a low power the pair is unquestionably a very fine one of its class" (p. 322); we find, on the other hand, Mr. Espin declaring that he has "never seen the blue colour." With the larger aperture he invariably found "the star" to be yellowish." It would be interesting to know on how many occasions Mr. Espin has observed this star with this result. It is to be noted that Mr. Tarrant's aperture is over 10in., much larger than the 3in. mentioned by Mr. Espin, in which the star had only "a bluish look." It is of importance to try to ascertain the cause of discrepancies such as these, because there is, I think, special reason to suspect variability of tint in this star, and also in a number of other blue stars.

In reference to what Mr. Ward says in letter 26570 (p. 322) about my not seeing V Cygni, I may say that I think it was due to my not being perfectly familiar, from previous observations, with the place of the star. I have not been able to get any recent observations, so cannot report anything further as yet.

In connection with M. Lihou's paper in the L.A.S. *Journal* for Dec. last, it may be of interest to quote from Mr. Honeyburne's paper in the *Journal* for April, 1883:—"Webb calls the companion to the Pole star 9·5, and that to Aldebaran of the 12th magnitude; but the latter is about as easy to me as the former—indeed, there have been nights when I could see Aldebaran's *comes* easily and steadily, and could only glimpse the Pole star's little twinkler." Struve's magnitudes for the *comites* to Polaris and a Tauri are respectively 9 and 11·2, and the "Star Guide's" magnitudes 8·4 and 10·3. But, of course, if the *comes* to Polaris be really variable, it is strange that the fact has not been definitely ascertained before this, seeing that the star is so often examined, and so frequently employed as a test, though, as to this latter matter, variability might explain some of the discrepancies in recorded performances of telescopes. But the circumstance noted in "Celestial Objects," that Dawes proposed it as a general standard, must throw very considerable doubt upon the hypothesis of variability.

Mare Serenitatis.—On the 17th November the Mare was favourably situated, and I examined the inlet from the east. I saw nothing, however, of any dark band such as was mentioned once by Mr. Bone in a letter in "Ours," as passing from Autolycus.

I see that the question of the respective powers of the different eyes in the matter of colour-perception has been brought up at the R.A.S. I have repeated the experiment at intervals, under different conditions, and have never found any difference in the tint of the star arising from the fact that it was being viewed with a different eye. There is sometimes a difference in apparent brightness, but never of tint. The difference in apparent brightness has its origin in the circumstance that, owing to the differing *foci* of my eyes, I observe, as a rule, with the left, and, therefore, when the right is employed it, being less used, is more susceptible to impression. This point is to be noted, for I think it is pretty certain that differences in brightness are sometimes mistaken for differences in hue. The point demands investigation, however: To what extent a difference in colour-perception between the eyes has entered or does enter as a source of error into the records of star-colour observations?

I am much obliged to Mr. Stanley Williams for his letter on p. 431. It is certainly strange that the study of these remarkable features of the lunar surface should have been so generally neglected. I hope that Mr. Williams will see his way to furnish some notes from his own observations, and would be glad if he would add any additional names he may know of to the list of systems which I gave. I think that Mr. Williams has overlooked Mr. Dennet's map of the system of Proclus, which was given in the "E. M." This is, as I have found, an exceedingly accurate map, and it is much to be desired that there were more like it. As to the classification of the rays, I do not so much mean to recommend the classification of *systems* as of *rays*. From my own experience, I conclude that the division into "Tychonic," "Copernican," and "Messier" rays is sufficiently precise to admit of being at least provisionally employed in the description of the rays. I intend to pursue the matter of the rays which I think I have seen coming round from the dark side, with a view of obtaining more definite information; but meanwhile may say that I think that some will be found near the limb of the north-western quadrant.

Mr. Dowsett inquires about 66 Ceti. I have only one observation of this pair, made with 45 upon the 3¼in., on Sept. 19, 1885. A was found to be fine yellow, and B blue. There was not quite one magnitude of difference between the components. This difference, of course, is considerably less than either given in Webb. The star is a suspected variable one, being 58 in Mr. Gore's Catalogue of Sus. Var. Stars. The supposed range of var. is 6—7, on the authority of Taylor. In the notes it is remarked that Dr. Gould finds no evidence in support of var. It is not in *Uran. Nov.*; but is 6—7 in Heis; 5·8, Gould; 7, Harding; 5·64, H.P. It appears, however, from what is stated in the notes, that, while on one occasion Mr. Franks found 66 equal to 63, on another Mr. Gore found the former a half mag. above the latter.

S. Maitland Baird Gemmill.

HORIZONTAL WINDMILLS.

[26790.]—'TIS an old saying that each generation is wiser than the last, and it seems a great pity, for "Medhurst's" sake, that "A., Liverpool," was not present at the trial of the vertical and horizontal mills as related by me, for he doubtless would have pointed out our mistakes in the matter.

His noting my silence on the weight and cost of

the metallic parts is also strange, as I give the cost of the mills I used in ploughing as £5, and in the mill I recommended I put the cost of the metallic parts at about £5, and the labour at £10—only, of course, as a rough estimate; but he appears to have overlooked all this.

I would point out to "L. W. D." that a mill protected from the wind on one side has been tried many times, and always failed.

Each sail of the mill I patented is acted on like the sail of a boat, at one part of a revolution beating up to windward, and on the opposite side going large down the wind. In the other two portions of its revolution, having the wind on the beam, and on the opposite side going large—I think the sailors call it. At all events, a single sail will drive the mill, showing that it gives off power in almost the whole of its revolution, as in the only place where it is head to wind the momentum of the mill carries it over that point, and it immediately gets the wind in a favourable position to drive the mill.

I acknowledge my mistake as to the pressure of the wind at 7 miles per hour; it was given from recollection. I give below Ferguson's table, which may be useful to many readers.

I'll begin at 5 miles as a gentle pleasant wind, giving a pressure of ·112 of a pound.

10 miles	Pleasant brisk gale	·492lb.
15 "		1·107lb.
20 "	Very brisk	1·908lb.
25 "		3·075lb.
30 "	High wind	4·429lb.
35 "		6·027lb.
40 "	Very high	7·872lb.
45 "		9·963lb.
50 "	....	12·300lb.

As this is a storm, I fancy this is far enough in the table. **Philip Vallance.**

CONCERNING THE LUMINIFEROUS ETHER.

[26791.]—IN letter 26675, page 414, "Sigma" suggests that there may be nothing in space, excepting matter in an ultra-gaseous condition—that is to say, gas at an excessively low pressure. We know, however, that the velocity of transmission of wave motion in a gas is altogether independent of the pressure, because any change of pressure alters the density and elasticity of a gas in the same ratio, and hence does not change the expression—

$$\sqrt{\frac{E}{D}}$$

Therefore, ultra-gaseous matter could not transmit wave-motion at the rate of 186,000 miles per second. This, however, is known to be the velocity of light, and we are perfectly justified in asserting that it cannot be transmitted by ultra-gaseous matter. My friend says that we know there is something which transmits light, and that is an end of our *knowledge*. In my opinion we know a good deal more; we know the rate of transmission, and from this we can deduce conclusions as to the nature of the substance. "Sigma" does not reply to my argument derived from the prediction of conical refraction and the verification thereof; it is, at least, curious if an utterly erroneous theory led to so accurate a conclusion. Again, the ratio between the electro-static and electro-magnetic units is of the dimensions of velocity, and this ratio, as determined in very different ways by various scientists, is the known velocity of light; and this brings me to remark that "A. X.," letter 26720, page 451, seems to be unaware of the theory developed by Clerk-Maxwell to the effect that electricity is itself a movement in the ether. Certain mathematical deductions have been made from this theory, and are found to be in accordance with fact. Coming now to the letter from Mr. A. Treyer Evans (same page), I really cannot see that quotations from old Hebrew writings have the slightest bearing on any question in science, and, further, I decidedly object to human beings being called "worms." It is sincerely to be hoped that "Abergwili" (letter 26720) will, in the interests of common sense, keep his ideas as to the disappearance of carbon dioxide viâ the luminiferous ether, to himself.

Wm. John Grey, F.C.S.,
Newcastle-on-Tyne. Analytical Chemist.

BURNT AIR.

[26792.]—WITH reference to the subject of "burnt air" (which expression, by the way, is a solecism), touched on last week by Mr. W. Archdeacon in your columns, the evil does partly arise from the decomposition by burning of the dust floating in the air; but the atmosphere contains, in addition to a mechanical mixture of oxygen and nitrogen and a small percentage of carbonic acid gas, a varying quantity of moisture; and hereby hangs a tale.

This moisture, when brought in contact with iron or any metallic surfaces heated much over the boiling point of water, is decomposed into its constituent elements, oxygen and hydrogen; the oxygen forming an oxide with the metal and the hydrogen remaining free. Now, the effects of breathing hydrogen gas are exceedingly injurious, for it produces, amongst other symptoms, difficulty of breathing, followed by abundant perspiration, tremor of the body, heat, nausea, and violent headache; the vision becomes indistinct and the hearing confused.

Another injurious effect produced by the highly heated surfaces arises from the greatly increased capacity for moisture which it produces on the air, which capacity increases with the temperature; but when air is artificially heated without being in contact with water, it is prevented from acquiring this additional quantity of vapour, and it then feels harsh and arid, and is exceedingly injurious to the animal economy. When received into the lungs it causes excessive pulmonary discharge. In addition to this the air rapidly absorbs the moisture from the skin, and this, by its refrigerating effects, contracts the blood vessels at the surface, and leads to other complications. These are only a few of its many physiological ill-effects.

In slow-combustion coke stoves carbonic oxide gas often escapes into the room, because the draught is not rapid enough to carry it off through the flue. **J. Q. D.**

[26793.]—IN connection with Wm. Archdeacon's letter (26772, No. 1,140), allow me to say he has made a slight mistake. CO, carbonic oxide, is extremely rare in air and very poisonous. CO_2 (carbon dioxide, or carbonic acid) is common (4 per cent. is, however, about the maximum) and is not poisonous, except that it will not support life. **Londiniensis.**

[26794.]—IN Mr. Archdeacon's letter (26772) he is mistaken in his formulæ, as he calls carbonic anhydride CO, and carbonic oxide CO_2, the reverse being, of course, the correct formulæ. In this way he has got into a muddle in his statement that the "air consists of a mechanical mixture of nitrogen, oxygen, and carbonic acid"; so it does, but not of a mixture of N, O, and CO, or we might be blown up alive! CO_2 (carbonic anhydride) happens to be rather a stable gas, so that it would not decompose as he suggests unless heated to 1,200°—1,300°, when it is partially decomposed into oxygen and carbon monoxide. Under these circumstances, I am afraid he must have recourse to the burnt-dust hypothesis, unless some deteriorating effect is produced by the heated iron.

Magd. Coll., Oxon. **R. A. R. Bennett.**

THE ACHROMATISM OF LENSES.

[26795.]—IN letter 26759 your valued correspondent, "O. V.," gives as the common approximate formula for achromatising two separate lenses as $\delta = \frac{(F - s)^2}{f F}$, where s is the distance between them. Would he kindly refer us to some authority where this is to be found?—for I think that it will be seen that a much more correct one will be $\delta = \frac{s - F}{f - s}$, δ being the ratio of the dispersive powers. This latter expression is found as follows: The usual formula for s is, approximately,

$$s = \frac{w_1 F + w_2 f}{w_1 + w_2}.$$

Divide numer. and denom. by w, and put $\frac{w_2}{w_1} = \delta$ and it becomes $s = \frac{F + \delta}{1 + \delta}$, which gives $\delta = \frac{s - F}{f_1 - s}$.

As a test of the correctness of the formula which we are objecting to, let us suppose the glasses to have the same dispersive power, so that $\delta = 1$, and the formula will give $s = F \mp \sqrt{Ff}$, whereas its true value is $\frac{F + f}{2}$.

With regard to the novel form of object-glass mentioned by "F. R. A. S.," I am quite as unable as "O. V." is to find any imaginary combination of any two lenses forming an eyepiece, with a small one in front, that will produce anything at all like a good correction; but for all that, such there may be, for if the new glass transmits four times the quantity of light that the usual sorts do, it is plainly a *miraculous* glass, and if we can believe one miracle of it, it is not difficult to believe that it may perform two. **W. G. P.**

A VERY NOVEL FORM OF OBJECT-GLASS.

[26796.]—I REGRET very much not having seen the letter of "F.R.A.S." (26685) for some days after it appeared, or I would have written sooner. It is proposed to correct the aberrations of a single crown glass o.g. by means of a small lens placed in front of the eyepiece, which seems to be virtually the same thing as using an e.p. of three lenses for the correction of the o.g. What we want is, of course, that the final image presented to the eye shall be as free from aberrations as possible. This is usually done by making each of the aberrations—viz., those of the o.g. and of the e.p.—individually as small as possible. But the proposed plan seems to be not to minimise either the one or the other, but to make them such as to destroy each other in the image presented to the eyes.

One would think at first sight that, considering the number of arbitrary qualities we have, this might theoretically be done; but what the practical difficulties may be is not so easy to say, without examining some particular cases. Most persons will suspect that it cannot be done.

Moreover, supposing that a given arrangement of curves and distances, which give an e.p. of, say, ½in. focal length, will correct the aberrations, it is plain that to get an e.p. of ¼in. to do the same we must have a different arrangement, and not a similar one of one half the dimensions of the other.

It seems, too, if I rightly understand, that by the new plan exactly four times the quantity of light reaches the eye compared with what usually does, which seems to be a complete "staggerer."

W. G. Penny.
6, Alexandra Villas, Redhill, Jan. 25.

NOTES ON THE CHURCH ORGAN.—TO MR. G. A. AUDSLEY, F.R.I.B.A.

[26797.]—I THANKFULLY accept your kind invitation to further discussion on the subject of the upper partials. I have no doubt that I have fallen into an error, probably caused by neglecting to allow for the inevitable "wolf"; but I reasoned (if reasoning it can be called) in this way:—I regarded the series of upper partials as describing a sort of tonal hyperbolic curve; well, when you pass from c''' to d''' and then on to e''', this curve appears to be obliterated in favour of a straight line, because the intervals between c''' and d''' and d''' and e''' are the same—viz., a whole tone.

Again, the number of vibrations you quote for e'''—viz., 2,560—I make 2,592, arrived at in this way:—I considered the ratio in number of vibrations for any note, compared to its major fifth above, to be as 2 is to 3; working up this, therefore, from C = 512 will land you at 2,592 for e'''. So, also, regarding from c''' to d''' as one whole tone, and d''' to e''' as a similar whole tone, we get:—

$$\begin{matrix} c''' & & d''' & & d''' & & e''' \\ \text{as } 2{,}048 & : & 2{,}304 & :: & 2{,}304 & : & 2{,}592; \end{matrix}$$

but as it is quite clear you know ten times as much of the whole subject as I do, I should have been quite content to have accepted your very kind statement (reply 61441, p. 464).

I conclude that the ear demands for musical satisfaction that the major third above keynote shall be rather flat, or, in other words, make a less number of vibrations than would appear from my method (no doubt false) of reasoning to be due to it.

I have an organ pipe about a couple of feet long, and little more than ½in. diameter. With this it is easy to blow with the mouth not only the fundamental note, but all the partials up to the ninth, and with a little practice all the bugle calls so familiar to those residing in a military town like this (Plymouth) can be easily imitated; I dare say you have tried this yourself, and I mention it principally for the benefit of other readers, as it is a pretty and interesting experiment.

Devon. **C. R. O.**

NON-FLESH DIET AND HARD WORK.

[26798.] — I WISH everyone would write as sensibly and temperately as our friend "Os," 26764, p. 477, on these subjects; but "faddists" would restore the Inquisition for unbelievers in their theories if they could.

My diet is very similar to that of "Os," and I get through a fair amount of both mental and bodily work thereon; but, notwithstanding, I find people constantly insisting, on the one hand, on the necessity of eating more meat and drinking more wine, and, on the other, of abstaining from both altogether.

I remember once placing one of these latter gentry, with myself, before a mirror, and asking if we should be taken for twins? "Certainly not," replied he, "there is no likeness between us." "Then," said I, "why can't you understand that there may be precisely the same difference internally as externally"? This spiked his gun.

B. Harcourt.

LATHE MATTERS.

[26799.]—MY thanks to "F. A. M." But the designs in Holtzapffel's Vol. IV., though admirable as exercises, belong to a period of taste that is, I

trust, passing away for ever. The general impression left on my mind by them is that they are the work of a clever man anxious to show off his tool and his command of it. Now, I maintain that this is inverting the proper order of all good designing, and that the important problem for the artist is, granted some requirement, to choose the right material and the right methods, and then devise pleasing and suitable forms.

Designs of this character can be found, and it would, I make no doubt, be a help to many artistically and mechanically if those who chanced to find or originate them would put them on record, and, indeed, there have been previous suggestions of the sort in the "E.M." I have already sought inspiration at Tunbridge Wells, and duly admired certain humming-tops, a plain platter, and a pincushion about the size of a crown-piece at the Tunbridge ware factory, but shall keep from picking and stealing nevertheless.

However, for turned-work on a small scale, metal, especially brass and other bronzes, is usually much more satisfactory in the end than other materials, as the objectionable flat appearance which is common on dead surfaces is destroyed by the reflections on the polished metal. At the present time I could lay my fingers on several charming designs; but it will be long before I could give particulars of patterns and core prints with confidence of accuracy sufficient for the use of brother amateurs. For instance, I have within reach a very nice old pattern of candlestick, quite old enough to be public property, and would gladly give an *accurate* drawing of the complete article, and *approximate* drawings of patterns and core prints to anyone who would be at the pains to work them out and correct them for the benefit of the "E.M." I do not for one minute wish to depreciate the inventive skill of "F. A. M." and others; but I think we are backward in applying its benefits to practical purposes. **W. A. S. B.**

LATHE MATTERS.

[26800.]—MY attention has been drawn to "F. A. M.'s" letter, No. 26704, "E. M." of the 14th inst. Probably you will be aware that the geometric lathe was offered for sale on the 17th ult., and we bought it in at £340, not having reached the reserved £350. We should prefer to dispose of the manuscript, drawings, and specimens along with the lathe. Father intended (had he lived) to publish the book on "Geometric Turning," &c., and had a list of 200 (unsolicited) subscribers. We should be very glad to show the lathe to any likely purchaser.

Salford, Jan. 31. **Alf. Hartley.**

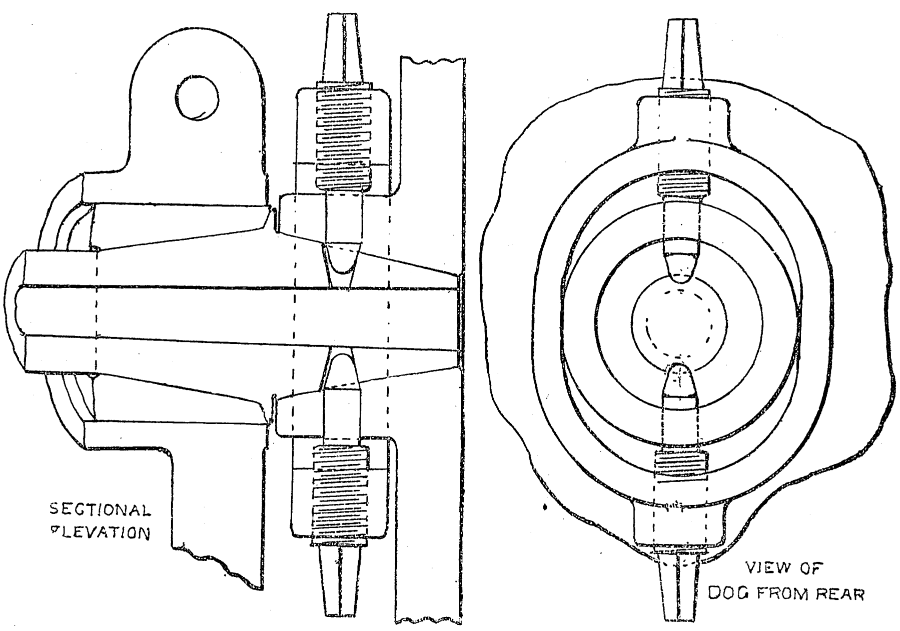
"F. A. M's." LATHE DESIGN.

[26801.]—IN glancing at the drawing of the above (in the number for September 24th, 1886), my attention was drawn to two minor points of interest. One is the oiling arrangement for the sliding bushes. I do not think sufficient provision is made to keep the surface of the mandrel oiled by cutting a groove round the bush and making a hole into the interior. It would be better, I think, to either make a spiral groove round the exterior of the bush, of about ½in. pitch, and with a number of small holes—say, $\frac{1}{16}$in.—leading into the interior, or to cut two or three small grooves round the exterior, drill opposite holes in them to interior, preferably small holes, and to cut a channel in the headstock to lead the oil from the oil-hole into all the grooves. To protect the sliding bush, I am inclined to think a temporary, or removable, boss on inner side of headstock would be better than an extension of casting.

To get the mandrel in and out with a shoulder at front of less diameter than collar, it is not necessary to disturb the pulley and division plate. If the pinion is made to slide up to cone, the removal of the back bush will enable the front one to be shot inwards, and the mandrel, &c., to be taken out sideways. By fixing the cone about 1¼in. back, the front bearing, &c., could be examined at any time without other disturbance of parts than that of the nuts behind. **Vulcan.**

MANDREL NOSE.

[26802.]—THE accompanying drawing is of a coned nose, specially schemed for suitability to 'F. A. M.'s" lathe design. It has many advantages, and the method of attachment is new, I believe. I believe also the arrangement would be found to give much satisfaction in working. For common chucks, two tapped holes in bosses might replace the dog; but the dog is put in to give an even grip at each side of cone, and so settle it truly and with even firmness. The large clear at each screw of dog from boss is to allow easy manipulation; in using, one screw is set to its place when home, and the other screwed out to clear; the dog then allows the screw that is set to be pushed clear, and leave the coned hole free to be put on nose; the chuck or plate can then be put on with both hands, held in place with one while the dog is pulled till the



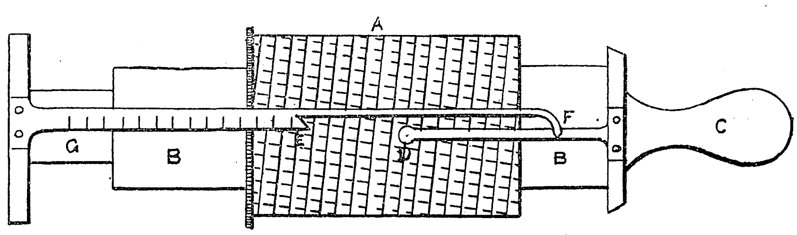
pin that is set enters, when both hands are free. A few turns of the other screw, and a very little nipping with a small, neat key, then sets the plate on the nose. This arrangement would be found very handy, and one dog and pins might be used for several articles. One for each article in frequent use is intended, however. The points in favour of the nose are (1) it is very strong; (2) the overhang is quite moderate, while the bearing is plentiful; (3) there is no movement under pressure on the nose, so a spring temper, or even a soft one, would be very durable; (4) it has, like the key, the advantage of set position and capacity to drive each way securely; (5) it is not unreasonably difficult to make. The taper holes are drilled while the nose is cylindrical, and reamed taper. They are in a belt of slightly reduced size round the cone, so as not to interfere with grinding true. A coarse thread on the set-pins in dog would give wear and quick action; but a thread $\frac{1}{32}$ or so at bottom diam., such as is shown, and that will leave that diameter of plain shank to go through boss, will be found good. For very nice working, both screws would need a little turn with the spanner, as the rotating screw would enter a little more easily than the set one. The dog shown is selected from quite a number of similar devices, as being the one most likely to suit all round. The contact of the dog with the boss is advisable, hence its elongated form, which checks the tendency to twist or wobble; a ring would be easier to make, but would spring more and get across. **Vulcan.**

ELECTRIC LOCKING.—TO J. DIXON.

[26803.]—I AM greatly interested in electric locking; but I must say I agree with J. Dixon (p. 480), for after reading Mr. Spagnoletti's explanation (26727) we are no wiser. "Rover," J. Dixon, and C. E. Stretton all point out that **you** must *first put your lever back before you can lock it*. Well, if that is so there is no safety in the system. If one man does not return his lever you cannot lock it, and all the electric catch lock, &c., is of no avail; it fails to do just what it should do. I join with others in asking Mr. Spagnoletti to give us a clear description of his invention. **Electric.**

PROFESSOR FULLER'S SPIRAL SLIDE RULE.

[26804.]—SOME time ago a correspondent asked for working drawings of this spiral slide rule. As none have yet appeared I send a rough sketch of the instrument, which may be of use to some of "our" ingenious mechanics. It consists of a cylinder A which can be moved up and down and turned round, sliding stiffly on an axis B, which is held by a handle C. On the cylinder A is wound in a spiral a single logarithmic scale. Fixed to the handle is the index D. The other indices, E and F, whose distance apart is the axial length of the complete spiral, are fixed to cylinder G. This cylinder slides in B like a telescope tube, and thus enables the operator to place the indices in any required position. Besides the ordinary operations of multiplication and division, the reciprocals, powers, roots, and logarithms of numbers can be easily and quickly obtained by this admirable instrument, the length of the scale being 500 inches, and the number of divisions 7,250. The method



of using it will be found on page 424 of Vol. XLIII. **Reymond.**

FAST TRAINS.

[26805.]—SIR O. H. P. SCOURFIELD asks (p. 479, 26774) why, if Midland engine 1568, with 18 by 26 cylinders, can run on a nice falling gradient from Luton to St. Alban's at 77 miles an hour, a Great Western engine cannot run a far greater speed on the G.W.Ry. The reply is clear: it depends on tractive force. If 18 by 26 cylinders can do no more work than 18 by 24, what advantage is there in big engines or long strokes? There *is* a difficulty with G.W. No. 10 on sharp curves. It is true she is not so long as the G.N. 7ft. 6in. singles, but then the G.N. engines have radial leading axle-boxes. **Loco.**

[26806.]—IN reply to Sir O. H. P. Scourfield, the distance from Luton to St. Albans is 10 miles 35 chains, and it is *never* run in less than 9¼ minutes, and generally 10 or 11 minutes. **M. R.**

THE results of the new censuses of France and Germany show a marked falling-off in the rate of increase. In the case of France the rate of increase was low enough before; now it threatens to stop altogether, and in many departments there has been a considerable decrease. The addition to the population in five years has only been 213,857, bringing the total up to 37,885,905. This is equal to an annual rate of only 0·1 per cent. per annum. Germany is not quite so bad, but the rate of increase between 1870 and 1880 was abnormally high. The population by the latest returns is 46,844,926, as compared with 45,234,061 five years before; giving an annual rate of increase of 0·71 per cent. per annum in 1880-85, as compared with 1·14 per cent. per annum in the previous five years.

THE amount of cobalt oxide produced in America in 1885 was 8,423lb., valued at 19,373dol. The total value of cobalt in ore, matte, and the above oxide was 65,373dol.

REPLIES TO QUERIES.

** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[60904.]—**Lilium Auratum (U.Q.)**—I do not think it would "injure the bulb" to ripen either one or the whole of the seed-pods left on the flower stem after blooming. In the first case, all the nourishment from the bulb would get concentrated into *one* seed-pod; whereas, in the other it would be distributed among the whole of them. The best plan is to allow only one pod to remain on the flower stem, and let that one be the *lowest* on the flower stem (the one nearest the soil); seed ripened here generally stand the best chance of germinating into good plants, with care. I suppose I hardly need inform "Hortus" that it is a difficult matter to raise lilies from seed? One of the chief requisites is a good stock of patience; the seed seems such an awful time germinating, however good and strong it may be. Again, the soil must not be disturbed for a whole year, at least, *after* the seedlings have appeared. As an instance of time taken in germinating, I might mention *Lilium giganteum*, which does not germinate until the second year of planting, and sometimes the third. The best and quickest method, however, is to take advantage of the fact that all lilies, speaking generally, may be multiplied by *division*. After the leaves have died down, pull the scales from the bulb, every scale, if desired, will make a new plant. Insert each scale, with its base downwards, into a mixture of sand and fine peat, and assist for a time with the greenhouse. Some varieties produce bulblets (little bulbs) on the flower stem; these fall off, take root, and thus increase one's stock. To produce these, pinch out the flower buds as soon as they appear; which will cause the flower stems to form these bulblets in great numbers in the axils of the leaves. I have not possessed, nor seen, any of these varieties myself, but have read of them.—WILHELM HEINRICH KOPE, Birmingham.

[60987.]—**Organ Query.**—In reply to "A. C." and "J.," I beg to say that the fourteen bottom notes of the stop diap. are ranged in a line along the back of the organ, the lowest four pipes being rollered off. The depth of the case, including keyboard is 2ft. 6in.; length of bellows, 3ft. 4½in.; depth, 1ft. 6in.; and the reservoir rises 7½in. when full. There are foot and hand blowers, both detachable when required; there is no octave coupler, but ample room for one. Length of windchest is 3ft. 10in., and depth 1ft. 3in. There is no separate building frame, as the case is quite strong enough to support bellows, windchest, &c., and the sliders are worked from the middle of soundboard, instead of the sides. As will be seen, the pipes are already inclosed on three sides, so that to have a swell the organ needs only to have a board covering the top and the swelling arrangement. I have adopted the gridiron principle, which consists of two wooden gratings, the one movable and the other fixed; these are placed in position immediately behind the front show-pipes, and worked with the left foot. The pallets and pull-downs are at the back of soundboard, instead of the front, and communicate with the keys by means of back-falls, the near end of back fall (through which is a thumb-screw wire for adjustment) resting upon the far end of key. The case is of mahogany, ebonised and gilt, and each piece of the same fits into its neighbour by means of pegs and holes; screws are only used for fixing bellows, keyboard, &c.—T. D.

[61018.]—**Optical Lantern (U.Q.)**—The only function of the condensers is to concentrate the light from the illuminant upon the picture. The lenses project a representation of the picture upon the screen, and so may be of any focus without regard to the condensers. You may have portrait lenses for any of the foci you mention; but will find that single lenses will be very much cheaper and practically quite as useful.—G. J.

[61048.] — **Electric Conductors.** — I am obliged to Mr. Lancaster for his reply to this query; but beg to be allowed to ask a little explanation of his table. (1) Am I to understand the figures under "Size of conductors, B. W. G." to mean 19 wires of 16 gauge, &c.? (2) What is meant by "The current per square in. section of conductors is 1,400 to 1,700?" With these points cleared up, I will try and understand the rest, and be thankful.—ACIER.

[61131.]—**Electric Cautery.**—My contention that the formulæ (p. 395) is useless so far as this query is concerned, must be either right or wrong. At page 481, "A. D. S." says he is perfectly able to use it. Now, if he will demonstrate in "Ours" how by means of this formulæ he could determine the current necessary to heat his cautery, I shall then at once admit my error. As regards my making any attack upon the medical profession, I fail to see it: it was "A. D. S." who deplored his being in the hands of others. And the need for my objection to Mr. Conry's remarks about using Leclanché cells for cautery purposes is again supported by the remarks of "A. D. S.," and if he had taken Mr. C.'s advice and procured Sprague's "Electricity," he would soon have found there would be no economy in using the Leclanché battery, and as regards its being satisfactory for cautery work, I hope we may soon have this settled. "A. D. S." shows us how doctors differ (queries 61400 and 61399). I have explained my slip in the former, but in the latter I don't see where I have erred. It is wonderful how easily we notice the slips of others, and I have no doubt the slip made by Lancaster in the former query was due to his forgetting that the water—viz., 1,500 tons, required 24 hours to fall. $\frac{1500 \text{ tons} \times 2240\text{lb.} \times 40\text{ft.}}{33000} = 4072$, or nearly what "Lancaster" stated; but $4{,}072 \div 1{,}440$ minutes $= 2{\cdot}85$H.P. per minute. This being a simple arithmetical question, "A. D. S." might easily have seen how the mistake arose. Curious the learned doctor did not see a case where doctors differed almost as much, and when a query addressed to himself by another in the profession has never been replied too; I refer to page 372, query 60982. This, of course, was not a simple arithmetical question.—OHM.

[61131.] — **Electric Cautery.** — TO MR. DUNLOP STEWART.—You have slightly misread one part (not very material) of my last reply hereon. I did not say that the same Leclanchés that would heat the bit of wire I particularised would light incandescent lamps for 20 minutes; but that this could be done with Leclanchés. I mentioned the matter merely as a curious result of a chance experiment. "Ohm's" offer to put down a sum of money as a stake, to be forfeited to me if I can perform the above experiment under certain arbitrary conditions laid down by himself, and which, as he very well knows, would render its performance impossible, is so overpoweringly generous that I do not feel myself worthy to take advantage of it. As a matter of fact, the experiment was performed with three batteries of Leclanché cells, coupled partly in series and partly in parallel, and a switchboard, so arranged that when the first battery began to fail the lamp could be switched on to the second, and from the second on to the third, and then back to the first, which had by that time recovered considerably. With this arrangement it was found possible to keep the light up for more than 20 minutes. Such an apparatus might be useful for furnishing a light by the aid of which to go to bed, or dress on a dark morning, or some similar purpose requiring a light for a short period only; but that is all. Its one merit is that it requires no attention or daily recharging. The measurement of the current which you refer to can only be done by the help of an ammeter of some sort. Mr. S. Bottone has kindly offered to allow me to test his 5s. ammeters, which he says will register from 5amp. to $\frac{1}{10}$ of an amp., and I have arranged to meet him at the end of the week for this purpose. I do not suppose Mr. Bottone would claim anything he was not certain of, and if my hopes in this respect are realised, I should certainly suggest your using these, for $\frac{1}{10}$ of an ampère is a close measurement, and you might easily pay, among the electrical apparatus shops, three times that price for an instrument not half as good, as I have done, to my sorrow, before now. —EDWARD CONRY.

[61138.]—**Yacht Steering.**—I have a steering gear that will, I think, just suit "G. H. V." It is simple, strong, and takes very little room. The tiller can be used as usual; but when extra power is required (without making any alteration, but simply raising the hand about 6in.), the power can be increased from four to eight times. As I think of patenting the arrangement, I cannot send drawings yet; but will, if the Editor thinks it of sufficient general interest, in the course of a week or two. If "G. H. V." will advertise his address I will communicate with him.—S. BEECHING (late Bombay Marines).

[61138.]—**Yacht Steering.**—As this query has not been satisfactorily answered by abler correspondents, I will advise "G. H. V." not to try any such "'long-shore" tricks as balancing his rudder, or substituting any machinery whatever for the simple and effective tiller; for so sure as he does it will "sell him a dorg," as the saying is, and "fetch away" the very first popple he gets into. If there is such a drag upon the rudder that a moderately short tiller with the assistance of the tiller ropes will not control it, why there is something radically wrong in the trim of the vessel, be it large or small; and when you consider that this pressure on the rudder means so much drag on the boat, and not only decreases her speed materially, but makes her "steer dead," you will find your wisest course is to put on headsail, or take a cloth or so out of the mainsail, if a cutter; and if a small yawl, knock out the mizen at any price. Failing this, the only practical thing I know of is a wheel, and this is more fit for a large yacht or steamer than small craft, which are often more lively than the wheel itself.—H. S.

[61145.]—**Does it Boil?**—Has "Weald" ever seen a cup of cold water steaming in frosty air? Knowing that visible steam is not vapour, but consists of minute liquid drops, how does he account for their presence on the "solution" hypothesis? Water vapour is lighter than air, CO_2 heavier; therefore, the water vapour will diffuse itself through the air rapidly as it is formed, the CO_2 will do so more rapidly; but I said nothing inconsistent with the fact that while the vapour is being evolved it will more or less replace air in a flask. If "Weald" will read up the subject, try a few experiments, and take a month to digest, and allow for mental inertia, he will be in a better position to test the value of his hypothesis.—W. A. S. B.

[61145.]—**Does it Boil?**—TO "REYMOND."—Vide my own remarks last week. As regards yourself and "W. A. S. B.," and any others who feel challenged by my imputing to the vapour from boiling water a "displacing" action, my feeling is that anyone who has failed to recognise such displacement or repression of atmo., at least as an initial action, howsoever disguised by subsequent or simultaneous diffusion, or by the conversion of the vapour (gaseous H_2O) into visible steam (liquid H_2O), has yet to learn what the quality of boiling is. Hitherto he has merely understood that boiling is a bubbling turmoil provoked by heat, and that the process commences when the water attains a particular temp. varying according to pressure. But why the same water which in the attenuated air of an air-pump receiver will boil when it reaches, say, 20° C., will not boil in natural air till it reaches about 100° C., this is a matter which he can never have sought to penetrate, and hence he lives in ignorance as to internal condition that constitutes boiling. Glad if these my advisers, as reward of kind desire to help me, may reap some useful instruction for themselves. However, the precise reason why water will not boil at standard pressure till it reaches 100° C. is that at any lower temp. its expansive stress (or elastic force, or molecular energy, or &c.), will not enable it to hold its own as vapour against the pressure above —e.g., vapour at 20° C., filling a flask placed under receiver, would collapse into liquid if standard pressure were restored. The hotter the water the greater its expansive stress, and when this is great enough the atmo. yields and "displacing" vapour bursts forth.—WEALD.

[61153.]—**Blowing Fan.**—Dr. Carl Hartman, in his "Berg und Hütteningenieur," gives the following rate for velocity of air through blast nozzles under given w.g. pressures:—

$$C = 125\sqrt{H} \text{ mètre.}$$

In which—

C = velocity in mètres per second.
H = w.g. in mètres.

Thus, the velocity of air through a nozzle under a w.g. of 0·200 mètre (7⅞in.) would be

$$125\sqrt{0{\cdot}200} = 55{\cdot}9 \text{ mètres.}$$
(or $55{\cdot}9 \times 3{\cdot}2809 = 183{\cdot}4$ft.) per second.

The same result would be obtained by substituting the height of a column of air equal to this purpose, and calculating the velocity as per rule for falling bodies. The equivalent air column is 800 times as high as that of the w.g. column, or $0{\cdot}200 \times 800$ = 160 mètres, or 525ft., and—

$$8{\cdot}02\sqrt{525} = 183{\cdot}7\text{ft. per second.}$$

The formula for volume is as per same authority—

$$M = 0{\cdot}85 \times 125 \times a\sqrt{H} \text{ cubic mètres.}$$

Thus, if a = area of tuyere, say, for 38mm. diam. (1½in.), and H as above = 0·200 mètre, and ·85 = coefficient, then—

$$0{\cdot}85 \times 125 \times {\cdot}00113 \times \sqrt{0{\cdot}200} = {\cdot}05364095 \text{ cubic mètres per second.}$$

Or—

$$3{\cdot}2184 \text{ cubic mètres } (3{\cdot}2184 \times 35{\cdot}3 = 113{\cdot}6 \text{ cubic feet) per minute.}$$

A more concise rule (taking coefficient into the formula, and giving result in cubic mètres per minute) is the following:—

$$Mm = 5004d^2\sqrt{H} \text{ cubic mètres.}$$

In which d = diameter of tuyere in mètres, H as before, and Mm volume in cubic mètres per minute. The work in the air at exit is calculated by the formula—

$$E = \frac{1{,}000\ M\ H}{75}$$

i.e., the H.P. (metric H.P. = 542·47 foot-pounds per second) is—

$$\frac{1000 \times {\cdot}05364 \times 0{\cdot}200}{75} = 0{\cdot}143.$$

Ordinary well made blast fans yield a useful effect of about 40 per cent.; therefore, H.P. required as motive power to drive fan for one such tuyere = 0·357. Would some of our friends supply particulars of proportions of fans for given work (volumes, pressures, powers, &c.), or for fires,

cupola melting, and ventilation? There seems as many different proportions as there are makers, and it would be a great satisfaction doubtless to many readers to have some correct standard to compare makers' statements with.—MARIENBERG.

[61154.]—**Lens Measurement (U.Q.)**—A $\frac{5}{8}$in. stop to a lens of 6½in. focus = $\frac{f}{10 \cdot 4}$ as follows: $6\frac{1}{2} \div \frac{5}{8} = \frac{13}{2} \times \frac{8}{5} = \frac{52}{5} = 10 \cdot 4$.—G. J.

[61161.]—**Converging Lenses (U.Q.)**—It is immaterial which sort of lens is used, the object being to direct the beam of light, after crossing at the focus of the lens, upon the mirrors. See "Ganot's Physics."—G. J.

[61167.]—**Water Tanks (U.Q.)**.—Divide the number of gallons a tank is to contain by 6¼ to get the number of cubic feet in the tank. The sizes of parallelopipeds can easily be determined according to choice; thus, say one to contain 1,000 gallons = say. 160c.ft., then tank may be 6ft. by 6ft. by 4ft. 6in. = 162c.ft. — sufficiently near. For a tank the frustum of a cone in shape of the same capacity all depends on the shape of the cone; but assuming a right cone, and that the frustum is half the height of the whole cone, suppose this frustum to be 4ft. 6in. high as in the preceding example, then tank might be 8ft. 8in. diameter at bottom and 4ft. 4in. diameter at top, which would give about 162 cubic feet contents; thus cube contents of whole cone = 8ft. 8in. × 8ft 8in. × ·7854 × $\frac{9}{3}$ =177 nearly, less frustum 4ft. 4in. × 4ft. 4in. × ·7854 × $\frac{\text{4ft. 6in.}}{3}$ = 15 nearly = 162c.ft.—G. J.

[61190.]—**Differential Feed.** — ERRATUM.— Read (12 + 20) : 20 = 32 : 20 instead of what is printed. Remaining portion is correct.— T. C., Bristol.

[61190.]—**Differential Feed.**—This subject is one which few in workshops understand, and "T. C., Bristol," in his last reply, has answered one question incompletely and another only approximately. I have thought out the subject, and come to the following short rules:—1. Multiply the pitch required by the number of threads in the screw. This will very probably be a fraction. For a right-handed screw, 2*a*, substract from this fraction (from 1) unity, and this will give the ratio of driving wheel to driven. For a left-handed screw, 2*b*, subtract the fraction (from 1) from unity, and this gives the ratio of driver to driven as before. It is to be noticed that the ratio obtained may be that of the *product* of the drivers and product of driven wheels—e.g., in the query to cut a pitch 0·148in. with a left-handed screw of four threads per in.—

$$0 \cdot 148 \times 4 = 0 \cdot 592,$$
$$1 - 0 \cdot 592 = 0 \cdot 408;$$

therefore, 408 to 1,000 is the ratio required, or 51 × 2 to 50 × 5, or a 51 wheel driving a 50 corresponding to A driving B (see ENGLISH MECHANIC, No. 1134), and a 20 driving a 50 corresponding to G driving D. This gives the pitch exactly, and for a left-handed screw as asked. With a right-handed screw, and using an even number of idle wheels, 49 driving 25 and 65 driving 50, we obtain 0·1481 pitch, which is a trifle nearer than "T. C.'s" pitch of 0·15626, using 130 and 80. An even number of idle wheels should be used except in special cases where with a left-hand screw the pitch required is greater than the pitch of the screw. When this is the case, Rule 2*b* is modified, and 2*c* add unity to the fraction (from 1), &c. This gives, in the case of three threads, the wheels 120 and 40, using, however, an odd number of idle wheels, without which six threads will be cut, and not three.—R. T. S.

[61202.]—**Fret Saws Breaking.**—I did not see the question till my attention was called to it by Saml. Ray's answer last week, or I would have replied before. You must be careful not to press too hard, especially when cutting straight; as there is more temptation to do so when you see a plain bit of work in front of you. You must be also very careful not to let the work jump. Perhaps you run the machine too fast, a very slow rate is quite fast enough. Try setting your saw looser or tighter, and try some thinner stuff at first, since you say you are a novice. What size saws do you use? Perhaps some alteration in that direction would make a difference, although I always use a fine saw, No. 1, no matter what the work is. I have done fretwork for over six years now; but I always use an ordinary 12in. hand frame. I can work better with it, and, strange to say, faster than I can with a machine. I should not advocate making the saw describe an arc if you want to turn out clean work, as I have always found that it leaves the marks of the saw in the wood more than a straight up and down motion; and, besides, you are either putting an undue amount of pressure on the middle of the saw, or else not using the ends so as to make them do their share of the work. Saws often break from being tempered badly. You often find some good and others no good at all in the same dozen. I believe sometimes they will break from one of the teeth being cut too deep in the making, but am not sure. Have you tried the "Griffith saw"? They are very good for straight, rough work; but I fancy they tear the wood too much for fine work. If you like to give your address, I will send you one or two to try.—HARRY FRIVOLI.

[61248.]—**Electrotyping.**—This query is not sufficiently definite. Is it required to deposit the copper as an adherent to the gelatine, or as a mask to be lifted off, as would be understood by the term electrotyping? The latter can be done by carefully plumbagoing the gelatine mould, and taking care that the surface is brought into metallic contact with the wire from the battery.—A. W.

[61255.]—**Embrocation.**—Mr. Shakespear will do more good by studying diet, than by any embrocation he can rub over his body at the seat of the liver. A good embrocation useful for many purposes is made by taking 1 drachm of oil of mustard, 40 grains of ethereal extract of mezereon, 2 drachms of camphor, 5 drachms of castor-oil, and 32 drachms of rectified spirit, mixing all together. If Mr. Shakespear will take advice, he should consult a medical man, and endeavour to forget that he has a liver.—NUN. DOR.

[61258.]—**Organ Couplers.**—If this querist will refer to No. 953, p. 391, he will find there an illustration of couplers applied to three manuals and pedals, which should give him all the information he wants. See also No. 547, p. 17. The coupling action has been illustrated many times in early volumes; but "W. W.'s" best plan would be to get a sight of one as actually arranged, before starting with the work.—ORGANON.

[61267.]—**Iron Poles.**—"C. F." omits an important part of his question, for though he gives dimensions of the tube poles, he says not a word as to the thickness of the iron in the "T's." However, if the weight of metal is equal, the "circular tube" poles will be stronger than those built up of T-iron bolted back to back.—NUN. DOR.

[61269.]—**Gramme Dynamo.**—I thought these questions had been answered almost to exhaustion. I should think the querist might be referred to back volumes.—J. T.

[61272.] — **Trains on Greenwich Line.** — Assuming the statements made to be facts, what more is to be said than that the line is so worked for sufficient reasons, which an observant traveller will discover at the terminal end?—E. G. P.

[61288.]—**Carmine.** — Thanks, "Cato." The recipe given is an old one, published many years ago in the "Encyclopédie Roret" (Fabricant des Couleurs). But "Cato" has been more fortunate than I. I have carefully repeated the process, and the result is absolute failure—a small quantity of precipitate of the colour and brilliancy of brick-dust, the greater part of the colouring matter remaining dissolved in the supernatant liquor.—P. O. V.

[61332.]—**Speeding Millstones.**—In my reply I took revs. of wheel as 10 per minute; but notice it is given as 5 only, so that in the case I suppose I should use 12 to 1, and then 2 to 1; or 8 to 1 and 3 to 1, according to size of water-wheel. But, as you are obliged to adopt the vertical spindle, and stones arranged around the central spur, this almost decides the case; but do not have the pinions on the spindles less than 20in. diameter, or the toes are apt to heat. This would only necessitate 3 to 1 on first motion—in fact, your present arrangement, under the circumstances, seems to me satisfactory.—T. C., Bristol.

[61349.]—**Spinning Metal.**—This art requires a good deal of practice; but it is rather surprising that it is not taken up by amateurs more than it is, for there is very little in it but practice! There is an illustrated article on the subject in No. 880, p. 513, to which the querist might refer for information.—SAML. RAY.

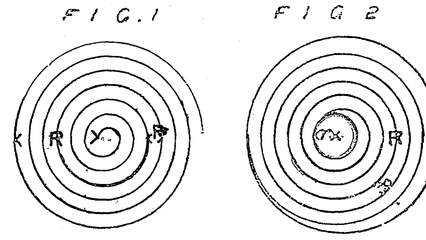
[61351.] — **Dip for Ironwork.** — Brunswick black will be the best to use for this purpose. This will dry in from one to two hours, and may be purchased from most oil and colourmen. He can make a good varnish himself, but will take much longer to dry. Boil a quantity of gas-tar for four or five hours, then add one quart of turpentine to every gallon of tar, and boil again for half an hour, care being taken that it does not boil over. Apply the varnish whilst hot.—G. G.

[61397.]—**Disposal of House Sewage.**—If "A. B." has a few square yards of garden, he will find the cabbage tribe to be greedy of all and every kind of sewage to an extent practically unlimited. A heap of the ashes, cinders, dust, &c., would effectually deodorise all house sewage; and when applied on his garden, the ammonia condensed in the cinders would be available ready to be greedily seized upon by his cabbage and other plant-rootlets. However, if the soil upon which his house is built be porous, then a cesspool would accommodate him. There is one other alternative: Get an empty cask or box, knock out the top and bottom, fix two handles on the sides, fill it (by a little at a time) with crushed coke or coarse cinders, pour on sewage, which will become filtered and deodorised. Renew the coke now and then, and sell it for manure to, say—THE DISPENSER (the Free Dispensary and Botanical Gardens, Lydney).

[61353.]—**Spiral.**—The following formulas will give the length of spiral:—

Let L = the length of a spiral
R r = radius
N = number of coils
P = pitch
π = 3·14

FIG. 1 FIG 2

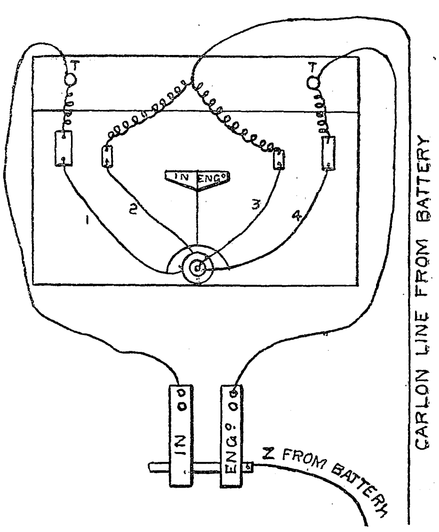


$$\text{Fig. 1} \begin{cases} L = \pi R N = \frac{\pi R^2}{P} \\ N = \frac{L}{\pi R} = \frac{R}{P} \end{cases}$$

$$\text{Fig. 2} \begin{cases} L = \pi N (R + r) \\ L = \frac{\pi}{P} (R^2 - r^2) \end{cases}$$

—JACOB GEORGE.

[61393.]—**Electric Indicator.**—"J. B." must bear in mind the bobbin is divided in two, the top being a little smaller than the bottom, and, of course, finer wire on the smallest part of bobbin. Wires: No. 1 is outer end of bottom part of bobbin;



No. 2 inner end of bobbin; No. 3 outer end of top part of bobbin; No. 4 inner end of bobbin; you will observe the action is by reversion of current through the bobbin; the wires being wound reverse. The sketch explains other connections.—E. SHEARER.

[61400.]—**Electric Light.**—This query seems to me to resolve itself into the following calculation: (Values used, 1H.P. = 33,000ft.-lb.; 1H.P. = 746 watts.) 1,500 tons of water per day of 12 hours; ∴ $\frac{1,500}{720} = 2\frac{1}{12}$ tons of water per minute = 4,666lb., and 4,666 × 40 = 186,640ft.-lb. energy of water fall. Efficiency of turbine wheel, 70 per cent. Therefore, 186,640 × $\frac{7}{10}$ = 130,648ft.-lb. = absolute energy conveyed to dynamo.

$$\frac{130,648}{33,000} = 3 \cdot 9, \text{ say } 3\tfrac{1}{2}\text{H.P.}$$

1H.P. = 746 watts. ∴ 3½H.P. = 2,611 watts.

Less by loss in dynamo, leads, and cables, 30 per cent. .... = 782 watts.

1,829

Efficiency of incandescent lamps is about 3 watts per c.p.; efficiency of arc lamps is about ½ watt per c.p. So that the dynamo would be capable of lighting 30 lamps, each taking 60 watts. But the number will vary inversely as their distance from the mains.—H. B. EDWARDS.

[61405.]—**Liquid Fuel.**—Redtenbecher gives the following equation for estimating the thermal value in heat units of any given fuel:—

$$W = 34500 \left(H - \frac{O}{8} \right) + 7050\ C$$

in which C, the carbon
H, the hydrogen, and } pro 1 kilogramme of the fuel.
O, the oxygen

Thus, taking as an example coal containing 78 per cent. of carbon, 5 per cent. of hydrogen, or 8 per cent of oxygen:—

$$W = 34500 \left(0{\cdot}05\ \frac{0{\cdot}08}{8} \right) + 7050 \cdot 0{\cdot}78 = 6879 \text{ heat}$$

units.—MARIENBERG.

[61432.]—**Voyage to Australia.**—A good supply of ordinary winter and summer clothing is all that is necessary, with topcoat and warm rug. Coldest weather likely to be met with equals moderate winter weather here, and hottest (at sea) little warmer than our hottest summer days—84° at the Line everywhere, and in the Red sea perhaps 90° or so. For hottest weather, a single flannel shirt, with summer jacket that buttons down (say, serge), and no vest is the best arrangement. Have come through the Red Sea 90°—94° in that way with the greatest comfort. Take old clothes for board ship and a decent summer suit for trips ashore, and you are well provided. A suit of flannel pyjamas make the best sleeping suit, and in hot weather is immensely convenient. Tennis shirts, with flannel collars, can always be washed. These should suffice for anything. Never wear cotton next skin. Two moderate sized portmanteaux are abundant accommodation for 12 months. They can both be kept in cabin as a rule, while a trunk has to go below. Avoid all fancy notions—linen suits, white umbrellas, revolvers, and sich. If on a sailing ship, a tin or two of water biscuits by way of private stores keep well and are always sweet. A pocket-flask of good brandy for emergencies is useful, though it may never be wanted.—H. P.

[61438.]—**Measuring Cloth.**—Are you not in error, "Milverton," in taking 12 as the first term of the series? I think it ought to be 12 plus the common difference, as the roller itself equals 12. This may seem a very small matter at first sight, but when wrought out for the different circumferences you tabulate in your reply it comes to be very considerable. By a little algebra we find the common difference to be $\frac{60}{199}$; then, by the common rules of arithmetical progression, we find, when—

C is 24 L = $722\frac{2}{5}$
C 30 L = $1262\frac{7}{10}$
C 36 L = $1922\frac{2}{5}$
C 48 L = 3600

differing, as you will see, by $9\frac{3}{5}$, $7\frac{4}{5}$, $5\frac{3}{5}$ respectively from the results of your working.—WORKMAN.

[61442.]—**Weight of Moist Air.**—Thanks to "Milverton"; but I do not see his reason for putting $V'' = V'$, or, rather, the bearing of this on the interpretation of the formula. The terms used in Watts's formula and mine have definite meanings; if these are the same in both cases, the formulæ cannot both be right. The formulæ differ in multiplying, or not, the wt. c.ft. vap." by $\frac{p - E}{p}$. I take "wt. c.ft. vap." to mean "wt. c.ft. sat. vap. at temp. t, and (necessarily) at the corresponding press. E." What meaning does Watts assign to make his formula right? Perhaps "Milverton" would kindly deal with the following, from Watts's table $p = 30$, $t = 100°$.

wt. c.ft. dry = 479·93gr.
wt. c.ft. sat. vap. = 19·84
wt. c.ft. moist = 486·65

Using E = 1·918 from another table in Watts, I do not get for moist 486·65 with either formula, but nearer to it with mine than with that said to be used in Watts.—L. S. A.

[61456.]—**Caustic Soda Process.**—An account of the torpedo boat *Peacemaker* appears on p. 82, this volume, in which it is distinctly stated that she is driven by steam generated by a caustic-potash boiler on Honigmann's plan, potash being better, I believe, than the soda. The principle of the Honigmann system will be found at p. 598 in No. 962, the No. for Aug. 31, 1883; but it has nothing to do with the query, except the title. The title of this query is misleading, for obviously what "C. L. S." wants to know about is the acetate of soda foot-warmer used on the L. and N.W.R., which was described in No. 785, p. 107, as having been tried on the Paris-Marseilles line. In No. 868 there are illustrations of the acetate of soda stove patented in this country by Herr Nieske, of Dresden; and in previous numbers there are more or less full descriptions of the invention of M. Ancelin, which is based upon the fact that solid bodies when passing into the liquid state absorb heat, which they give out when reverting to the solid state. Acetate of soda is a suitable material for the purpose. A foot-warmer of a capacity of about two and a half gallons will hold about 33lb. of acetate of soda, which melts at 139° Fahr. The loaded foot-warmer is, then, immersed in boiling water, which causes the acetate to melt, when it absorbs heat; and assuming its temperature when placed in a carriage to be about the same as an ordinary water-filled foot-warmer, it gives off about four times as much heat. Thus, in cooling to 140°, it gives off so many units, and then as it enters the solid state it yields up the heat which had been rendered latent; but the chief merit of acetate of soda is that it enters the solid state slowly, and the whole of the latent heat is not given up suddenly. Perhaps some of your railway readers can tell us how the system answers on the L. and N.W.R.—SAML. RAY.

[61458.]—**Circular Saw.** — The sizes I gave were for a separate saw bench. What I said was that "many tool-shops kept them in stock."—T. C., Bristol.

[61458.]—**Circular Saw.**—Don't put an 18in. saw on a lathe; small saws up to 8in. are very useful but 18in. will never do driven by power, say, between one and two thousand revolutions a minute. Here are a few reasons:—Lathe framing too shaky, saw table being above centres, too high to work at, and too convenient for a crack in the face by pieces flung from the saw; besides, a saw and spindle that weight would be a nuisance in shifting every time the lathe was wanted for turning, &c. Let Mr. Walter Payne get No. 11 this Vol., and on p. 231 he will find, in a first-class article, how to go to work to build a good, solid, separate frame, and do not be afraid of making it too strong.—ALBERT COLLINGRIDGE.

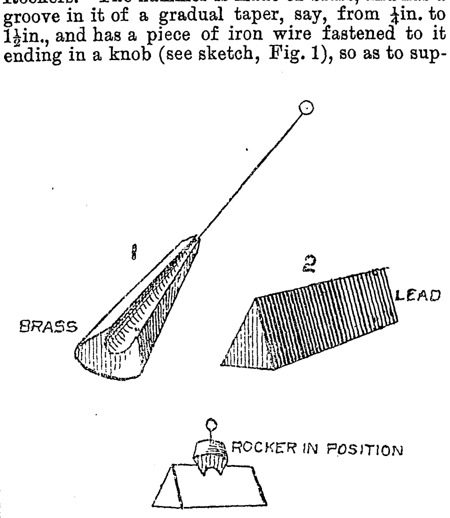
[61459.]—**Coils for Galvanometer.**—In last line but one of my reply, page 485, for "then make, &c.," read "these make."—OHM.

[61463.]—**Propulsion of Weight.**—Thanks to "Elag" and Mr. Conry for their replies; but the reference of the former to the balloon does not answer my question as to air, as a balloon is a mere inanimate bulk dependent for its motion on an outside current of air. I want to know what power a bird uses to propel its weight. Could he not also inform me as to the man and horse? I want to get at the power given out at the foot and hoof to move the weight of the body only.—W. G. G.

[61466.]—**Gold Gilding.**—Get some gold-size and mix a little chrome yellow with it; paint the article, and when nearly dry, but still a little sticky, gently brush your hair with a flat brush, and the brush will then pick up the gold leaf, which you can then lay on the work, and pat it down gently with a pad of cotton wool, when it ought to look like solid gold.—E. R. DALE, F.S.Sc.

[61470.]—**Legal.**—As to bulging out, much depends on the terms of the lease, and on the state of the building when tenancy commenced. As to defective roofing, leaseholder is without doubt liable.—G. J.

[61497.]—**Singing Hammers.**—I have never made one of these myself, but have seen one on the lecture-table. They are also known as Trevelyan's Rockers. The hammer is made of brass, and has a groove in it of a gradual taper, say, from ¼in. to 1½in., and has a piece of iron wire fastened to it ending in a knob (see sketch, Fig. 1), so as to support one end on the table. The piece it rocks on is not wood, but a △ of lead (Fig. 2). When the narrow part of the groove is placed on the lead a very sharp note is produced, and vice versâ. The sound will last for about 20 minutes. The inclosed rough sketches will give "S. H. W." some idea; but they are only from memory.—A. R.



[61472.]—**Damp Houses.**—The simplest form of hygrometer is a strip of carbon tissue, as recommended by W. B. Woodbury. In an atmosphere at all damp, the tissue becomes limp, and is a visible witness of the state of the air, and could be understood by the meanest capacity; in a dry atmosphere the tissue is quite hard and brittle, and curls up, pigment side inwards; if the air be very damp the tissue will curl up pigment side outwards.—G. J.

[61486.] — **Petroleum Gas - Engine for Launch.**—Before attempting to give "Glasgow" *reliable* advice regarding the most suitable form and proportions for a 40ft. steel launch intended to steam at not less than ten miles an hour, it would be necessary to know something of the purposes for which the craft is required—e.g., for pleasure or for heavy work. If "Glasgow" will advertise his address, I will be glad to assist him.—DUMBARTON.

[61499.]—**Storage.**—I am afraid that the only way to prevent the gas coming off is to discharge slower; gas given off is, as you say, energy lost, and occurs more or less at all times when using secondaries. When charging, you will see the same escape if you only charge fast enough; it is, however, more economical to both charge and discharge slowly; in fact, it is only by a moderate rate of charge and discharge that efficiency as claimed of 90 per cent. can be obtained; but when the batteries are charged and discharged at the rate stated by the makers, then the efficiency will rarely exceed 60 per cent.; however, the great convenience of this cell is worth some loss. It is quite true that a stranded conductor has more weight, and hence less resistance, than the same number of wires unstranded. This is simply owing to the fact that in stranding, the wires going round each other like the strands of a rope, become shorter, and the quicker the lay, or the greater number of twists per foot, the less the resistance. You can easily satisfy yourself upon this point by cutting a few 6ft. lengths of wire and twist them up together, when on completion you will find they are considerably under 6ft. Incandescent lamp bulbs are silvered by the same process as the silver-on-glass mirrors are done, and full details are given in back numbers.—OHM.

[61503.] — **Radial Axles.** — Yes, the Great Northern 7ft. 6in. new engines and the 715 class have radial boxes, or they could not get round curves.—LOCO.

[61504.]—**Double Electric Bells.**—A full-stop should be placed after "moment," 6th line from bottom; and the 5th line should read "For telegraphic purposes though." Altering the punctuation (as it now appears) makes the last six lines contradict the former.—M.M.I.SC.S.

[61505.]—**Eyepiece for 3⅛in. Telescope.**—I should advise "Enquiry" to procure his three eyepieces of the following powers: 65 for clusters and nebulæ, 120 for planetary and general work, and one of 200 to 250 for double stars. The o.g. is certainly all the better for being of long focus, a larger image being formed.—H. A.

[61505.]—**Eyepiece for Telescope.**—If "Enquiry's" 3⅛in. be achromatic, he might provide it with astro. powers of 50, 100, and 200, which would be pleasant to use and not too much for the object-glass to bear. The focal length he mentions is no drawback—rather the reverse, as it takes some of the strain of magnification off the eyepiece. He will, of course, mention it to his optician in ordering the lenses.—ARTHUR MEE.

[61507.]—**C ondensing Benzoline.**—It cannot, as a liquid, be compressed to any extent sufficient to make it worth while doing. You could freeze it, but that would be no use for carrying about, except, perhaps, on an Arctic expedition, and then artificial freezing would be needless. As to compression, the very act of compression generates heat.—EDWARD CONRY.

[61508.]—**German Root Words.**—J. Shippam, if he understands French and does not object to the use of a book beyond his dictionary, will find what he contemplates doing already done in a small work — viz., "Vocabulaire Allemande-Français Etymologique," by J. A. Weiss-Haas, published at Geneva, by H. Georg, which he can obtain for about 2s. 6d. from any foreign bookseller in London.—EYE-WITNESS.

[61510.]—**Roller Covering.**—You might try Prout's cement, procurable in Broad-street, Golden-square, and elsewhere. I think it is guttapercha and pitch mixed. It is sold in penny sticks, applied with heat, something like sealing-wax. The best cement I have found for leather is Le Page's carriage glue, procurable at Richards, Terry, and Co., 46, Holborn-viaduct, and nearly all tool shops, &c.—T. F. S. T.

[61510.]—**Roller Covering.** — Do not quite understand what you mean by "fastening cloth on iron rollers and under leather." The following will, however, piece leather. Bisulphide of carbon 4oz.; indiarubber, in shreds, 1oz; isinglass two drachms; guttapercha ½oz.; dissolve the whole lot in the bisulphide of carbon. Apply a thin layer

to each of the two pieces required to be united, and let it dry. Then heat to melting, place the parts together and hammer the air bubbles out. Le Page's liquid glue is a capital thing for the same purpose.—W. HOLDER, Newport, Mon.

[61511.]—**Dynamo.**—A dynamo giving 6 ampères at 45 volts would probably light well six 20c.p. lamps of about 48 to 50 ohms cold resistance. A gas-engine of about ½H.P. would do the work if the dynamo is well made. I cannot, owing to my natural modesty, reply to the question about the best lamps; the Otto or the Atkinson engines are the best and cheapest in the long run. A heavy flywheel on dynamo steadies it.—S. BOTTONE.

[61511.]—**Dynamo.**—If this querist could speed up his dynamo a little, he could light five 20c.p. 50-volt lamps, each absorbing 1·3 ampère, and having a resistance of 38 ohms. Otherwise he must use 45-volt lamps 45 ohms resistance and absorbing one ampère each, arranged in parallel arc, and probably 16c p. If a gas-engine is the motive power, a flywheel on the dynamo-shaft is almost a necessity, especially if the engine is not well up to its work. Employ an engine of ¾, or preferably 1H.P. indicated.—J. H. H., Edenfield.

[61512.]—**Magic Lantern.**—The kaleidoscope would have to have the revolving part fixed so as to come into the same position as an ordinary lantern-slide. Then a lens will be required of an equivalent focus to the length of the kaleidoscope tube to be placed at the end instead of the front lens of the lantern.—JAMES W. GARBUTT, Leeds.

[61513.]—**Incandescent Lighting.**—To MR. BOTTONE.—There need be no change of wire on field magnets; of course, the E.M.F. of the machine will be less, say, equal to four, or at most five, 20c.p. lamps. I should almost advise you to wind the F.M.'s as a shunt machine, and put on about 8lb. of No. 20 (2lb. on each limb, connected all up in series), and then attach the ends of the F.M. wires to the brushes. See No. 1113, Vol. XLIII. p. 466.—S. BOTTONE.

[61514.]—**Lining for Accumulators.**—I can tell you what you want; but the description would be too long for publication, as more lies in the peculiar application of the substance than in the substance itself. If you like to write to me I will explain further; you will get my address from the proper column.—EDWARD CONRY.

[61514.]—**Lining for Accumulators.**—An acid-proof cement may be made by dissolving caoutchouc by carefully heating it in twice its weight of linseed oil, and then adding twice its weight of pipeclay. This composition, when heated, becomes softer, but does not melt, and can be kept for a long time in a damp place without hardening, and when it does get hard it can be softened again by oil of turpentine. The last few remarks refer to a mass of the substance, and not to a thin layer. The following is a heat and acid-proof cement: Sulphur, 100; tallow, 2; resin, 2. Melt these together to a ruddy syrup, and add sifted ground glass to form a paste, and heat when used. Marine glue might also suit your purpose.—W. HOLDER, Newport, Mon.

[61515.]—**Photographs.**—To R. A. R. BENNETT OR OTHERS.—I think something must be wrong with this besides over-development, unless you have got the image reversed in some way, which does not often happen. If the negative is too dense, it will have to be reduced with chloride of iron, or something similar. If it really is turned into a good positive, the shortest way would be to take a negative from it by contact.—R. A. R. BENNETT.

[61516.]—**Gramme Dynamo.**—This machine, if query be correctly understood, will certainly not present a very compact appearance with "yokes" 18in. long. Taking into consideration the diameter of the armature, the length of these might have advantageously been decreased one-third. One good point is in the single pair of field magnets, which are preferable to the double pair as described in the 30-lighter. The armature will take about 6lb. of No. 18, giving a running res. of ·88 ohms. The field magnets for incandescent lighting should be wound as a shunt. The machine will probably light eight 20c.p. lamps, at an E.M.F. of 50 volts, and absorbing 1·3 ampère each, with a resistance of 38 ohms. These arranged in parallel would present a res. of 4·75 ohms, so that the total external res., allowing for leads, &c., may be taken at 6 ohms. This resistance, squared, and divided by the res. of A, will give res. of shunt coils = 40 ohms, or, say, 20lb. of No. 20. If this quantity does not sufficiently excite the field magnets, querist might add 5lb. No. 16 on each F.M. in series. The speed will be about 1,500, and should be regulated to give just 50 volts current, 11 or 12 ampères. Employ a 1½H.P. engine. There is no fear of heating unless the machine is overloaded, or the terminals short-circuited.—J. H. H., Edenfield.

[61518.]—**Gas-Engine.**—The two statements are very much conflicting, and if you have accurately quoted the latter one, I should advise you to throw that book overboard. The cooler the cylinders of a gas-engine can be kept the better; it is even cheaper to pay an increased water-bill, in order to keep a constant circulation of cold water round the outside of the cylinder, than to let the latter run hot; the mischief of over-hot cylinders is not merely that of loss of power: it is a continual risk of the engine straining itself, especially a gas-engine, these being more lightly built than steam-engines, and a strained engine is like a strained back—half crippled for ever after.—EDWARD CONRY.

[61519.]—**Lead Cylinder.**—Take a belt 1in. wide, section = 1in. × ½in. = ½ square inch. Tensile strength of lead = 1,792lb. ∴ ½ square inch = 896lb. Half diameter = 9in. × width of belt 1in. = 9 square inches. $\therefore \frac{896}{9}$ = 99·5lb. per sq. in. = bursting pressure.—ELAG.

[61519.]—**Lead Cylinder.**—Taking this as being cast, and of a tensile strength of 1,790lb. per square inch., the bursting pressure = 1,790 ÷ 18 = 100lb. per square inch nearly; but this assumes the cylinder kept its form until it ruptured, which it would not, and 60lb. is nearer the mark.—T. C., Bristol.

[61520.]—**Brass.**—There must have been some defect in the fittings of the thermometer. I have had one in constant use for more than ten years in an exposed situation, and the fittings appear as good as ever. If "G. M. S." lives in a very smoky neighbourhood, his brasswork will have been affected by the action of sulphur.—H. A.

[61520.]—**Brass.**—The plain English of the thermometer business is that the fittings were not "brass" at all, but some vile compound of scrap metal and odds and ends which had been thought good enough for thermometer fittings on account of there being no mechanical strain upon such. Good brass will stand any amount of exposure, even to sudden changes of temperature; as a matter of fact, brass is much less affected than iron or steel by a sharp frost. Good brass fittings, however, are only to be found in apparatus bought from good makers at good prices. Most of the "brasswork" sold nowadays is a nondescript alloy that even the makers could not particularise.—EDWARD CONRY.

[61520.]—**Brass.**—I don't think the optician that "G. M. S." went to knows much about brass; if he does, will he be good enough to explain how it is that brass door handles, door-bell handles, door plates, dog collars, &c., to say nothing of firemen's and soldiers' helmets, buttons, &c., do not fall to pieces when they are being cleaned a "few days" after purchase. I have seen brass all thicknesses cleaned the proper way every day, or every week, for many years; but I have never seen it fall to pieces as stated by "G. M. S." I have always found the cleaner you keep brass the better it will resist the atmosphere. The brasswork on "G. M. S.'s" thermometer must have been neglected to be cleaned a good many times before he had it, or the brasswork has been brightened with nitric acid, or some other acid, and the acid not properly cleaned off after—in that case, the brass would soon perish and fall to pieces.—DUNCAN.

[61521.]—**Does Iron Fossilise?**—It is quite possible that iron should fossilise; but it is more probable that the fossil is that of an encrinite, or other marine growth, coral, shell, &c.—M. YORK.

[61521.]—**Does Iron Fossilise?**—No. Iron is an element which you may disperse or adulterate, but cannot change; iron will, however, become coated first with rust, and over the rust with calcareous deposits, giving it the outward appearance of a pure fossil.—EDWARD CONRY.

[61522.]—**Questions as to Evolution.**—Last year two papers appeared almost simultaneously, one in German, by De Graaf, and the other by Baldwin Spencer, of Oxford, on the "Pineal Gland." Both worked independently and in different animals, and both arrived at the conclusion that the gland represented a rudimentary eye, comparable with that of amphioxus, and was apparently of an invertebrate character. The pineal gland is best developed in "Hatteria." In this animal the optic vesicle of the pineal eye consists of a lens and retina, both of which are derived, apparently, directly from the brain, thus differing from the paired eye of vertebrates, where the lens takes its origin as a secondary invagination of the epiblast, and from the invertebrate lens, which is epidermal in its origin. The retina shows decided invertebrate characters; the rods bound the cavity of the optic vesicle internally, and the nerve enters it posteriorly, and the nervous elements generally are directed towards the light. The eye is connected by a solid stalk with the "epiphysis," which is merely an enlargement of the optic nerve of the pineal eye. In no living amphibian does the pineal gland develop into an eye; but it did possibly so develop in the extinct Labyrinthodonta. In Pisces it is merely a hollow outgrowth of the brain, and in Mammalia and Aves it has become much degenerated. I have a diagram of the pineal eye of Hatteria punctata at hand, and would be glad to send it to "E. M." if it would be of assistance.—L. B. AND S. C. R.

[61523.]—**Bell Circuit.**—The earth can be used for return wire in an electric-bell circuit, and will be quite as efficient as running another return wire. If you have gas or water laid on to your premises, or where you want to put up the bell, connect one pole of the battery to the gas or water pipe at one end, and one wire from the bell to gas or water pipe at the other. If you have no gas or water, you will find full instructions in No. 1138 "E. M." in the Reply Column.—JOHN THOS. GARBUTT.

[61523.]—**Bell Circuit.**—Yes; earth can be used efficiently as a return circuit for an electric bell, provided your battery is sufficiently strong and you make a good earth connection, which can very easily be done by soldering your wire to a pump pipe or to a thin sheet of copper or lead (say 1ft. by 3ft.) and burying it about 3ft. under ground in a good moist place. If you surround plate with coke, it will improve the connection, and an occasional bucket of water won't hurt it if it should happen to be upset somewhere about there.—W. HOLDER, Newport, Mon.

[61523.]—**Bell Circuit.**—"Earth" makes an admirable return for a bell circuit. To make a good earth take two short wires down to earth, one at each end of the stretch—the first one from the zinc of the battery, the other from the bell—solder each wire well to a copper plate about 1ft. square and any thickness, and bury your plates in the earth not less than 4ft. down. Or strip and scrape or polish with emery paper three or four yards of each short earth wire, and dig a small trench at, say, 4ft. depth, put a bushel of coke (broken up small) into each and bury the wire in the coke, winding it in and out like a serpent; drench the coke well with water and fill up with earth, beating the earth next to the coke down upon it so as to consolidate it. Or solder each short earth wire to a waterpipe. Or drive two lengths of gas-barrel about 4ft. down into the earth, and solder the wires firmly to the respective ends. Galvanised iron pipe is better still.—EDWARD CONRY.

[61526.]—**Wheel Barometer.**—The spindle of the large pointer is attached to a pulley at the back of the instrument; on this pulley is a silk thread, at one end of which is fastened a glass float resting on the mercury, on the other a counter-weight. It is very likely this thread has got on to a wrong groove in the pulley. I should strongly advise "T. G." to take his barometer to some practical instrument-maker to be put right.—H. A.

[61526.]—**Wheel Barometer.**—To make your instrument read correctly, either take out a little mercury or move the hand round upon the spindle. To reconnect the brass pointer, take out the wood back and then take out the tube, when you will see the long brass plate tacked on to the barometer. Take this out, and at the other side of it you will find two small pulleys, which, if the barometer is in working order, will be connected by a small band, made of silk or cotton. In your instrument I think this must either be too slack or broken altogether. Either make a new band, or shorten the old one. You will have to take both hands off before you can take brass plate off. If you get firm hold of the small double-grooved pulley at the back of baro. with a pair of ordinary pliers, and then take hold of the hand at the front, I think you will find it will come away.—JOHN THOS. GARBUTT.

[61527.]—**The Agar-Agar Cell.**—The only description I can find of this cell is the following, which I take from the *Electrical Review* of June 18th, 1886. It originally appeared in *Engineering*, on June 11th. "The cell consists of a flat glazed earthenware tray, containing a sheet of silver foil on its floor. Dry powdered chloride of silver is spread over this plate, and a vegetable jelly is laid over that to support the zinc plate, which is the upper pole of the cell. This jelly is made by dissolving ammonium chloride (2½ per cent. of the salt) in Ceylon Moss or Agar-Agar. A pile of these cells makes a convenient battery.—W. HOLDER, Newport, Mon.

[61528.]—**Seeds for Microscopic Objects.**—Speaking generally, the seeds—or, more correctly, the fruit—of the umbelliferæ are by far the most interesting for the microscope, on account of the varying number and shape of the ridges and channels, and the oil receptacles, or vittæ, in the substance of the pericarp. Nearly all the English genera have vittæ, Conium being the most notable exception. You may try Coriander, Parsley, Fool's Parsley (Æthusa cynapium), Hemlock, Anise (Pimpinella anisum—not the star anise), Parsnip, and Celery. Pepper, cloves, and coffee also make good objects.—REYMOND.

[61528.]—**Seeds for Microscopic Objects.**—If "Lavant" will procure any of the seeds

named in the following list, he will find they possess beautiful and peculiar markings; they all belong to the wild species. I simply give common names. If "Lavant" requires the scientific names, and will advertise his address, I shall be pleased to furnish the same, also orders to which they belong. Hound's Tongue, Wild Carrot, White Campion, Red Campion, Ragged Robin, Ground Pine, Common Mallow, Bur Marigolds, Sundew, all the Poppies, Foxglove, all the Orchids, all the Geraniums, Mullein, Bog Asphodel, and, in fact, they would all repay the trouble of hunting up; all, except the Asphodel, Sundew, and Orchids should be mounted dry opaque.—WORKING-MAN BOTANIST.

[61528.]—**Seeds for Microscopic Objects.**—Beginning with the seeds of Collinsia, which, if the testa be cut and placed in water, will begin to throw out fibrils which seem to be alive, and the movable elaters of the Equisetum spores, we have the following striking and interesting seeds, some of which may be viewed with a low power, say, 1in.:—Stellaria holostea and media, Lychnis dioica and diurna, Dianthus barbatus, Papaver somniferum, Spergula arvensis, Eccremocarpus scaber, Coreopsis tinctoria, Wahlenbergia hederacea, Eschscholtzia Californica and tenuifolia, Portulacca oleracea, Lepigonum marinum, Silene inflata, Euphorbia Greca, Plantago psyllium, Loasa aurantiaca, Antirrhinum majus, Nicotiana tabacum, Sphœnogyne speciosa, Bœhmeria nivea, Linaria minor, Centaurea cyanus, Nycterinia capensis, Lophospermum scandens, Erica cinerea, Euphrasia officinalis, Calluna vulgaris, Antirrhinum orontium, Eutoca viscida and multiflora, Whitlavia grandiflora, Verbena pulchella, Pedicularis palustris, Digitalis purpurea, Isotoma longiflora, Anagallis indica, Eucharidin concinnum, Oxalis rosea and acetosella, Campanula speculum, Apium graveolens, Blumenbachia insignis, Ulmus montana. See "Cooke's 1,000 Objects for the Microscope."—S. BOTTONE.

[61529.]—**Mathematical—Measurement of Drums.**—Take 1ft. for the unit of measure. Let l be the length of the rope, t the thickness of the rope, h the length of the barrel of the drum, d the diameter of the barrel, and e the diameter of the end of the drum. Then the number of layers of rope required to fill the drum is $\frac{e-d}{2t}$, and the number of turns in each layer is $\frac{h}{t}$. Adding together the lengths of rope in each layer, we have, for the whole length of rope, the following series:—

$$l = \frac{\pi h}{t}\left\{d + \overline{d + 2t} + \overline{d + 4t} + \&c. \ldots\ldots\ldots\ldots + d + \left(\frac{e-d}{2t} - 1\right) t\right\} = \frac{\pi h}{4t}(e-d)(e+d-2t).$$

From this we derive—

$$e = t + \sqrt{(d-t)^2 + \frac{4t^2 l}{\pi h}} \ldots\ldots\ldots\ldots \quad (1)$$

$$h = \frac{4t^2 l}{\pi(e-d)(e+d-2t)} \ldots\ldots\ldots\ldots \quad (2)$$

in which expressions $\pi = 3{\cdot}1416$.—J. R. CAMPBELL, Charing, Kent.

[61531.]—**Lantern Transparencies.**—The only way is to fix up the ½-plate negative in front of a camera with a reflector, say of white paper, at an angle of 45° at the back of it, and take a positive in the camera of the required size. All light must be shut out between the negative and the camera. —G. J.

[61531.]—**Lantern Transparencies.**—The best way is to make the transparencies in the camera. I do all my lantern-slide work by wet collodion, and so make all slides in the camera from ¼ upwards. Get an extra bellows made to fix on front of your ordinary camera, which should be clear through, and say 24in. long, the diameter at the end farthest from the camera, say, 9in. by 9in., so as to take a carrier for a ¼ either way up; have a foot made to the end and clamp both camera and extra bellows to a long board. You will find that you require very long exposures with the ordinary chloride plates.—JAMES W. GARBUTT, Leeds.

[61531.]—**Lantern Transparencies.**—Get an old box about a foot square, and take off the lid, cut a hole in the bottom slightly smaller than the negative you desire to reduce, fasten the negative outside this hole, film side inwards, lay the box on its back. Nail a board so as to increase the height of where was formerly the back of the box. On this screw the camera at such distance as is found necessary with the lens pointing to the negative. Put the lantern slide plate in a carrier in the camera back, having previously focussed, and expose. To get even illumination, tilt the apparatus so that nothing can be seen on looking through the negative but sky, or reflected light through the negative by a looking-glass or sheet of white paper. The inside of the box should be blackened, and during exposure everything should be covered with a black cloth except the side of the box where the negative is, that no light may pass through the lens except that which has come through the negative. The plates should be fairly rapid ones (I find Chapman's lantern plates answer well), and a short-focus lens is more handy than a long-focus one. I use a 4in. portable symmetrical.—T. PERKINS Shaftesbury.

[61533.]—**Speed Wheels.**—Will "A Country Millwright" buy the MS. of the book, and himself undertake the responsibility of the "ready demand?"—M. YORK.

[61533.]—**Speed Wheels.**—I beg to second this request for a book of speed wheels. At present there is only a very small one, which has a very poor selection. But I should also suggest that it contain "A complete division table from 12 to 200, the result expressed in decimals, which, multiplied by pitch of lathe-screw, would give pitch required." Also a few complete sets of numbers for division plates, showing exactly what each primary can be reduced to. I have been obliged to make a small book for private use, simply to save frequent calculations and time.—VULCANITE.

[61534.]—**Lathe Tools.**—I expect you burnt the steel in heating. It should never be heated beyond "cherry red."—EDWARD CONRY.

[61537.]—**Bleaching Silver.**—Boil the articles in cyanide of potassium till the frosting comes up clear and white; then wash in very hot water, using a stiff brush with a touch of soap and carbonate of soda, and dry off by shaking in a bag of hot boxwood sawdust. Boiling in a solution of alum will answer for some articles, but it takes a longer time, and is hardly so effectual as the cyanide.—DENS.

[61537.]—**Bleaching Silver.**—The cyanide of potassium is used for gold lace, and I think, for silver also. The lace is merely dipped into a mixture of the cyanide with water, more or less strong according to the state of the lace; half and half is a general mixture. The time of dipping is very short, and depends on how much the lace is tarnished; often a single second is enough. The lace is then rinsed well in clean water and left to dry.—EDWARD CONRY.

[61537.]—**Bleaching Silver.**—To one half-pint of water add thirty drops of oil of vitriol. Smoke the article to be bleached over the gas until it is black, then place it on a piece of charcoal, and heat the article until the smoke disappears—that will be when the article is about red hot; when cold, place it in the above solution from fifteen to thirty minutes, then place it in clean hot water. If you want to burnish parts, dry at once in boxwood sawdust, then burnish; if to be finished with the scratchbrush, dip in hot water, scratchbrush, and dry in box dust. There is lots of silver jewellery that would not be safe to bleach for many reasons; but, above all, be careful and see that there is no pewter solder about the article. It would take too much space to explain other reasons; but if you are in doubt about any article, apply again, or publish your address, and I will help you. —DUNCAN.

[61541.]—**Polish.**—You should have used spirit to it.—EDWARD CONRY.

[61542.]—**Clock and Sundial.**—Think the matter carefully over again, and try to reason it out. You will, I fancy, find Lockyer to be right. —H. A.

[61542.]—**Clock and Sun Dial.**—The quotation implies that at January 1 the sun is gaining most on the clock, which is true; but it is only very slightly before the clock; but at July 1, when it is "in apogee," and moving slowest eastward, in reference to the stars, therefore "fastest" westward per hour, in reference to the dial, it is also gaining on the clock, and quicker than it ever loses; for the days in spring and autumn, wherein it is losing, are about twice as many as those in summer and winter, wherein it gains. The whole quotation is certainly very faulty.—E. L. G.

[61544.]—**Darning Machine.**—These were returned by some of the sewing-maching shops as unsatisfactory, and as needing further development before they were likely to come into good use. And there is a splendid opening for some inventor who will supply a really efficient darning machine. To work it, my recollection is that you raise the clamp, put the part needing darning over it, press the clamp down, which presses the material into corrugated ridges; then force the needles through till all the eyes project through the work; then pass the thin hook (supplied with the machine) through all the needles, hook the worsted, and draw it back through all the eyes, hold on to the end, and draw from between each needle enough worsted to hook over one tooth of the many tongued forks. When all is threaded, draw back the needles, which draws the double threads through the stuff; cut off all the ends, lift the clamp, turn the material at right angles to its former position, clamp it, and go through the operation as before, when the darn will be finished. The only thing I am not quite sure about is whether the needles have to be threaded before the work is put into the clamp. It was in the Centennial Exhibition in 1876 I tried the machine, so I may be excused if I have forgotten the exact process. Will "F. C. A." return the compliment now, and let me know where I could pick up one of these machines? I have not seen one for many years.—T. F. S. T.

[61545.]—**Railway Couplings.**—An ordinary screw coupling should not break with less than a strain of 25 tons.—ENGINEER.

[61546.]—**Harmonium.**—Mr. Begg cannot easily add a half-set to his present harmonium, for he will require a new pan, which, being wider than the present, cannot well be got into the case.—ORGANON.

[61546.]—**Harmonium.**—The addition of a half-set of reeds would certainly be an improvement to your instrument in one respect; but it is well to consider the matter sufficiently before commencing the desired alteration. If your harmonium contains a good and sound 10in. bellows, you can make it do; but you will require a new pan, arranged in three registers, so as to receive a row and a half of reeds. Buy a good pan, with beech veneers, from a good maker, and don't forget to pay a reasonable price for it. A cheap or inferior pan or soundboard is a curse to any harmonium. A good tone depends largely on the quality of the soundboard. Buy Turban's or Esteve's best reeds. You will also require a valve-board, arranged for three registers, and furnished with three valves actuated by the stops. You can introduce the following stops:—Cor Anglais (bass), Flute (treble), Voix Celeste (additional half-set of reeds). You can have them to sound celeste without having the reeds put out of tune to the flute set. I will explain how to accomplish this, if required. By all means have the expression stop. This stop merely consists of a valve placed at the bottom of well underneath the valve-board, and which covers the hole through which the wind enters the reservoir of bellows. When the expression-stop is drawn out, the valve closes, and prevents the air from entering the reservoir. If I may be allowed to express my candid opinion with regard to the matter, I do not advocate or advise anyone to make any addition with regard to number of reeds to any instrument (more particularly one-row reed organs) unless there is ample space in the instrument for doing so. Where space is very limited, and the mechanical portions are cramped for want of room, satisfactory results can scarcely be expected.—G. FRYER.

[61547.]—**G. and S.W. Locos.**—The G. and S.W. engines are very fine, and do good work with the joint stock traffic. They have one fault: they require domes, so as to get the steam more dry to the cylinders.—LOCOMOTIVE.

[61547.]—**G. and S.W.Ry. Locos.**—In reply to "G. and S.W.Ry. Fitter," although I have never had very much travelling to do on this line, my experience of these 6ft. 9in. four-coupled and the 6ft. bogie express engines has been very satisfactory. They have always kept excellent time, notwithstanding heavy trains, bad weather, &c. Their coal bill, I believe, is not at all heavy, the trains and gradients being taken into consideration. There is one detail of construction which I do not so much admire—that is, the absence of a dome. I suppose that these engines are liable to prime if they have a full boiler at starting; it is well known that the G.N.R. cannot carry a full boiler, which is really perhaps the only bad point in them. Does the joint of the steam-pipe with smoke-box give any trouble, as it is under steam at all times? The reversing gear I consider particularly ingenious, but if anything was to go wrong with the steam connections the engine could not be reversed or even notched up to suit the gradient. I am glad that Mr. Smellie keeps to the link motion, notwithstanding the disadvantages of short axle bearings, which cannot be avoided when the slide valves are between big cylinders, as 18¼in. I hope that no more new engines will be fitted with the Bryce-Douglas gear; it has had a fair trial, and to all accounts has not acquitted itself satisfactorily. —G. T. G.

[61548.]—**Shipbuilding.**—"Novice" should say what sized ship he means, and the material of which it is made. If only a small one, say, 4ft. long, a gimlet will suffice, and it is easy to carry the vessel to the water. Is his query intended to be funny?—VIDEO.

[61549.]—**Coil.**—It is a settled fact that silk-covered wire is better for the secondary coils of inductoriums than cotton-covered. This depends on two reasons: 1. Superior insulation of silk-covered. 2. Because the insulating covering in the case of silk occupies very much less space, hence the coils lie nearer to the core, and to each other. This greatly enhances the effect. Yes; but a paper tube soaked in paraffin wax is decidedly better.—S. BOTTONE.

[61549.]—**Coil.**—Not at all. Cotton-covered wire will do perfectly well; only cotton insulation taking up more room than silk, you cannot get as many layers of cotton-covered wire into a space as you can of silk, and consequently, size for size, you cannot get as good results with cotton-covered coils as with silk-covered. With small coils it costs almost as much in extra cotton-covered wire to get the same result as it would have done to use silk-covered, and the latter insulation is always much better than the former. I would as soon have one covering of silk as two of cotton for insulation. I expect the No. 40c.c. was for making what is called "net" for bonnetmakers. I hardly understand your last question. It is absolutely certain that you cannot make an "ebonite tube" out of "a piece of sheet iron," unless you are a necromancer of high ability.—EDWARD CONRY.

[61549.]—**Coil.**—Fine wire covered with cotton used as a secondary in spark coils will only result in a disappointment. The tension between the layers of secondary is great, and the cotton covering has not sufficient insulating power to resist it. If the cotton covering were doubled or soaked in shellac varnish, paraffin wax, &c., it would, of course, prevent more resistance; but the processes would thicken the wire and remove the secondary layers too far from primary and core, diminishing induction and lessening spark. Galvanometers, &c., can be wound with varnished, cotton-covered, thin wire, as the tension is comparatively small, and it is, of course, much cheaper than silk-covered. How an ebonite tube is to be made out of sheet-iron is, I confess, beyond me. If sheet-ebonite is meant, the reply is "Yes."—B. HARCOURT.

[61551.]—**Flow of Water through Pipes.**—Size of pipe required would be inversely as the velocity, and the velocity may be found thus:—$V = 97{\cdot}05 \sqrt{R\,S} - 0{\cdot}08$ (Prony) where R = mean hydraulic depth in feet = area ÷ wet perimeter $= \frac{d}{4}$ for circular section of pipe

S = sine of slope $= \frac{H}{L}$
H = head of water in feet
L = length of pipe in feet
d = diameter of pipe in feet
v = velocity in feet per second.

—ELAG.

[61552.]—**Flat Foot.**—I know two young boys with weak insteps, threatening flat foot as they grow. They wear boots which have the space under the instep quite filled up with leather from heel to toe, so that the foot rests all along on a firm bed.—T. F. S. T.

[61552.]—**Flat Foot.**—Impossible for any correspondent to say exactly what is the matter with your foot. Flat foot is generally the half-way stage to a far worse deformity, and may very probably be cured now if you see a medical man at once, instead of tinkering it with the nostrums of well-meaning, but incompetent, correspondents. —REYMOND.

[61554.] — **To Mr. Bottone.**—Your 30c.p. dynamo is doing fairly good work. Still, it will certainly do better in every way if you can get on ½lb. No. 20. The No. 24 opposes useless resistance. Three 10c.p. lamps are easily lit by such a machine. —S. BOTTONE.

[61556.]—**Substitutes in Photography for Glass.**—Stanley, London Bridge, sells paper for use instead of glass for negatives, and frames for using it in ordinary cameras. Yes, you can have carriers to take plates as small as you like, so long as their face is kept in the proper plane for focus. —T. F. S. T.

[61556.]—**Substitutes in Photography for Glass.**—If "Iris" will take the trouble to look through the indices, he will find that so far from there having been little on this subject in your pages, there are many articles descriptive of patented and other substitutes for glass. Let him look in No. 1114, p. 475, for instance.—T. J. M.

[61556.]—**Substitutes in Photography for Glass.**—Get the *British Journal of Photography Almanac*, price 1s., and you will find many experienced opinions on the subject. (2) Yes, certainly; any size smaller can be taken by means of carriers, and you can make them yourself out of an old cigar-box.—B.SC., Plymouth.

[61556.]—**Substitutes in Photography for Glass.**—(1) What is it that you want to know? Eastman's paper and Pumphrey's "flexible glass" are generally considered the best substitutes; the difficulty in the case of the paper is to get rid of the grain. Except for the weight, paper films have no very great advantage which glass does not possess, and they have many disadvantages. You can take any intermediate sized plate by means of carriers—thus with a ½-plate camera you can take full size, 5 by 4, 4¼ by 3¼, and 3¼ by 3¼ negatives.—R. A. R. BENNETT.

[61560.]—**Engineering.** — This is a most important query for parents having sons about to enter practical life in the profession, and I trust friends of "Ours" who are in a position to give particulars as to the mutual obligations of the firm and of the pupil will kindly do so, for the benefit of the interested, but oftentimes uninitiated, of which I am one.—MARIENBERG.

[61561.]—**Gravitation.**—Since the force (if it be a force) called the "force of gravitation" has never been known to suddenly take hold (so to speak) of a body of which it had not hold before (for the simple reason that it has always, as far as is known, had all known bodies in its possession since they were first known), the velocity with which it would do so has not yet been determined accurately, but is estimated roughly at about $\frac{00}{1}$ miles per $\frac{1}{00}$ seconds. I myself have, nevertheless, seen no mention of this in any works with which I am acquainted.—ANOTHER DISGUSTED.

[61563.]—**Torricelli's Theorem.**—Four cubic feet in 30 minutes $= \frac{4}{30 \times 60}$ c.ft. per second, or a stream $= \frac{4 \times 144}{30 \times 60}$ sq.in. of section per second; velocity of efflux from vessel per second $= \sqrt{2gh} = \sqrt{64 \times 4} = 16$ft., ∴ effective area $= \frac{4 \times 144}{30 \times 60 \times 16} = {\cdot}018$sq.in. The actual opening would need to be larger by about 10 per cent.—T. C., Bristol.

[61563.] — **Torricelli's Theorem.** — Where v = theoretical velocity due to head of water in feet per second $= 481{\cdot}5 \sqrt{H}$
Q = quantity of discharge in cub. ft.
E = velocity of efflux
K = coefficient for orifice (for hole in thin plate $= {\cdot}62$)
A = area of hole
$E = VK \qquad Q = EA$

$$A = \frac{Q}{E} = \frac{{\cdot}0022}{963 \times {\cdot}62} = \frac{{\cdot}0022}{597{\cdot}06}$$
$$= {\cdot}0000037 \text{ square feet}$$
$$= {\cdot}0005328 \text{ square inches}$$
$$\therefore \text{diam.} = {\cdot}0005328 \div {\cdot}7854 = {\cdot}00068$$
$$\text{diam.} = {\cdot}00084246 \text{ inch.}$$

—ELAG.

[61563.]—**Torricelli's Theorem.**—A stream of water flowing through a small orifice in a thin plate at the bottom of a wide vessel naturally contracts itself, and it is found by experiment that the smallest section of the stream is below the orifice at a distance of about half its diameter. This point is called the "Vena contracta"; the diameter of its section is about $\frac{4}{5}$ths of that of the orifice, so that about $\frac{5}{8}$ths of the water would flow through the section, as compared with what would otherwise be due to the size of the orifice. Taking then A as the area of the section of the vena contracta, and V as the velocity of the stream at that point, the volume of water that would flow through the section in one second would be—V A and in 30 minutes the volume would be—180 V A,

$$\therefore 180\,V A = 4 \text{ cubic ft.}$$

But V is the velocity due to a fall of 4ft.

$$\therefore V = \sqrt{2g \times 4} = 16 \text{ nearly}$$
$$\therefore A = \frac{4}{16 \times 180} \text{ sq. ft.}$$

$= {\cdot}5$sq.in. And the area of the orifice $= {\cdot}5 \times \frac{8}{5} = {\cdot}8$sq.in. The radius of a circular orifice would, therefore, be slightly over half an inch.—MILVERTON.

[61564.]—**Instantaneous Exposures.**—TO S. BOTTONE and "B.SC., PLYMOUTH."—If the plates are really under-exposed with the exposures given, there must be something wrong with the plates. To certify this, try another brand, say Sykes' "Albert." If the results are the same, the developer then must be at fault, and your only remedy will be to make up a fresh batch, or change developer altogether.—S. BOTTONE.

[61564.] — **Instantaneous Exposures.** — I founded my opinion that you had over-exposed on my own experience. I will now give you the time worked out by "Platt's Systematic Exposure Tables." The circumstances you give are ("Subject and Light") Panoramic View and Sunshine = 1 in Table I. ("Time") 12 o'clock summer = 1 in Table II. ("Lens and Stop") R.R.S. lens, full aperture, F 10 = 1 in Table III. ("Plate") you don't say which; but supposing it is a slow one = 20 in Table IV. The formula now stands thus: $1 \times 1 \times 1 \div 20 = \frac{1}{20}$th of a second; you exposed for 5 seconds, therefore you have over-exposed 100 times. Beach's developer is very good for instantaneous work; make up a new one, and see that your sulphite of soda is pure and fresh, and not sulphate, because that may be the cause of the slow development, notwithstanding the fearful over-exposure. A rapid portrait lens is, as you found it, far quicker than an R.R.S. lens; but then you can't take a landscape with it.—B.SC., Plymouth.

[61565.]—**Daniell's Battery.**—I find by experience that the Leclanché battery is more economical, needs less attention, and is equally if not more permanent than the Daniell's. For electric-bell work I should certainly always use the Leclanché. I think that it will be found that the Post Office more generally adopt the Leclanché by preference.—H. A. B.

[61565.]—**Daniell Battery.**—To prevent the salts creeping up porous-pot, take a new one and heat it before the fire till nearly 100° C., or so that you could just lift it; stand it thus, mouth down, in melted paraffin wax, and let it stand, say, 2in. deep till the wax commences to freeze, then take out and wipe superfluous wax off. If you want the cell for such work as you name, then charge it inside porous-pot with water only, and outside with water and copper sulphate; then connect the two wires together for three hours before you require to use it. Put the cell inside a box to prevent evaporation.—OHM.

[61565.] — **Varnish for Accumulators.** — "Volt" should try Scott's hardened rubber varnish. If two or three coats applied, he will find it very good.—OHM.

[61566.]—**Difference between Shunt and Series.**—TO MR. BOTTONE.—This query recurs about once a month. I send this time a reference to the place where I last figured and described a series and shunt-wound machine—viz., "E.M.," Vol. XLIII. p. 466, No. 1,113. With regard to getting different powers from a dynamo, it can be done, as you suggest, in a series-wound machine, by putting on each layer of the F.M. wires, in separate strands, which can be connected at will by means of a switch. If only one layer is used, the current is of the lowest E.M.F.; but if all the layers are connected in series, it is of the highest. But a machine as small as described by you will not give sufficient E.M.F. for physiological effects, unless, indeed, you employ an interceptor to break the current, or short-circuit it, as described in my last article on "Electrical Instrument-Making for Amateurs."—S. BOTTONE.

[61567.]—**Strength of Materials.**—Was not this answered a week or two back? Taking the tensile strength of iron at 22 tons sq. in. of section, the strength of any piece of iron in tension is directly proportional to its sectional area, whatever its sectional shape may be.—T. C., Bristol.

[61567.]—**Strength of Materials.**—Here is another "Novice," who may be recommended to the textbooks for an answer to his query. If he will give the dimensions of his pieces of iron, he may possibly receive an answer.—VIDEO.

[61567.]—**Strength of Materials.**—This query is indefinite, insufficient particulars being given; but if the iron is to be compared for crushing or tension, the proportional strengths will be as the areas are to one another; if for girders, multiply breadth in inches by the square of the depth in inches of each sample, and compare results. Thus a section 2in. × 6in. deep is four times as strong as 2in. × 3in. deep; thus, $2 \times 6^2 = 72$, and $2 \times 3^2 = 18$. —G. J.

[61568.]—**Gold.**—In colouring gold, the tone of the colour depends upon the alloy, and as the dish that "Dublin" has to repair is probably one of the old-fashioned kind, made from gold alloyed with copper only, he will either have to get a piece of gold as near the same as possible, or melt and roll out a piece to suit, as unless any two bits of gold are very near the same in quality and alloy, they can never be made to have the same tone of colour so as to stand wear or use.—DENS.

[61568.]—**Gold.**—Fine gold can be alloyed to many different colours and qualities. "Dublin" does not say what carat the dish is made of; therefore I cannot tell him the alloy he requires. The dish may be 9, 15, or 18 carat. If he will publish his address and the quality of gold the dish is made of, I will send him the alloy he requires; but if he would take my advice, as I see he is a novice as regards alloying gold to a particular colour, he should cut two or three grains off the dish, and send the cuttings to any refiner, with size of piece he requires, or take the dish to the refiner, and he will match it at far less cost than Dublin can.—DUNCAN.

[61571.]—**Organ Accordion.**—If "Derfla" will advertise his address in Address Column, I will send him a drawing of a good arrangement free by post; or if a drawing would be of sufficient interest to the readers of "Ours," I will send it to the Editor for insertion in the "E.M."—G. FRYER.

[61572.]—**Wimshurst Machine.**—TO MR. BOTTONE.—Yes, the mode suggested by you will be efficient. It is well that the two outer coatings should be metallically connected by means of a strip of stout tinfoil.—S. BOTTONE.

[61573.] — **Microscope Lamp.** — If "Neo-Microscopicus" will remove the metal chimney from the lamp directly after use, and only replace it at the time he wishes to light the lamp, the evil will be cured. The cause of the unpleasant smell is the heating of the chimney, on which some of

the volatile paraffin oil has been condensed.—EDWARD M. NELSON.

[61574.] — **The Calculus.** — "Tyro" should imagine a square magic-lantern sheet before him, which in a very magical way is growing bigger and bigger—as in a nightmare—and yet preserving its square form. By some magic law each edge of the sheet grows longer, so as to gain a yard in length in each second, at a steady pace. It is then obvious that the lapse of each second adds also to the area of the sheet. But the area does not, like the edge, increase at a steady pace, such as, say, 30 square feet gained every second: the area grows at a rate which depends on the size of the sheet at the time. The bigger the magic sheet gets the more rapidly it gains in area. "Tyro's" problem is: At what speed is the magic sheet growing in area just at that critical moment when its edge is 10ft. long? and the calculus answers, 60 square feet per second. This result will appear reasonable on inquiring (1) how many square feet will be added in the second then commencing? and (2) how many have been added in the second then elapsing? 1. Edge 10ft. becomes edge 13ft.; area from 100 square feet to 169 square feet; gain = 69 square feet during the second. Average rate during the second naturally greater than rate at commencement of the second, seeing that the rate is continually getting faster. 2. Edge 7ft. becomes edge 10ft.; area from 49 square feet to 100 square feet; gain = 51 square feet during the second ending at the critical moment in question.—WEALD.

[61574.]—**The Calculus.**—This is a question in "fluxions," a branch of mathematics which gave rise to the differential calculus. The lengths and areas we are dealing with are supposed to vary continuously or to "flow" at a steady rate instead of by fits and starts as supposed by "Tyro." In this case the side of a square increases uniformly at the rate of 3ft. in a second, and we require to find at what rate the square itself is varying when the side of the square has arrived at any given length. Suppose the side to have arrived at a length of 10ft., then suppose it to go on increasing for a very small distance, say $\frac{1}{10}$th of a foot or ·1ft. Now, as the side is increasing at the rate of 3ft. in a second, or 1ft. in $\frac{1}{3}$ of a second, it will increase ·1ft. in $\frac{1}{30}$th of a second, and the increase of the square itself in that time will be $(10\cdot1)^2 - 10^2 = 2\cdot01$ square feet in $\frac{1}{30}$th of a second, or $30 \times 2\cdot01$ square feet in one second, or 60·3 square feet in a second. Now, if we had taken our small distance at less than ·1ft., say, ·01ft., our result would approach still nearer to 60 square feet per second, and if our small distance became infinitesimal, the result would tend to 60 square feet exactly as the limit. Put in the language of the differential calculus, the above would be stated as follows:—Suppose x to be the side of a square and y the area of the square, then we have the equation $y = x^2$, and suppose x to be increasing at the rate of 3ft. per second, and consequently y to be also increasing at another rate, and suppose x to have arrived at a certain known length x_1, then to be allowed to go on for a very small distance $\triangle x_1$, and then stop; then the time it would take to do this short distance would be $\frac{\triangle x_1}{3}$ seconds. Now, in this short time y has also been expanding, and we may call the small quantity that it has expanded $\triangle y$; the square has, therefore, expanded $\triangle y$ square feet in $\frac{\triangle x}{3}$ seconds, or $3\,\frac{\triangle y}{\triangle x}$ in one second. Now, suppose $\triangle y$ and $\triangle x$ to become infinitesimal, then the square expands at the rate of $3\,\frac{dy}{dx}$ in one second, or three times the differential coefficient. The differential coefficient of x^2 is $2x$, so the rate of expansion is $6x$.—M.I.C.E., Bath.

[61574.]—**The Calculus.**—"What has time to do with the increase?" It is not asked, What is the increase, but what is the rate of increase? Time is concerned in the answer, inasmuch as it is part of the question: "the side increases at the rate of 3ft. per second; at what rate is the area increasing, &c.?" Answer = at so many ft.^{2} per second. That's where the calculus comes in. The side increases uniformly, the area does not. Suppose the side started from 0: at the end of 2nd second, side = 6ft., area = 36sq.ft. During the 3rd second, side increases 3ft., area increases 45 sq.ft. During the 4th second, side increases 3ft., area increases 63sq.ft.—that is, the area increases 45ft. during one second, 63 during the next, &c., &c. For each fraction of a second the side increases exactly the same as it did for the previous fraction, while the area increases more than it did during the previous fraction. The side has a uniform increase, the area has an increasing increase; therefore, it has a different increase for every point in the side. It is very easy to say how much the area increases from the end of the 3rd second to the end of $3\frac{1}{3}$ seconds (or from 9ft. side to 10ft. side), as "Tyro" has done—that is, during the $\frac{1}{3}$rd of any second (as "Tyro" says, during that $\frac{1}{3}$rd of a second it increases 19sq.ft.); but at the end of the $\frac{1}{3}$rd second it is increasing faster than at the beginning—i.e., more per fraction of time. And it is this which is wanted, the time being given in seconds. It is more than I can do, too; but, short of the calculus itself, I will give "Tyro" any further assistance I can.—M., York.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, W. H. Kope has replied to 60904; "G. J.," 61018, 61154, 61161, 61167.

60990. Steel-McInnes Brake, p. 292.
60991. Brakes on the North-Eastern, 292.
60992. New Midland Engines, 292.
61014. Chocolate Glaze, 292.
61018. Optical Lantern, 293.
61029. Gourd Drinking-Cups, 293.
61037. Indigo-Dyed Serge, 293.

61236. Colliery Winding Engines, p. 376.
61238. The Brown-Allan Relay, 376.
61240. Microscopical, 376.
61244. To Tell the Age of Eggs, 376.
61245. Saccharine Matter in Mortar, 376.
61246. Wrought-iron Castings — Aluminium added to Wrought Iron, 376.
61250. Telescope O.G. for Photography, 376.
61256. Hand Planers, 377.
61270. Coil, 377.

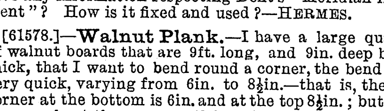
QUERIES.

[61575.] — **Indicator Diagram Puzzle.** — Will some kind correspondent give me information and explanation of these circumstances? I took three pairs of cards from engine with steam jackets on (these jackets drain or return to boiler). Boiler pressure, 16lb.; vac. by gauge, 25·1in.; bar., 28·8in.; revolutions, $20\frac{1}{4}$ per minute. Av. press. of cards (three) gave 10·725H.P. = 63·75. I close jacket cocks on boiler and drain jackets, leaving drain cock open, and after two hours I took three other pairs of cards. Let me here remark this is from a pumping engine, and the load certain. The cards in their figure to the eye had not altered a single phase; but here comes the point or puzzle: The boiler press., 16lb., same as before; vac. gauge, 24·9in., slight fall; bar., 28·8in., same; injection water in both cases the same, 50°; but jacket on, hotwell temperature, 98°; jacket off, 102°. Speed had fallen to 18·75 revs. per min., and av. press. in cylinder 10·74lb., H.P. 58·43. Now, with an increased average pressure in cylinder and load the same, cut-off same, boiler press. same, initial press. and release the same, we have a decrease in speed and an increase in the hot-well temperature, the injection flow remaining the same, being from main through meter.—WATER THUMPER.

[61576.]—**Chimes for Grandfather's Clock.**—I am fitting chimes into a grandfather's clock. I wish it to sound the same notes and in the same time as the clock in the tower of the Houses of Parliament at Westminster. Will someone kindly tell me the notes—their time and order? Also what size and length of steel wire I must have for each particular note.—EIGHT-DAY CLOCK.

[61577.]—**Meridian Instrument.**—Can any reader give any information respecting Dent's "Meridian instrument"? How is it fixed and used?—HERMES.

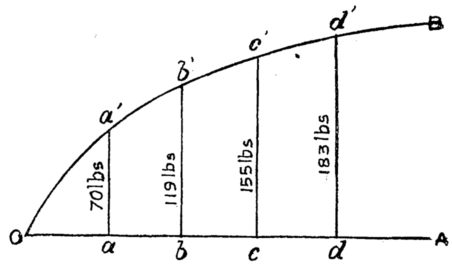
[61578.]—**Walnut Plank.**—I have a large quantity of walnut boards that are 9ft. long, and 9in. deep by $\frac{3}{8}$in. thick, that I want to bend round a corner, the bend being very quick, varying from 6in. to $8\frac{1}{2}$in.—that is, the bend corner at the bottom is 6in. and at the top $8\frac{1}{2}$in.; but when they are bent they are parallel at the top and bottom, and have to be cut out on a sort of sweep before they are bent, something like rough sketch, and at the points A and B



they are a bit on the cross grain of the wood, and at these points, many of them, say about 75 per cent., crack, or break right off, or splinter. The mode I have of doing them is this: I put them into an iron cylinder and close up the ends, and let steam into the cylinder from a boiler at 60lb. pressure, having first filled the cylinder with water, and let them remain there for from three to six hours, and then I take them out and put them into a vice made the shape I want them bent, and by pulling up the jaws against the wood I am able to squeeze them to the required shape; but the trouble is the splintering and breaking of sometimes one end and sometimes the other. Will any of our kind readers help me? Are there any chemicals that I could put into the cylinder that would make the walnut slabs more pliable, to prevent the cracking and splintering, or can any other way be pointed out, as this walnut wood is very expensive, and the failure in each case costs about 15s.? I will be glad if any friend of "Ours" can help me out of the difficulty. I have back numbers from 1881.—JOE BLAIN.

[61579.] — **Storage Cells.** —I have made a trough case of five storage cells. Divisions are glass, and painted inside with marine glue. Each cell contains five lead plates, 4in. by $3\frac{1}{2}$in., alternate plates connected so as to form four faces to each "pole." Please say how I should set about forming. I did as Mr. Conry advised, *re* nitric acid, and have spent some time with a good current, but cannot get signs of formation. Is it of any service continuing charging after the gases have commenced to be evolved? In my cells, gas comes off almost immediately on commencing to charge. Should they be connected in parallel to charge, or is that only to be done when charging current is too low E.M.F.? How many ampère hours?—ANOTHER READER.

[61580.]—**Helical Spring.**—Would a reduction of section of the metal of which a helical spring is composed, from the outer end towards the centre, cause a diminution of increments of tension as the spring is wound up? I wish to obtain a spring, in a drum about 2ft. diameter, which will give approximately the subjoined diagram of



tension. *Oa*, *ab*, *bc*, *cd*, show the amount of circumferential movement of the drum for each revolution, and *aa'*, *bb'*, *cc'*, *dd'* the amounts of force to be exerted by the spring at the circumference. Is there any book on the subject?—HELIX.

[61581.]—**Telephone Switch.** — Can any reader inform me how to make a switch for a central of A, B, and C stations, so that central station B can communicate with A or C separate, and for B to be able to couple up A and C? The greatest difficulty to me is how can A or C tell central B they have finished communication, unless B's bell is always in the circuit? — EN-SWITCHED.

[61582.]—**Chloride of Mercury for Battery.**—To "SIGMA."—Is there any reason, apart from the expense, why chloride of mercury (corrosive sublimate) should not be used instead of the sulphate for a single-fluid battery?—F. R. R.

[61583.]—**Castings.**—Can any reader inform me the class of metal that is used in making children's toy metal tea sets? Also, what metal is the mould for casting usually made of?—CATHODE.

[61584.]—**Stamping.**—I am about making a quantity of medals about the size of a penny piece out of soft metal. Could any reader give an idea of the size press I should require to stamp these up? I have one, but it is too small; but it will do for cutting the blank pieces out before striking up the design on the sides. Not knowing anything regarding power of presses or amount of power required for stamping medals, I should be thankful to receive whatever help you may be pleased to give.—G. H.

[61585.]—**Polishing Fretwork.**—I have some fretwork in walnut to polish. I have treated the wood in the usual way: first with linseed oil, then with wax and turpentine, then with Harris's French polish; but there is no gloss. Will one of our experienced readers help me, and also tell me how to treat the edges?—ONE IN A FIX.

[61586.]—**Waterwheel.** — Will some fellow-reader kindly tell me whether 14gal. of water per min. coming through a 3in. pipe with a 10ft. fall upon an "overshot" waterwheel, 3ft. diam., 18in. wide, is sufficient to pump 1,000gal. of water in 24 hours with a $1\frac{1}{4}$in. force pump through 1,000ft. of 1in. piping and to a height of 100ft.? If it will do it, kindly give formula.—ZULU.

[61587.] — **Street Medical Coil and Phonograph.**—I have no doubt there are others besides myself who would be glad of instructions to make, and a sketch (to scale) of a good street medical coil, and also the phonograph. I am anxious to make both, but uncertain how to start. Some of the coils have a wheel revolving or bell ringing. I want to make for a bazaar. Will someone kindly assist?—COUNTRY.

[61588.]—**Brass-Cleaning Composition.**—I have noticed the G.N. carriage cleaners at Peterborough rub the carriage door brasses with some composition which gives a good polish to the most tarnished metal. Can any of "ours" state what it consists of? Having a deal of brass-work to clean, should find it useful, as might also other readers.—COUNTRY.

[61589.]—**Coal Economy.**—In your issue of the 14th ult., under the above heading, "Nun. Dor." empties the vials of his contempt on the sugar refiner who used 900 tons coal to refine 1,800 tons of sugar weekly. Now if "Nun. Dor." can show in what manner this quantity can be lessened, I feel sure that every refiner in the world would gladly adopt his suggestions. I do not know what power said refiner used; but I do know that in a refinery working about 400 tons weekly it is nearly 130 horse.—CANE SUGAR.

[61590.]—**Electrical Footwarmers.** — Can any correspondent give me any information concerning the above, as to working, and construction, current, and E.M.F. required, &c., particularly that of Mr. Rabache, about which a reply appeared in "Ours" lately?—EDWARD CONRY.

[61591.]—**Lifeboats.**—What is the maximum number of lifeboats carried by any man-of-war, taking the definition of a lifeboat to be a boat fitted with special apparatus to enable her to ride out a heavy sea and venture out in such for the saving of life, and regarding such boats as distinct from the ordinary boats of the ship intended for the usual purposes of marine conveyance?—EDWARD CONRY.

[61592.]—**Tinned Steel Spiral Springs.**—Would any of "ours" be kind enough to say if tinned steel (1-16 wire) spiral springs keep their spring pretty well?—LIGHT WEIGHT.

[61593.]—**Electro Deposition.**—In an article in "Ours" on "Electro Deposition," by Watts, I see you speak of lead being deposited under a process known as Nobili's rings. Could you give me full details how I could do this, and if it would be possible to procure this on tin? I find that when Banka tin is recast and rolled out as fine, some of it is smooth and other parts granular, and as this prevents it being rolled out very thin, I desire to find some means of checking. The smelters say that it is caused by the metal being cast at different temperature. Could this be the reason, and, if so, say at what temperature it should be cast for granular? I must also add that pure Banka tin is used without any alloy. I also desire to know if I could deposit tin, lead, or antimony in a crystaline form on tin foil? I have tried the two back numbers mentioned, but have not succeeded (that is, dilute nitric acid and hydrochloric acid, also tartaric acid with hydrochloric acid). Do you think that acid and tartarate of tin and caustic potash would do for it? I think I saw this in a book. Where I work, we use a large reverberatory furnace for converting lead and tin dross into lead and tin; but we find, with all the precaution of dovetailing the firebricks and using good fireclay, that the metal runs out in large quantities. Could anyone help me?—CAMMIADE.

[61594.]—**Walcot Battery.**—TO "SIGMA," OR OTHERS.—Can I get the constant of tangent galvanometer by a voltameter or closed Smee cell (as described by you in your "Electricity") in chemics and ampères, single ring 18⅝in., needle 1⅛in.?—STUDENT.

[61595.]—**Lead Burning.**—Will some brother reader kindly tell me how to join the corners of a small lead box without soldering? Can it be done without the aid of a blowpipe, as I do not possess one? The lead is 4lb. to the foot, and the joints must be perfectly liquid tight.—ARCADIAN.

[61596.]—**Goniostat.**—TO MR. EVANS.—I am thinking to try to make a goniostat after Mr. Evans's instructions, Vol. XXXV. No. 888; but there are two or three little matters which do not appear quite clear. It is not stated of what material the plates and some other parts are constructed. He says: "Before proceding with the steel parts." It may therefore be assumed that some of the parts are not steel, but it is not stated which. He also says in one part that 3-16th Whitworth threads, as a rule, will do for the screws; but almost immediately afterwards says: "I will take it that these—viz., ¼ Whitworth, shall be considered the threads throughout." But the most important omission appears the omission of any directions for cutting the graduated degrees on the arcs, and without which the instrument is, of course, quite incomplete. Perhaps Mr. Evans will kindly add to our obligations to him by supplying this information.—B.

[61597.]—**Organ Pipe Scales.**—Is there any rule for making pipe scales? For instance, I have a length rod; but if I make a larger scale, my pipes are too long, and if I make a smaller one they are too short. Cannot I know at once what the lengths ought to be if I decide upon certain depths and widths?—B. BOLT.

[61598.]—**Hall Mark.**—Will someone of your numerous readers kindly give the date and country of the following Hall mark, which occurs on a standing cup, in the Renaissance style? Beginning at the left, the first mark is the numeral 13 in Court hand, then follows an anchor with a rope attached, then what appears to be a human head, then a lion rampant, then the maker's initials, two capital L.'s back to back, which I take to read J. L. The latter is in a sexagonal shield; all the rest in circular or oblong.—ARGENT.

[61599.]—**Gunmetal.**—Would someone kindly say how to mix gunmetal, as I wish to try some castings, such as bicycle hubs?—BLACKSMITH.

[61600.]—**Cone for Lathe.**—I have a 3in. backgeared lathe, with three speeds—viz., 2⅞in., 2 5-16in., 1⅝in. Would someone kindly say what size of a cone I would require to work on crank-shaft not to have the belt to shift? I wish to make the smallest size 6in.—BLACKSMITH.

[61601.]—**Decomposition of Carbonates.**—Can carbon or acetylene be obtained from carbonates by heating them to a sufficiently high temperature in an atmosphere of hydrogen, and what degree of heat is required?—ALPHA.

[61602.]—**Pile Driving.**—Will one of "ours" kindly give a description and good sketch of Doherty's patent ram for pile-driving, or any other kind of approaching automatic "monkey," not forgetting to find fault, if needed?—GUILLAUME BOIS.

[61603.]—**Reduction of Numbers.**—Can any reader tell me whether any number containing, say, from 10 to 60 figures can, by some method, be reduced step by step to one of two figures in such a manner that, by reversing the method, the original number can step by step be worked up again from the two figures found? I have to work with numbers of great compass (I mean by this, containing a great many figures), to which logarithms are wholly inapplicable.—REDUCTION.

[61604.]—**Chemical Equivalents.**—Is there any chemical book or tables of these published giving the complete symbols and combining proportion of all the usual metallic salts and their water of combination and crystallisation, as, doubtless, many besides myself would be glad of being relieved from unnecessary calculation?—VULCANITE.

[61605.]—**Jerusalem.**—Will any subscriber kindly inform me if he has visited Palestine, and date when, or has executed work in that country? The cost of lodgings and living there, and if the climate is healthy? Also, what quality or kinds are the stone? Also the various woods?—JAFFA.

[61606.]—**Railway Fish-plates.**—Is there any advantage in having fish-plates clip under the rail, and, if so, what? When were fish-plates invented, and how did they join the rails before the introduction of the fish joint?—STUDENT C.E.

[61607.]—**Proportions of Locomotives.**—What proportion should the cylinder of an engine bear to the boiler or heating surface?—INQUIRER.

[61608.]—**Compound Engines.**—It is often said that the compound principle is best for goods engines because they run at a slower speed. Now we know a goods engine runs at a less speed per hour by reason of its small wheels; but does not a goods engine make as many revolutions per minute as the express engine?—LOCO.

[61609.]—**Warming Railway Trains.**—I think every one who has had the bad luck to ride in trains this winter will say our railway carriages are fearfully cold. What plans are there to warm them, either by exhaust steam from engine, or by gas or hot water?—HALF FROZEN PASSENGER.

[61610.]—**Circular Saw.**—I have two Howe sewing machines, toothed wheels—two 8in. diam., four 2in. diam., with spindles. What thickness of wood will those wheels cut with an 8in. circular saw? Also, how are the wheels to be placed to run?—J. T.

[61611.]—**Improving Clay for Pottery.**—Can ordinary white bricks and white chimney-pots be made of clay such as would make common stock bricks? White brick is made by Cubitt's at the Isle of Dogs. The clay there must be very poor; and I am told they grind up broken crockery from dust-hole refuse for the purpose. If so, what sort of mill would be used? Doulton's and Stiff's both make chimney-pots of a light-coloured clay at Lambeth. Can anyone say where it is obtained?—MURANO.

[61612.]—**Food for Animals.**—Will someone please tell me which of the following (or any others) is the best to feed calves or pigs on, not to fatten, but to make them as large-framed as possible: Beans, peas, barley, oats, pollard, bran, or will any of the patent foods give the desired effect better? Does skimmed milk added improve matters in case of growing pigs?—THOMAS.

[61613.]—**Dynamo and Continuous Current Battery.**—Will a dynamo giving, say, 40 volts and one or two ampères answer the same purpose for medical uses as a battery coupled up in series to give the same amount of current and E.M.F.?—F. G.

[61614.]—**Clutch.**—Would any reader give me illustrations of the clutch—how it is thrown in and out of gear, and how it is fitted together for screw-cutting lathe?—A. SEDGLEY.

[61615.]—**Porcelain Clay.**—Can any correspondent inform me where this can be obtained, and if any special knowledge is required in treating same for moulding and baking, or if special furnace is needful? I am desirous of making some insulators of a particular form, and should like them to be of this material, or of vitrite or glass.—H. T. C.

[61616.]—**Gramme Dynamo.**—I have a Gramme dynamo, fields wound with 40lb. 20d.c. The pole-pieces will take in an armature 6in. dia. What ought this to be wound with to give 20 by 20c.p. lamps easily? The armature preferred would be a Gramme ring made from iron wire. The total resistance of wire on fields is about 70 ohms.—A. B.

[61617.]—**Removing Ink Blots.**—A so-called "fluid ink eraser," which causes ink blots and marks to disappear, is being sold in shops. Of what is the solution composed?—X.

[61618.]—**Variable Pitch Propeller.**—How is this propeller shown on a working drawing? I understand and can depict a true screw.—GIL BLAS.

[61619.]—**Varnish.**—I want to find out which varnish will stand the greatest amount of heat. It is to be used in combination with asbestos. Will any of our experienced readers give me results from practical experience?—OILMAN.

[61620.]—**To Mr. Bottone.**—I am making small dynamo with laminated H armature, but do not know how to fix sections of armature on rod. Will you kindly advise me?—FIXED.

[61621.]—**Dividing a Circle.**—Will any reader tell me how to divide a circle geometrically into any number of equal parts, say three, (1) by lines drawn parallel to any given diameter, (2) by lines drawn from any given point (other than the centre) to the circumference?—A SUBSCRIBER.

[61622.]—**Planetary Drawings.**—Would any of your readers kindly inform me how the dead black representing sky is obtained in planetary drawings? I have been trying Indian ink, but not very successfully. What paper is generally used, and where obtained, and what colours employed? I allude especially to the fine sketch of Saturn presented by Mr. Green to the Royal Astronomical Society; also the beautiful sketches of Venus, showing phosphorescence of the dark side. How is the transparency of Saturn's crape ring best rendered? The Merope nebula, which many observers affirm they have seen with small apertures, is not nearly so large or conspicuous in Mr. Roberts' photograph as that surrounding Maia, Alcyone, and Electra; that round Maia seems by far the largest, judging from the photograph.—CONSTANT READER.

[61623.]—**Legal and Revenue.**—Receipt for succession duties paid seven years ago has been lost. Is it necessary to show a receipt for these duties on selling any portion of the property? If so, how can one be reobtained?—SUCCESSOR.

[61624.]—**Speculum.**—I have been grinding and figuring a speculum, but am rather disappointed with the result. It gives a perfectly defined image of the moon, and the sun also; but when it is placed on Saturn, or any star, the image is ill-defined and woolly. Under the shadow test, the curve is certainly parabolic; but is the correction carried too far, or the reverse? The shadows are not very dark when the speculum is under test.—ETANIN.

[61625.]—**Chemical.**—Will some chemical friend kindly inform me how to make ozonic ether? I can procure hydrogen peroxide of 20 vols. strength.—OZONIC ETHER.

[61626.]—**Assaying of Ores.**—Will some of your numerous readers give me advice as to becoming capable of assaying gold, silver, lead, copper, and blende ores—that is, to make the shortest way without going to the Royal School of Mines to have a thorough course, but the quickest way? I have a knowledge of the different ores. What time would it take me? What books and instruments would it require?—CYMRO.

[61627.]—**Boring Hard Wood.**—Will one of your numerous mechanical subscribers kindly describe the best bit or tool for boring hard wood? The hole I want is 1⅝ dia., and wood 1⅛ thick. I have been using a centre bit, speed about 2,000 revs. per min.; but it spalters off about 1-16 of wood on the under side, which I want to avoid.—H. F.

[61628.]—**Lard Oil.**—I use a good quantity of English lard oil in my work, which at present time is an item considering the competition in the manufacturing line. I therefore bought, through the "E.M," Sixpenny Advertising Column, several recipes how to make substitute for lard oil, but none of these turned out of any value. I should like to learn the experience of others in this matter. Can any of your numerous readers direct me how to make, say, from American lard, which I can get at a very low figure, a good substitute for English lard oil? I shall be very much obliged, and would publish the result.—MACHINE TOOLMAKER.

[We have ourselves found Bell's asbestos lubricant the best substitute for lard oil in connection with our printing machinery, after trying a good many things.—ED.]

[61629.]—**To Analysts.**—A sample of flour is supposed to contain a mineral poison—viz., As, Sb, Cu, &c. How can it be got into solution so as to estimate it? Could the sample be treated with dilute HCl, filtered, and the filtrate treated with the group reagents? I know the method of treating the ash with HCl, &c.; but find it very tedious, as such a large portion of the flour has to be taken to obtain sufficient ash. How can strychnine be detected and estimated in flour, &c.? Will the method of detecting and getting into solution prussic and oxalic acids in viscera hold good for flour, oatmeal, &c.?—X. Y. Z.

[61630.]—**Loss of Power in Model Lifting Crab.**—In a model of a lifting crab, the circumference of the circle described by the end of the winch handle is 43in., and the circumference of the drum which raises the weight is 14·9in. The wheel work gives an advantage of 8 to 1, and it is found by trial that a power of 3·1lb. on the winch handle just suffices to raise a weight of 56lb. hanging on a cord wound round the drum. What proportion of the power exerted is lost in this model?—S. B.

[61631.]—**Whiskey Distilling.**—What is the greatest strength whiskey is ever made for sale? How strong could it be made for sale if required? What is the greatest strength of the spirit as it comes from the still—e.g., soon after the spirit begins to distil and before much water comes with it?—KANET.

[61632.]—**Specific Gravity of Spirits.**—What proportion of spirit to water is "proof" spirit? What are "degrees" over and under proof, and how is "proof," "over-proof," and "under-proof" to be calculated from the specific gravity? What is the difference between 30° over proof and 3 per cent. over?—KANET.

[61633.]—**Dynamo.**—TO MR. BOTTONE OR MR. CONRY.—I have a series-wound dynamo, which I should like to make into a shunt-wound. The size is F.M. 7in. high 2in. thick, pole pieces 8in. by 3in. wide, with the opening 7¼in., and wound with 10lb. of No. 16 c.c. wire, armature 7¼in. by 3in. wide, Pacinotti type, cast iron, wound in 12 sectors, with 2¼lb. of No. 18 c.c. wire. Will you tell me what quantity of No. 16 to add to it, or would you think it will be best to wind it with No. 18 c.c. wire, and what quantity, and at what speed to drive it at, and what volt lamps to use? I want to run eight 16c.p. lamps.—DIAMINE.

[61634.]—**Will o' th' Wisp.**—Has any living reader heard of anyone who has seen this phenomenon? I had a nursemaid from near Hindon, Wilts, who used to describe it; but, without knowing this literary name, nor "corpse-candles," or any other that we see in books, she called it "Kit candlestick," which was the trade name, early in this century, of a candlestick with a slide; the flames over marshy ground always, according to her, dancing up and down, as if raised and lowered in such a candlestick. Has drainage entirely extinguished Will o' th' Wisp in Britain or everywhere?—E. L. G.

[61635.]—**To "T. C., Bristol."**—I have a 12-horse horizontal engine doing about 4-horse work. Her speed is 90 revs. per min., driving a shaft at 30 revs. per min. Would it be a saving of much steam for the engine to travel same as the shaft? The cylinder is 14in. bore by 20in. stroke. The back-pressure is but little more than the pressure of the atmosphere.—ANXIOUS TO KNOW.

[61636.]—**"Feed" Wick for Paraffin Lamp.**—I have a duplex lamp, with very deep reservoir. The lamp will hardly burn at all except when filled to the brim, and I am told the wick should have an extra wick to act as a feed, and that lamps with very deep reservoirs are so fitted. I sewed two pieces of wick (trebling it), and it burnt very well, but this is manifestly an inconvenient plan. How could I add a feed wick? A sketch would be useful.—MURANO.

[61637.]—**Romsey Observatory—Dewing of Object-Glass.**—Will any practised observer give me his experience of the above kind of observatory? Mine is built according to Mr. Berthon's instructions. It has a space of about 1½in. between top of wall-plate and bottom of dome-ring. A zinc-hood 4in. deep is nailed all round this opening on outside to keep out snow and wind-driven rain. In warm, damp weather the iron pillar and circles, &c., are always covered with moisture, in spite of ventilating space between dome-ring and wall. My dew-cap is of metal, having a cover like a camera-cap, lined with velvet. Should this leather cap always be put on the end of dew-cap when shutting up for night? as I often find the o.g. anything but "bright" next morning. I have been in several well-appointed observatories, and find the owners never cover the open end of dew-cap, and do not complain of dewing. My observatory is all wood, canvas-covered dome. Any hints by owners of Romsey observatories would be gladly received.—H. A.

[61638.]—**Vertical Boiler.**—TO "T. C., BRISTOL."—I have a vertical boiler which is 2ft. 9in. high, 14in. dia., with firebox 18in. by 10in. at top. Is it large enough to work an engine 2in. bore by 3½ stroke, boiler made of ¼ plate? And will you kindly tell me what size hole it will take for the safety-valve, which is a lever valve, and what weight to put on it; and what pressure it will stand; and at what pressure to keep it working to keep it at half-horse? It is to work a dynamo of eight 16c.p lamps.—DIAMINE.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding : No. 613.
Electric machines : Nos. 1,009, 1,025.
Electro-magnets : Nos. 772.
Lacquers : No. 866.
Pattern Making : Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating : Nos. 1,009, 1,010.
Varnishes : Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 2, and unacknowledged elsewhere :—

CROSSLEY BROS.—U. Dini.—D. H. Sinton.—W. Yonge.—J. E. H. Andrews and Co.—P. H. Anderson.—S. and Co.—W. H. Smith and Son.—King, Mendham and Co.—W. Stanley.—F. A. Smith.—E. S. Hindley.—Vulcan.—Herbert Ingall.—R. T. Lewis.—A Fellow of the Royal Astronomical Society.—J. H.—Jas. G. Shepherd.—W.—J. S.—Sanderson.—J. R. Campbell.—Garrison Gunner.—R. P.—W. A. T.—Foreman.—Wm. White.—Q. E. D.—J. P., Aigburth.—Electrical Student No. 2.—Iota.

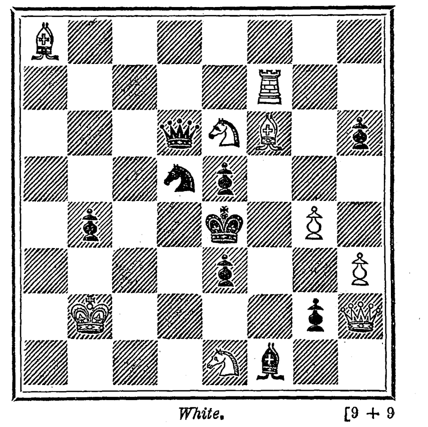
TOR. (A couple of small chloride of silver cells would do; or you could make Leclanché cells up to that size, by special arrangements. Look through the indices of back volumes for directions for making.)—G. M. (You must wait patiently. Inventors, if they are wise, do not describe their devices before the patent has been obtained; for "provisional protection," as it is called, is now only the acceptance of an application.)—H. F. G. (It does not say a "third part," but "three parts," and "parts" means ounces, pounds, or anything else, according to the quantity of the mixture required. 2. About three or four ounces. No coils. See back numbers—p. 561, last volume, for instance.)—T. D. (Culley's "Handbook of Practical Telegraphy," Longmans, price 16s.)—C. (Directions frequently given; but the construction of the coil must be known. See p. 53, this volume.)—SPARKS. (Electric gas-lighting arrangements have been frequently described and often illustrated. For a portable appliance, see p. 403, No. 1033, or p. 391, No. 927. For the stationary arrangement, all that is needed is a little coil of platinum wire over the burners, which is made nearly white hot by the passage of a current from a battery; or, instead of that, two platinum-tipped wires are adjusted close over the burner, and a spark is passed when it is required to light the gas. See indices.)—P. E. A. (Apparently made for some special purpose. No one can do more than guess.)—T. EASEL. (Perhaps you do not rub the work down between the successive coats. The finishing coat must be either a varnish paint, or the work must be varnished as a finish.)—F. W. (See pp. 352, 378, this volume; pp. 348, 390, Vol. XLII.; p. 226, Vol. XXXVII., and the indices generally. 2. You want a "changing bag," for which see pp. 487, 512, last volume, and the indices.)—T. W. WOODHEAD (You might obtain a second-hand copy by advertising in the Wanted Column. Thomé's "Structural and Physiological Botany," published in Longmans' series of Textbooks of Science, 6s., might suit. 2. Would "Coal: its History and its Uses," by Profs. Green, Miall, Thorpe, Rücker, and Marshall, be likely to suit? If so, it is published by Macmillans, 12s. 6d. See Hints No. 5.)—VIR. (A special preparation is necessary, we believe. See p. 392, No. 1032, and p. 226, last volume.)—H. MCC. (Papier-mâché is what its name implies, but it can be moulded up from any pulp that would make paper. You would require powerful machinery to exert the requisite pressure.)—WALTER WHITE. (The only way we know of is to examine the local papers for announcements and advertisements.)—E. CHAPMAN. (You can obtain sketches in some of the trade catalogues. They are made just the same as other rising bellows, except that they are round.)—GREASEY. (No, it is the heavy oils, after the burning oil and paraffin have been extracted. Quantities of it are no doubt brought into your port; but try some of the large dealers in oil, or insert an advertisement in the Wanted Column. 2. Tallow is made from the fat of animals, mainly the ox and the sheep.)—G. WILCOX. (To answer such a question it would be necessary to search the records at the Patent Office. A patent agent would be able to tell you.)—PNEUMATIC SHUTTER. (Many of those illustrated can be made to work inside camera; but to what good purpose?)—C. LESTER. (We might be able to answer your question if you could determine the age of the Runic characters. They were most probably introduced by Phœnicians. See the article "Alphabet," in the "Penny Cyclopædia.")—E. R. DALE. (The calculating machine at the Railway Clearing House is, or was, De Colmar's, illustrated in No. 571. 2. Where is the reference to the gas floating lamp? At present it seems to be unknown.)—A CONSTANT READER. (Silvering on lead is not easy; but it may be accomplished by scraping the lead surfaces clean and immersing in a bath of cyanide of silver solution containing a large proportion of free cyanide. A current of considerable E.M.F. is used, and as soon as a thin deposit of silver has been obtained the articles are removed to the ordinary plating bath.)—E. A. HANCOCK. (If you mean Wheatstone's bridge, in No. 1105, p. 286. See also p. 328, No. 1107.)—MANCHESTER. (Query too indefinite. If you mean that the core is No. 9 thick, use No. 26 or 28 wire.)—TELEGRAPHIST. (See indices. You do not say what is the resistance of the lamps or the voltage they are adapted to. If of low resistance, two or three cells would answer.) — INFORMATION. (Sprague's "Electricity," published by Spons; but see indices.)—NIL DESPERANDUM. (If opening the door is a remedy, it is clear that sufficient air does not otherwise get into the room. You can take a pipe from the outer air to the hearth under the grate, or put in a stove with a chamber at the back, which will draw air from the outside and deliver it warmed into the room. A Boyle's cowl will create a draught if there is sufficient inlet for the air. You will find many suggestions in back volumes.) — ONE WILLING TO LEARN. (Reynolds's "Stationary Engine Driving," Crosby Lockwood and Co., Stationers' Hall-court, E.C., price 4s. 6d.)—DIDDEMEWASS. (One hundred cubic inches of hydrogen at 60° Fahr., and 30in. bar., weigh 2·143 grains; roughly, 13½ cubic feet will lift a pound. 2. The "capacity" of a circle is a misnomer. You mean its area or superficial contents. To find that, multiply the diameter by itself (square the diameter) and multiply again by ·7854.)—A CONSTANT READER, E. T. (An illustrated description of the xylophone in No. 1063, p. 494. Lengths of wood can be found by trial.)—STEREO. (They are supposed to be identical, but in practice the composition varies. Lead 4 parts, antimony 1 part, is the standard; but founders never care to take tin out of any old metal they may buy, but they most religiously exclude zinc. The working temperature is a straw colour on a bit of paper, momentarily dipped into the pot; but if the moulds are of plaster, the metal may be a little hotter. You should have stated the process you are working, and with what plant. Put a small piece of tallow in and stir briskly, when the dross will rise, and can be removed.)—WILLIAM PETERS. (Cannot you put some ventilating gratings in by removing a few bricks from the course just below the ceiling? 2. Do you mean real soap powder? That should be made by shredding Castile soap very fine and allowing it to dry. It is then rubbed through fine muslin. If you mean the so-called soap powders, take yellow soap, 6 parts; soda crystals, 3 parts; pearl-ash, 1½ part; sulphate of soda, 1½ part; palm oil, 1 part. Mix, spread to dry, and grind.)—A SUBSCRIBER, East Molesey. (Your opinion is quite correct. Ice often forms at the bottom of rivers, and is well known as "ground ice." The phenomenon is, perhaps, best known to those who frequent the St. Lawrence, a river which habitually freezes at the bottom, to such an extent indeed that the ice sometimes drags up ship's anchors: hence the name there of "anchor ice." Lyell in "Principles of Geology," gives an interesting account of the phenomenon, and there are several references to it in Geikie's "Textbook.")—W. A. A. (If you mean the rubber tire, there is no satisfactory way of mending one. You can join with rubber solution and bind round with canvas smeared with the same, securing all firmly with string.)—CHIPS. (Have you tried the experiment? If so, what is there to explain?)—INVALID. (The cause, so far as it can be stated, is mentioned in the article.)—M. F. (You do not say at which port; but apply to Don P. Martinez del Campo, 175, Cromwell-road, S.W. He has charge of Mexican affairs. 2. You can procure the Act from the Queen's printers, East Harding-street, E.C. 3. Sixpence.)—A SHOPKEEPER. (Ventilation is the only complete remedy. There has been a good deal of discussion about it in back volumes; but so long as there is vapour to be condensed, and the air outside is colder than that inside, the windows will steam unless well ventilated. A suggested remedy is a very thin film of glycerine.)—W. CHEST. (Against the rules. The answer could be only a gratuitous advertisement, though it might be given in perfect good faith. Why not consult our advertisement columns, and read the many articles and letters on the gas engine? You should remember that the lowest-priced is not, as a rule, the cheapest article.)—ENGINEMAN. (All sorts of fancy recipes have been given in back volumes—the latest in Vol. XLI. More depends on the smith than on the solution; but plain water or salt and water ought to answer.)—CHYM. (Filter through flannel and then through animal charcoal, or adopt one of the acid processes for bleaching.)—BLACKSMITH. (You will find diagrams for a fan-blower in No. 915, p. 120, and can diminish or increase size to suit.)—W. A. L. (Yes, the brasswork must be dipped and thoroughly cleaned before the lacquer is applied. The usual dipping-acid of the shops—a mixture of nitric and sulphuric. See an article on the subject in No. 1101, and many hints, recipes, &c., in back volumes. 2. A model boiler is illustrated in same number. See also Nos. 1045, 1029, and the indices generally.)—J. P. B. (You want the pure "white" guttapercha, generally sold in sheets. If you cannot procure it in your district, send to one of the dental houses.)—TEMPUS. (For "how to make a sundial," see p. 316, No. 924, and the indices.)—J. G. (Leclanché cells are best, but data not sufficient to answer how many—perhaps three. Look under heading Electric Clocks in indices.)—IGNORANT. (Perhaps the best way to recover gold from cyanide solutions is to add hydrochloric acid slowly until no further precipitation is observed; then boil, and set aside to cool. Separate the precipitate by decantation and filtration, and add zinc filings to the liquor, which will throw down the remaining gold, which is treated as before, and added to the precipitate. The latter is then mixed with an equal weight of sulphate of potash, fused and ignited, the saline residue being dissolved out with boiling sulphuric acid. Wash with water, and the residue is pure gold. Such work ought not, however, to be done by novices on account of the poisonous fumes.)—ALEX. PAICE. (We do not think the idea would be of any great actual advantage to riders.)—B. B. (Change yours; it is preposterous to fancy that any two letters of the alphabet can become any man's special property, or that we could bear it in mind.)—WILLIAM R. WYNNE. (We prefer a drawing or tracing that we can reduce.)—REYMOND. (Correspondents should *not* put letters into the box when the office is open, but take them inside; a box is provided after office hours. We really can do nothing in the other matter; if the medical students are appropriating the copy sent for the patients, we cannot help it.)—J. FULLER. (If either communication ever reached here it was inserted or attended to. Absence of more precise particulars prevents us saying more.)

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXIX.—BY G. J. SLATER.

Black.



White. [9 + 9

White to play and mate in three moves.

SOLUTION TO 1,027.

White.	*Black.*
1. B-K B 8.	1. Anything.
2. Q, B, or P mates.	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,027, by Avon, V. S. Pochin (but variation 1. ——— Kt takes Q omitted; full marks scored for 1,025), A Beginner, T. W. Hanill (sorry that to 1,024 was overlooked; no additional marks scored for duals discovered in two-ers), Country Boy, A. Bolus, H. Hosey-Davis, J. Mackenzie, F. Krasser, Black Pawn, Major (very good; no duals), T. H. Billington (very neat and pretty), W. J. Carpenter, O. K., James Palmer, and A. Dean; to 1,026, by F. Krasser, F. T. Richardson (please write out solutions as printed), Black Pawn, H. Hosey-Davis, Pomfret, and Snowdrop.

J. PALMER.—What is the matter with the solution to 1,026?

F. T. RICHARDSON.—It is allowable to have 10 Kts. of the same colour on the board at the same time if you can get all your P.'s to the 8th square.

G. T. STRINGFELLOW.—Marks are deducted for imperfect solutions sent. Should, however, a correct solution come afterwards, full marks are then allowed, unless the fault of the previous solution has been pointed out in the Notices to Correspondents. Your solution to 1,026 is incorrect. How do you proceed if 1. ——— Kt takes R?

F. L. C.—How can Q mate in 1,027, after 1. B-K B 3, if K takes Kt?

SNOWDROP.—Thanks for Prospectus. We wish the new venture all success.

The English Mechanic

AND WORLD OF SCIENCE AND ART.

FRIDAY, FEBRUARY 11, 1887.

NOTES ON THE CHURCH ORGAN.

V.

By GEORGE ASHDOWN AUDSLEY, F.R.I.B.A.

IN the two concluding articles of this series, devoted to the consideration of the Church Organ, I touch on what may be accepted as the most important branch of my subject, namely, the arrangement and appointment of the different departments—Great, Swell, Choir, and Pedal organs. Some of the suggestions I have to submit to my readers may, on first impressions, strike them as strange and unworthy of serious thought: but I must ask them to grant the suggestions a little consideration, feeling convinced that truth will obtain in the long run. None of my ideas on this subject have been hastily arrived at; on the contrary, they are the result of nearly a quarter of a century of careful study of the organ under by no means unfavourable circumstances.

The following remarks are of very general application, that is, they are not confined to Church Organs of any special class. The methods of arrangement and appointment suggested are applicable to instruments of all sizes, from fifteen stops upwards to any desirable number.

Great Organ.

It is a prevailing and, indeed, at the present time, an almost universal impression—an impression which, in the minds of almost all organ builders and organists, appears to admit of no reasonable doubt—that the Great is the most important and most useful department of the Church Organ: and that it accordingly should contain the loudest and most assertive stops in the instrument, or, in short, that it should be able to produce as much sound as all the other departments put together. This notion has been founded upon the old German system of organ building, which obtained before any attempt was made to impart powers of expression to the instrument, or to give any part of it the means of producing a *crescendo* and *diminuendo*, without a perpetual manipulation of the stops.

I unhesitatingly affirm that the Great organ, as an *absolute* and (in the sense I here use the word) *unexpressive* department, should neither be looked upon as the most important and useful, nor be made the loudest and most assertive part of the instrument. Now, let us see if my opinion can be supported on any reasonable argument, or is based on any sensible foundation. The organ cannot be compared with any other musical instrument ever invented: as an instrument under the control of a single performer it stands alone. The only musical machine before which it assumes a secondary place is the complete grand orchestra, and it is with this complicated and animated piece of mechanism alone that any comparison can be established.

Now, for the sake of argument and illustration, let us suppose the orchestra divided into two or more sections, fairly complete in themselves; and that the destiny of one section is to produce sounds of a uniform strength or intensity at all times, without a possibility of any variation—*crescendo* or *diminuendo;* and that the other sections are permitted to exercise their full powers of musical expression. Which of the said sections would a musician decide should be the loudest and best appointed—that which he is always compelled to listen to and use at its full and unvarying power, or those which are capable of every gradation of tone and effect of light and shade? The answer is almost too obvious to require insertion here. Would he not say—"Let the *unexpressive* section be composed of those instruments which produce the purest, roundest, and quietest tones, to the uniform flow of which the ear may listen with as little fatigue as possible, if not with absolute enjoyment; and let the *expressive* sections embrace all those pungent, loud, and assertive instruments, as well as the greatest number and variety of instruments, which must be played with expression to be tolerated by the musical ear or to reach the musical sense"?

Turning now to the organ, what does the lesson of the divided orchestra teach us? Surely, that we do wrong to follow the old-world system, and make the *unexpressive* department, called the Great organ, the largest, the loudest, and the most assertive portion of the instrument. I know it is vain to expect that our organ builders of to-day will listen to such a piece of heterodoxy as that which I am here guilty of suggesting; but I am convinced, in my own mind, that my ideas will be found to be worthy of adoption in the long run. *Musicians* will, I feel sure, acknowledge the force of my proposition. Putting aside the argument based on the illustration I have ventured to draw from the divided orchestra, there is another consideration which supports my proposition—one which has a more direct bearing on the question at issue. When it is borne in mind that the Great, like all the other departments of the Church Organ, has for its chief office the accompaniment of the human voice, it must be obvious that, in its *unexpressive* nature, the tonal structure of the entire department should be characterised by a full volume of quiet, refined tone, rather than by those bellowing and screaming qualities which the majority, if not all, of the Great departments in modern organs possess. It must not be for a moment understood that I advocate the impoverishment of the Great department of the Church Organ, for such is far from my intention. I seek, rather, to increase its dignity, grandeur, and usefulness, by adapting it, in a true musical sense, to the place it occupies and the work it has to do, by imparting to it that rich refinement of tone, that volume of quiet intensity which overcome even the necessity for light and shade. To my mind the Great department of the Church Organ should be a normal organ—fundamentally and essentially an *organ*—producing sounds and combinations of sound strictly born of and peculiar to the *organ*, and unproducible by any other instrument, or any collection of instruments, under the sun.

The question now arises, How is such a Great organ to be schemed, and how should it be disposed with reference to the other and especially the *expressive* departments of the instrument?

It will be remembered that, in a previous article, I have strongly condemned the present pernicious practice of using heavy and unnecessary pressures of wind; and have advocated the universal adoption of moderate pressures, copious windage, ample scales, and a refined system of voicing for the pipe-work. All these virtues are necessary for the formation of that amiable character of tone on which the true beauty and utility of the Great organ depend. It is, perhaps, unnecessary to go into the question of wind pressure again; but I may, to save the reader the necessity of referring, reiterate one passage already written which is very much to the point:—"There can be no question that the tones produced from large-scaled and substantial metal pipes blown by a copious supply of wind at moderate pressure are in every way vastly superior to those produced from small-scaled pipes blown with high-pressure wind. For Church Organs, there can be no comparison between the two; for the tones yielded by the former are characterised by richness, volume, and great travelling power—just the qualities required for choral accompaniment—while the harsh, thin, and unimpressive tones of the latter utterly fail to satisfy the conditions of a sympathetic accompaniment." To be as practical as possible, I may at once give my opinion in favour of the adoption of $2\frac{1}{2}$in. as the maximum pressure for the Great organ. With this weight of wind, combined with a plentiful supply and proper voicing, everything desirable for this department can be arrived at.

The tonal scheme of the Great organ deserves most careful and thoughtful consideration. First of all, the proper quantity and quality of *unison tone* has to be provided by *Diapasons* and certain other stops of 8ft. pitch. In small instruments one *Open Diapason* will be sufficient, supported by two or three other unisons; but in organs of larger size two *Open Diapasons* will be necessary, for use separately and together. The first Diapason should be of large scale, yielding tones characterised by great volume and roundness—tones forming, as one might say, a cushion of sound upon which all other tones will rest in a beautiful repose. The second Diapason should be of much smaller scale, producing pure tones, characteristic of the stop, of medium power—say, midway between the strength of the first *Diapason* and that of the *Dulciana* as it is usually understood. The windage and voicing of the second *Diapason* must be essentially different to the first, so that all tendency to absorbing sympathy may be counteracted. Apart from this important consideration, the diversity presented by the two *Diapasons* will be invaluable in accompaniment. As a rule, at the present time, when two *Open Diapasons* are introduced in the Great department of a Church Organ they are far too near both in scale and strength of tone; and, accordingly, their independent utility is minimised, and a poor result is attained by their combination.

The next unison in order of importance is a covered stop, preferably of wood, of quiet, round, filling-up quality. I unhesitatingly give my vote in favour of the *Doppel-Flöte*, as it is met with in the organs built by Roosevelt. This stop mixes well and is satisfactory under all conditions. The *Doppel-Flöte* is, however, as I have previously said, unlikely to make its appearance in English organs, so we shall have to fall back upon the good oldfashioned *Stopped Diapason*, a perfectly satisfactory register for such a Great organ as I am attempting to scheme.

Difference of opinion has right to obtain with reference to the next unison to be introduced, simply because, now, circumstances alter cases. I may just remark, in organs where there is no second, small-scaled *Open Diapason* in the Great, a *Dulciana* may be added with advantage; but where the small *Diapason* is inserted, a stop of the *Gamba* species will have better effect on the general tone of the department, and be very useful in giving a diversified colouring to accompanimental music. Let the *Gamba* be voiced to produce a rich and refined rather than a pungent and rasping string-tone. The latter quality belongs to the *expressive* department of the Church Organ.

Of the stops of 4ft. pitch, the *Octave*, derived from the foundation *Open Diapason*, is, of course, the most important in the Great department. With reference to its scale, in proportion to the *parent* unison, I have, perhaps, already said enough in my third article; but may here add a few words anent its strength of tone and its true office in the tonal scheme. On referring to the particulars relating to the harmonic partial tones, given at the end of the article just alluded to, it will be seen that the first upper partial tone of a prime tone is its octave, produced by twice the number of vibrations, and, accordingly, in the organ, by a pipe half the

speaking length of that yielding the prime tone. This teaches us that the true office of the *Octave*, in the tonal scheme of the department under review, is to corroborate the first harmonic upper partial tones of the sounds produced by the unison registers; and that organ builders err when they introduce *Octaves* of too loud and assertive tones. When justly proportioned, the *Octave* materially enriches, brightens, and purifies the unison sounds, without in any way disturbing their pitch; but when of too loud intonation it imparts a screaming character to the general tone, materially aiding in upsetting the tonal balance of the organ. There is a point in every tonal scheme beyond which the harmonic sounds must not go; and he is the true artist who knows that point and never goes beyond it in his work. *The laws of musical sounds cannot be neglected or broken with impunity.* When the size of the Great department renders a second stop of 4ft. pitch desirable, it should be introduced in the form of a *Flute* of full and clear intonation, capable of enriching the general tone and of corroborating the first harmonic of the lesser *Open Diapason* and the other subordinate unison registers. More than two flue stops of this pitch are never really necessary in the Great of a Church Organ; but a third, in the form of an *Octave Dulciana* or very soft *Octave Gamba* may sometimes be introduced with advantage.

I now come to the mutation and compound registers belonging to the unison or 8ft. series. The only stops of the former class introduced in organs are the *Twelfth* and *Seventeenth* or *Tierce*.* The latter may, however, be dismissed as quite unnecessary in a separate form, notwithstanding that it was frequently introduced by the old builders in that way. The *Twelfth*, giving the second upper partial tone, when kept unobtrusive materially enriches the general tone of the department, although it is by no means indispensable in small instruments. The *Twelfth* requires the introduction of the *Fifteenth* or *Super-Octave*, which gives the third upper partial tone of the unison prime. The latter stop should always find a place in a Great department of any pretensions. In what form it should be introduced is a matter of taste; but care should be taken to have its tone subordinate to that of the *Octave* and rather more assertive than that of the *Twelfth*.

I consider one or more *Mixtures* to be absolutely necessary in the appointment of every Great organ, worthy of the name; but, as I have before remarked, the compound harmonic-corroborating stops must neither be of too large scales nor too assertive in tone. The practice of making such stops loud and screaming is decidedly fatal to that round and grand volume of tone which I hold should characterise the Great department of a true Church Organ. When a *Mixture* is of powerful intonation, it is, of course, only available with the full Great; but this is an objectionable narrowing of its utility. A soft *Mixture*, such as properly corroborates the higher upper partial tones of the unison stops, without imparting a disturbing element to their fundamental tones, will prove available with soft as well as loud combinations. Having already enlarged on the important subject of *Mixtures*, in my previous articles, it is unnecessary to say more at this point.

For Great departments of ordinary size no reed-stops beyond the *Trumpet* and its attendant octave, the *Clarion*, need be contemplated. When these are inserted, in an uninclosed condition, their tones, like those of all the other stops in the department, should be characterised by fulness and roundness rather than by a brassy and piercing quality. Their general utility and effectiveness will be much enhanced if they are inclosed in a special small swell-box. A *crescendo* on the reeds with the full Great drawn would be extremely telling and serviceable in loud accompaniment.

No stops of an essentially solo character should be inserted in the Great organ unless provision is made to impart *expression* to them. This is a principle in Church Organ apportionment which I unhesitatingly lay down and urge on the attention of all interested in organ building.

It is usually the practice to place the Great department in a front and prominent position, the Swell organ being situated behind. There is, of course, no objection to such a relative location if the entire instrument occupies a favourable place in the church, free from obstructions to the emission of its sounds; but it is unfortunately a fact that nine out of ten Church Organs are crammed into chambers, or jammed into corners and recesses totally inadequate and unsuitable. When an organ is to be placed in a chamber, or anything of the nature of a chamber, care must be taken to give the most important *expressive* department a favourable locality, so that its accompanimental office may be satisfactorily fulfilled. In such a case, the Swell must occupy the most effective position, the Great organ occupying a rear or less favourable one. The travelling and uniformly delivered volume of tone of the latter department allows it to be placed, with but little sacrifice of effect, in a position which would be destructive to the Swell organ. In some instances it may be found advisable to divide the Great organ, placing one portion in advance of, and the other behind or under, the Swell. The importance of advancing and elevating the Swell organ will be gone into in the next and concluding article of this series.

(*To be concluded.*)

* M. Cavaillé-Coll, carrying out consistently the corroboration of the harmonic upper partial tones has, in the organ in the Cathedral of Notre Dame, at Paris, introduced the "Septième" (sixth upper partial tone) in the 32ft., 16ft., and 8ft. series, the stops being respectively $4\,^4/_7$, $2\,^2/_7$, and $1\,^1/_7$ft. speaking length. This introduction is, so far as I am aware, unique.

FIG. 1.

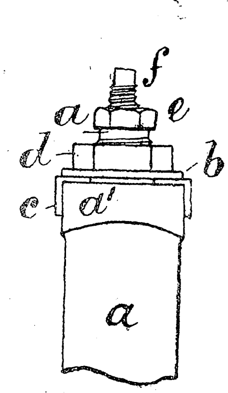


FIG. 2.

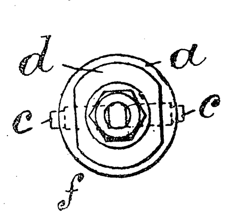


FIG. 3.

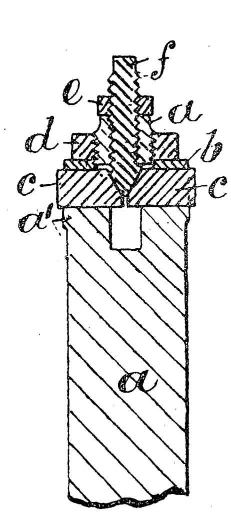
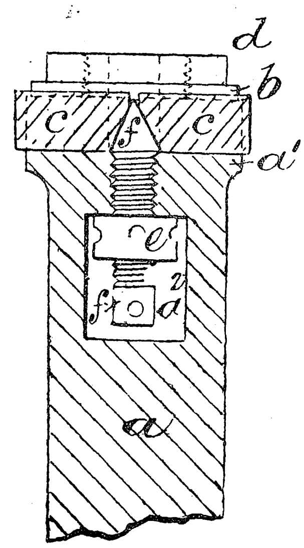


FIG. 4.



BRAMWELL'S IMPROVED BORING TOOLS.

An improved boring box, carrying various sized cutters, for use in the slotter or other machines, has been patented by Mr. S. Bramwell, of Princess-street, Stockport, the object being to make a bar in which the cutters can be readily moved or expanded to compensate for wear or for other purposes. The patentee makes the bar with a boss at one end, through which is cut a slot or slots for the cutters. In front of this slot the boss is reduced in diameter to form a projection which has a fine thread cut upon its outer surface, and it is drilled up some distance, passing through the slot with a thread cut in the hole. The cutters consist of pieces of steel fitted into the slot or slots, and these pieces are bevelled where they meet in the centre.

To secure the cutters after putting them in their places, a collar preferably somewhat smaller in diameter than the boss is screwed on to the projecting end of the boss; a washer is placed between the cutters and collar, and a set screw, with its end coned to correspond with the bevelled cutters, is screwed into the boss until its coned end bears against the bevelled ends of the cutters, so that by moving the screw further, the cutters can be expanded to the desired diameter. When this is done the collar is tightened fast up to the washer and cutters, and the set screw is then locked by a nut or nuts against the end of the boss, when the tool is ready for use. To alter the diameter, or compensate for wear, the collar is slackened and the set screw moved further into or from the cutters, when the parts are again secured and the tool is ready for use. Fig. 1 is an elevation, Fig. 2 a plan, and Fig. 3 a vertical section of a boring tool or bar made according to the invention, and Fig. 4 is a sectional view of an alternative construction. *a* is the body or shank of the boring tool or bar which is shown flat, except near the front end at a^1 where it is circular in section, the front end being reduced in diameter and formed with an external and internal screw thread. A slot is cut through the enlarged portion a^1, into which are fitted two pieces of steel *c* which form the cutters; the adjacent faces of these cutters are bevelled in opposite directions as shown in Figs. 3 and 4, and their upper edges project above the upper surface of a^1. Over the cutters is placed a thin washer *b*, and a collar *d* provided with a fine thread, which screws on to the boring bar for the purpose of securing the cutters in position. A set screw *f* with its point coned to correspond with the bevelled faces of the cutters is screwed into the front of the bar, and locked when set or adjusted by a nut *e*. To increase the diameter of the cutting edges of the cutters, to compensate for wear or for other purposes, the nut *e* and the collar *d* are slackened, so that the screw *f* may be turned in the direction necessary to force the cutters apart to the desired distance, when this has been done the collar *d* and nut *e* are again screwed up and the boring tool is ready for use. Fig. 4 represents a boring bar made of a slightly different form. In this construction the position of the set screw *f* is altered, the lock nut *e* rests in a slot a^2, formed in the bar *a*; the cutters *c* are secured in position by a screw collar *d*, the screw *f* being turned to bear against and move the cutters outward. When it is necessary to repair the cutters remove the screw *f* and screw a plug in its place into or on to the bar, *a*, and then put the bar on the centres of a

athe or grinding machine where the cutters can be turned or ground in their working position. It is evident that cutters of different sizes may be used in the same boring bar, the shank of which may be either flat as shown or round or of any suitable section.

THE THEORY OF MACHINES.—II.

By FRANCIS CAMPIN, C.E.

Friction.

THE term "friction" is exceedingly simple, but it cannot be disposed of by a mere definition that it is the resistance of bodies moving in contact with each other. At the hands of the mechanical scientist it demands a very careful consideration, encountered as it is at every turn, and in some form or other becoming a factor in all his calculations.

Generally a body or machine appears to be in one of two conditions—either at rest or in motion; but there is a condition which has been called that "bordering upon motion": this term, although it has found favour with some eminent mathematicians, does not seem to us sufficiently explanatory; the mass either moves or remains quiescent. We cannot conceive of an intermediate state between rest and motion, so far as actual phenomena are concerned; there may be, however, forces acting upon a body in such a way that it is not freely at rest, that is to say, some insufficient pressure may be acting upon it in a direction in which it is capable of moving if sufficient force be brought to bear upon it, as soon as the force is sufficient to balance the friction; then any additional force will cause the body to move with a velocity proportioned to the quantity of force applied in regard to the weight of the mass put in motion.

It has been found from carefully-conducted experiments that the friction from solids upon one another is, so long as the insistent pressure is not sufficient to cause abrasion, independent of the rubbing surfaces, and that it varies directly as the force pressing the surfaces together, varying also with the nature of the surfaces in contact. It is not affected by the velocity of the movement. When unguents are used, the friction depends upon the nature of the unguent alone if the pressure per square inch on the surfaces is not too great to allow a complete layer of the unguent to remain between them; if, however, the unguent is pressed out the friction will increase, the condition approaching that of two surfaces rubbing together in immediate contact. The pressure actually necessary to cause the motion of one surface upon another, divided by the pressure acting upon the surfaces in contact, is called the coefficient of friction.

The amount of this coefficient has been said to be greater for the friction of rest than for the friction of motion; but when the body is at rest there cannot be any friction. It would seem that this distinction has been suggested by the fact that a greater effort is required to start a mass than to keep it moving; but this is at once accounted for by the fact that in addition to the force to balance the friction, a force must be applied to overcome the inertia of the body, and supply it with the accumulated force corresponding to its velocity.

In Fig. 6 let $a\,b$ represent the surface of an immovable solid body, and let g represent another surface in contact with it, and acted upon by the pressure P; so long as the pressure P acts upon the surfaces at right angles to their plane of contact, it will have no tendency to slide the upper one upon the lower; but if the force be inclined such a tendency will at once arise to that effect, and should the inclination be continued a position P′ will be found when the frictional resistance of the surfaces will be equalled; then the angle PgP′ is termed the limiting angle of resistance, and if g be put in motion it will continue to move with a uniform velocity, and if it is stopped it will remain at rest.

Continue the direction of the force P until it meets the surface $a\,b$ in the point c, and produce P′c to e, making $c\,e$ represent the intensity of the force P′. This force may now, by the parallelogram of pressures, be resolved into two component resistances, one being the resistance of the surface $a\,b$ at right angles to itself, and the other the frictional resistance

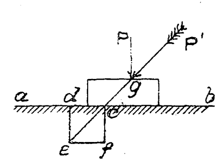


FIG 6

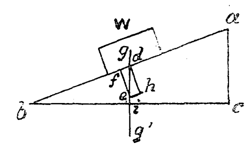


FIG 7

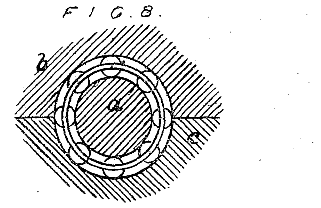


FIG. 8.

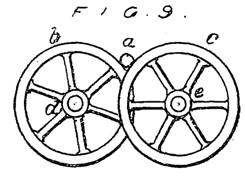


FIG. 9.

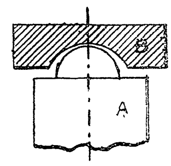


FIG 10.

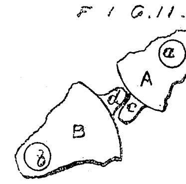


FIG. 11.

parallel to $a\,b$; complete the parallelogram $c\,f\,e\,d$, then will the normal pressure against $a\,b$ be represented by $c\,f$, and the frictional resistance between the surfaces in contact will be represented by $c\,d$ or $e\,f$, for $c\,d$ and $e\,f$, being opposite sides of a parallelogram, are equal.

The force then necessary to equal the frictional resistance due to a pressure $c\,f$ is measured by $f\,e$; therefore $\frac{f\,e}{c\,f}$ = the coefficient of friction for the material which is under examination.

Now it is to be observed that whatever the actual intensity of the force P′ may be, motion will ensue on its passing the limiting angle of resistance.

In Fig. 7, let $a\,b$ represent the surface of an inclined plane upon which is a body W; let $b\,c$ be a horizontal, and $c\,a$ a vertical line; $c\,a$ will be at right angles to $b\,c$.

Let the elevation of $a\,b$ be such that the mass W is on the point of slipping from its centre of gravity g, let fall the vertical line $g\,g'$ cutting $a\,b$ in the point d, mark off $d\,e$ equal to the weight W, and complete the parallelogram $d\,h\,e\,f$; then $d\,h$ will represent the normal pressure on $a\,b$, and $d\,f$ or $e\,h$ the force parallel to $a\,b$ $\frac{e\,h}{d\,h}$ = coefficient of friction $= \frac{a\,c}{c\,b}$, because, $g\,g'$ being drawn vertical, is parallel to $c\,a$ and at right angles to $b\,c$, which it cuts in the point i; $d\,h$ and $f\,e$ are drawn normal to $a\,b$, therefore $d\,h\,e$ is a right angle, and the remaining angles $e\,d\,h$, $d\,e\,h$ together equal to a right angle. Because $d\,i\,b$ is a right angle, the remaining angles $i\,b\,d$, $b\,d\,i$ are together equal to a right angle, and therefore equal to the angle $e\,d\,h$ $d\,e\,h$ together; but $b\,d\,h$ is a right angle, and is equal to the two angles $b\,d\,i$, $e\,d\,h$ together; therefore, deducting the common angle $b\,d\,i$, the remaining angle $i\,b\,d$ is equal to the remaining angle $e\,d\,h$; but if two angles of one triangle are equal to two angles of another triangle, the third or remaining angles are equal, and the triangles are similar; and $e\,d\,h$ is similar to $d\,b\,i$. It may also be shown that the triangles $d\,b\,i$ and $a\,b\,c$ are similar for the lines $d\,i$ and $a\,c$ being parallel, the angles at d and i will be equal to the angles at a and c respectively, and the angle at b is common; hence the triangles $a\,b\,c$ and $e\,d\,h$ are similar, and $\frac{a\,c}{c\,b} = \frac{e\,h}{d\,h}$ = the coefficient of friction.

When a body rolls upon another there is no friction, as the rolling motion consists in placing the parts normally in contact, and again lifting them away, and between this and the friction of sliding contact innumerable modifications of the frictional resistance may be obtained.

Let us consider what is the work done in overcoming friction, and that will lead us to find methods of diminishing it. In the first place, for a given material the coefficient of friction is constant—let it be represented by F: then if S be the distance through which the moving body, whose weight is W, passes in a given time the work done will be W × F × S. Let this be supposed to apply to a mass of iron weighing one ton (2,240lb.) drawn upon a surface of iron through a distance of 1,000ft.; the coefficient of friction for iron is 0·25; the work done will be = W × F × S = 2240 × 0·25 × 1000 = 560,000ft.-lb.

Now, instead of sliding the load, let it be mounted on wheels 3ft. in diameter, fitted with axles 2in. in diameter, and let it be run upon a perfectly level road. It is evident that the distance through which the friction of the rubbing surfaces is overcome will be much reduced, for while the moving mass passes over a length equal to the periphery of the wheel, the rubbing surfaces only pass through a distance equal to the periphery of the axle, and as the circumferences of circles are in simple ratio to their diameters, the work in the latter case will be to that in the former as 2 to 36, or one-eighteenth, the loss by friction in the first case being one-quarter the weight would be at the rate of 560lb. per ton of load, but in the latter 31·1lb. per ton. If unguents are used the coefficient of friction will be about 0·08, or for the sliding mass 179·2lb. per ton; but for the load on wheels the loss would be 9·95lb. per ton.

About this matter there must be no confusion. It is usual to say the frictional resistance of a train is 10lb. per ton, or whatever it may be for the particular class of rolling stock; but this must not be looked upon as a co-efficient of *friction*, as it involves the coefficient of friction multiplied by the distance through which the rubbing surfaces pass, and divided by the distance through which the whole mass passes.

If perfectly cylindrical rollers are placed on a true surface and support a plate having a perfectly true under surface, then there would be no friction; but the plan would not be practicable, because the rollers themselves would run out from under the surface they are required to support. A system of rollers may, however, be interposed between the neck or "journal" of a shaft, and the bearings by which it is supported as shown in the section Fig. 8; a is a section of the shaft to be supported, b and c being the top and bottom bearings, between the shaft, and the bearings are shown eight small rollers, which are kept at their proper distances apart by means of two rings having holes in them, through which the centre pins of the rollers pass; the whole friction will be that due to the weight of these rings and any pressure caused by the tendency of one roller to overtake another by slipping or inequalities of workmanship.

Another method of reducing the friction of revolving shafts which is applicable to very delicate scientific apparatus is shown at Fig. 9. a is the shaft to be supported; at each end it rests upon two large wheels, b c, placed close, one behind the other, and themselves supported on axles d e, and as such contrivances are only used for very delicate apparatus, the ends of these axles may be turned down to exceedingly minute diameters, so that the effect of frictional resistance upon a becomes practically inappreciable. It has been stated that the *coefficient* of friction is not in any way affected by variations in the amount of surfaces of contact, and this is perfectly true so long as the pressure upon those surfaces is not sufficient to approach abrasion; but, notwithstanding this, it can be shown that an increase of surface may materially in some cases increase the loss of work by friction.

It must be remembered that the velocity does not affect the coefficient of friction; but the work absorbed by it is dependent on the distance passed over by the rubbing surfaces.

We are now going to instance the case of a vertical shaft supported upon an end bearing or step, such as occurs with the shaft of a

turbine, or with the bearings of a certain description of turn-table for locomotive engines; only, in this case, the vertical spindle is fixed, and the revolving bearing rests upon its top.

If we have a plain, flat bearing it is evident that the distance passed over by the rubbing surfaces will be measured by the circumference of a circle having a radius one-half of the external radius of the bearing surface, so that the loss of work by friction will vary directly as the radius of the end of the shaft; it is therefore incumbent upon us to keep this as small as possible, and in those turn-tables to which we have referred the minimum must be reached. The arrangement is shown in Figure 10. A is an upright pillar carrying at its top a steel paraboloid, upon which rests a steel cup, B, firmly fastened to the superstructure of the turn-table. The interior surface of the cup is of a larger radius than is the exterior surface of the bearing piece, so that the actual bearing surface is that due to the change of form by compression under the superincumbent load. These turn-tables consist of two girders attached at their centres to the frame carried by the cup B, and upon them are rails on which the engine to be turned is run. At each end of the girders are two wheels, under which are fixed rails, running in a circle round the turn-table pit. These wheels are to take the weight of the engine while it is being run on to the table, and are so proportioned that on the balancing of the engine in the centre of the table they hang suspended just clear of the rails; one man can then, without difficulty, push round a table with a 60-ton engine upon it.

In certain kinds of machinery the value of the limiting angle of resistance is a most important factor indicating the forms necessary to be given to the contact surfaces of driving and driven elements, such as toothed wheels, canes, screws, and other elements to be fully treated of subsequently.

In Fig. 11, let A represent a driving element, mounted on an axis, *a*, and carrying a projection, *c*, which, by pressing against the projection *d*, which is part of the element B, mounted on the axis *b*, will cause B to rotate when A is put in motion. Now, it is evident that to obtain satisfactory results the surfaces of *c* and *d* should be so formed that their motion one upon the other will be a pure rolling motion; otherwise there will be friction, which means both loss of power and rapid wearing away of material.

In order that there may be no friction, the direction of the pressure at the point of contact of the driving and driven surfaces must always be at right-angles to those surfaces, and the more the direction of that pressure deviates from this position the greater will be the loss by friction.

(*To be continued.*)

THE PATENT "GREENSHIELD" BRUSH-HOLDER.

THIS tool, which seems to us likely in no small degree to facilitate the work of painters, is designed to carry an ordinary paint brush of any size on the end of a wooden stick or long arm, for painting or cleaning the sides of ships and other inaccessible places. Fig. 2 shows the brush in one of its extreme positions. It is adjustable to any point between the position shown and a horizontal one. A is a taper socket for holding the paint brush E. B is a thumb nut for closing socket A to grip the brush after it has been pushed in. C is a thumb nut for adjusting angle of brush in slot S to suit the work to be done. D is an ordinary taper socket with nail or screw for holding stick or long arm F. F is the long arm or stick, shown broken off, any length as desired. A special form of socket A may be provided for stock brushes, &c., as may be required. The advantages are that, as may readily be imagined, it effects a great saving in time over the usual process of tying the brush on to a stick; the brush is readily adjustable to any angle to suit its work, effecting an economy in time, paint, and brushes; and, lastly, simplicity, durability, and lightness are secured. There are no springs or anything that can get out of order. The price is remarkably low.

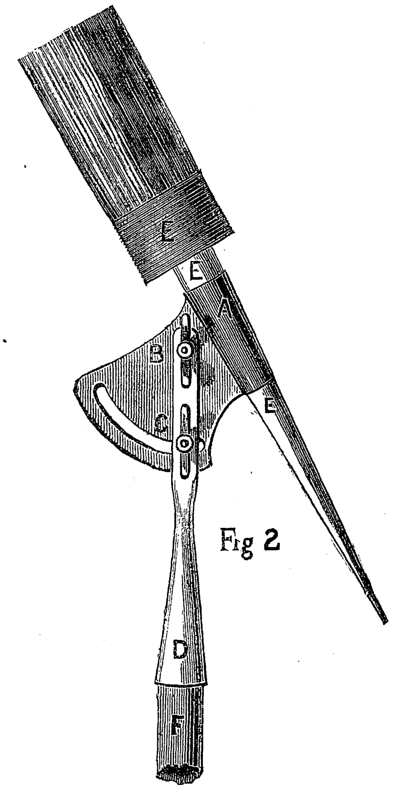


Fig 2

The makers are Messrs. Wimshurst, Hollick, and Co., 602, Commercial-road, London, E.

OVER AND UNDER EXPOSURE.

IF upon applying the developing solution the image takes a very long time to appear, it may be concluded that either a too brief exposure has been given or that the developer is too weak. If the former is the case, it will be signified by the high lights eventually acquiring vigour, the deep shadows being either exceedingly tardy in appearing or failing to come out at all. If, on the contrary, there be no such wide distinction between the lights and shadows, but only a general disinclination of any image to appear, the presumption is that the fault lies with the developer. The remedy in this latter case is to increase the proportion of the alkali, which treatment will never fail in bringing out the details. As we have said before, it is not wise to add so much as to render the development too rapid. Again, it happens with many brands of plates that the presence of alkali in such a proportion as would effect a very quick development may fog or veil the shadows. This is prevented by the addition of two or three drops of a fifteen grain solution (*i.e.* fifteen grains to an ounce of water) of bromide of potassium or bromide of ammonium, the function of which is to prevent any abnormal deposit on the shadows, or to keep them clean. But owing to the retarding influence of the bromide it must be used sparingly. However, it permits of the employment of a larger amount of alkali than it would be safe to introduce into the developer without such a check upon its energy. It is not quite easy to say precisely how much ought to be added, because of the diversity in character of commercial plates, the best treatment for one brand not being necessarily that for another. There are some plates which require no bromide at all, while others are very liable to fog unless a liberal proportion is present.

Should the image make its appearance with too much equality all over, the shadows coming simultaneously with the lights, it may be taken as evidence of over-exposure. In this case it is necessary to act promptly, and at once to pour the developer back into the graduate or cup, and add to the solution a liberal dose of bromide, say four drops or more, according to the circumstances of the case, and having stirred the solution so as to mix it well up return it to the plate. The object of this is to retard the action of the developer upon the shadows, which are thus held in check, while the developing action goes on in the high lights. Under this altered condition of the developer the plate may be subjected to its action for a prolonged period without danger of the shadows becoming fogged. If it is known beforehand, or very strongly suspected, that the plate has received much too long an exposure, then will it be wise to introduce two or three drops of the bromide solution along with the pyrogallic acid previous to adding any alkali at all, as this will in some measure ameliorate the effect of over-exposure, while the alkali may also have its action checked by a similar addition of bromide.

What has been here said applies, of course, to pyrogallic development, and it can be readily inferred that by an intelligent adjustment of the component parts of the developer, or perhaps, more correctly speaking, of the alkali and the bromide, a considerable latitude in the exposure is permissible. In all photographic operations development, more than any other, requires the exercise of judgment. Almost everything else can be effected by a hard-and-fast rule, but development is amenable to the intelligence of the operator, an intelligence that must be exercised in the case of every individual plate.

In ferrous-oxalate development there is not the same degree of latitude as in that by pyrogallic acid, although in cases of over-exposure the latent or even partially developed image is amenable to the retarding influence of bromide, a few drops of which may, especially at the initial stage of development, be added with marked advantage.

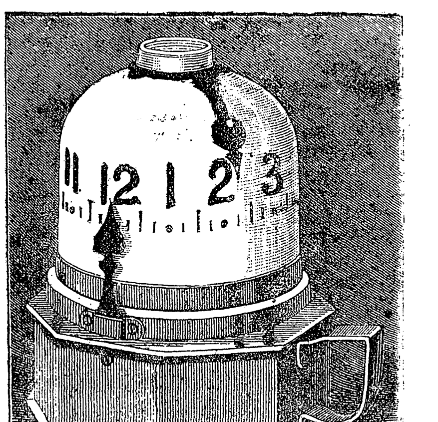
Another factor in facility of development is weakening the developer by the addition of water. But concerning the effects of this we shall have occasion to speak more fully when we come to consider the best circumstances under which to develop snap shutter or instantaneous exposures.

The darkening of the pyro developer, which not unfrequently becomes of a muddy-looking nature after remaining on the plate for a few minutes, may be prevented by sulphite of soda. One of the best ways to employ this salt is to saturate with it the water in which the pyrogallic acid is dissolved. Provided this is done, an aqueous solution of the acid may be made which will keep good for a long time, whereas if it be dissolved in water alone without the sulphite it will decompose with so great a degree of rapidity as to render its preparation in this way a loss.

There are several other additions which may be made to the solution which will prevent the pyro from decomposing, but the consensus of opinion points to sulphite of soda as being the best at present known. It will prove highly educational to the beginner if he will develop a plate without such addition, and note the state in which he finds the developer at its close, and afterwards go through the same operation with a second plate, a liberal proportion of sulphite being mixed with the developer. So clear will it remain in the latter case, compared with the muddiness of the former, that he will be tempted to use it over again on the succeeding plates, which may, in many instances, be done with advantage.—*British Journal of Photography.*

ILLUMINATED CLOCK.

THE accompanying engraving represents a simple and practical device which embodies a day, night, and medicine clock, and which also provides a night light. Within the base is placed a clock mechanism, the hour spindle of which



passes up through the centre of the top and is secured to a dished plate, which is by this means revolved once in twelve hours. Resting upon the plate, and, of course, turning with it, is a dome-shaped globe of white glass, having the hours and quarter divisions marked distinctly in a circle upon

its exterior. Secured to one side of the base is a pointer which extends to the row of figures. It is evident that as the globes revolves, the time will be indicated by the pointer. Within the globe is placed a small lamp, which serves to render the figures and pointer plainly visible, so that the time may be read at night, and also to illuminate the room with a soft and yet sufficient light. Adapted to rest on the top of the globe is a second pointer, which may be placed at any desired distance in advance of the stationary pointer. This will be found of value in the sick room, as, when giving medicines, the second pointer can be placed the required interval between doses — say two hours—in advance of the other, the lapse of the time being noted when the pointers are together. By thus combining a lamp and clock, a most convenient and valuable article is produced. These clocks are manufactured by the W. C. Vosburgh Manufacturing Company (Limited), of 418, Fulton-street, Brooklyn, N. Y.—*Scientific American.*

NOTES ON THE PROCESS OF POLISHING AND FIGURING 18in. GLASS SPECULA BY HAND, AND EXPERIMENTS WITH FLAT SURFACES.*

By H. F. MADSEN.

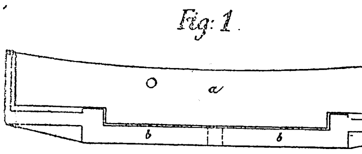
THE full text of the paper of which we gave an abstract on p. 58 having been received from the author, we give it complete, with the diagrams:—

So much has been written upon the production of glass reflectors for use in astronomical observations, and so many of these being in use at the present time, any improvements in their construction would be difficult, if not impossible, to attempt; still, as the method which I have followed is not altogether the usual one, and as I am not aware that any mirrors of the size under discussion have been attempted by hand, I have thought it probable that certain notes taken down by me during my experiments might not be altogether void of interest to some of the members of this society.

It is now more than four years ago since I first began polishing specula-flats, &c., with other optical experiments. During this period several mirrors from 7in. to 18in. diameter have been completed with gradually increasing success in the result. As the rough castings for the 18in. mirrors were somewhat expensive, these have been refined and repolished several times to gain practical information in their construction. They were imported from Chance Bros., Birmingham, and when polished, were found to have been well annealed.

A piece of plate-glass 10in. diameter was cemented to the back of each mirror to suit its intended cell or mounting, and the weight of the whole speculum when finished was about 70lb. (Fig. 1). In producing these specula the first

Fig: 1.



a, Speculum; *b*, Iron Cell.

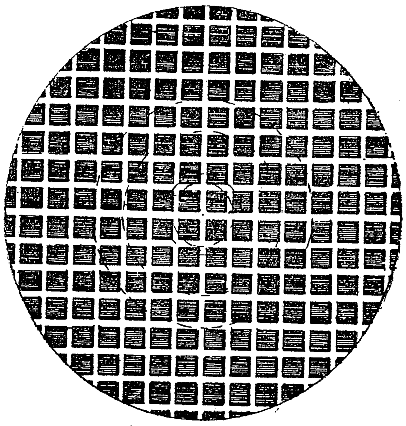
thing to consider is naturally the convex tool with which they are ground to the proper curvature; and my first attempt was made by procuring two flat discs of glass of the same size, and grinding them together with emery and sand, the intended speculum occupying the uppermost position until they had attained the desired form; it being well known that two flat discs when ground together will form themselves into spherical surfaces, the overhanging part of the top one producing convexity in the one underneath.

My succeeding trial was made by the usual iron tool turned to approximate curvature in a lathe; but it was found that two of these had to be ground together for a considerable time before they became of a true spherical form; and knowing that the coefficient of expansion of iron was 0·000012, that of glass only 0·000008, and that in both cases the surfaces were very sensitive to small variations in temperature (as illustrated hereafter by my flat surfaces), I formed the opinion that a truer surface could be produced by having the tool made of the same material as the intended reflector, and, therefore, in producing the two larger specula under consideration, I reverted to my former process.

Three plates of rough glass, 1in. thick and 18½in. diameter, were ground together to fit one another, and then cemented so as to form a firm and solid block.

To produce the proper convexity in so large a size in the usual manner would occupy a considerable time, and require a great amount of labour; yet such a form would be easily given to it by the machinery used by plate-glass grinders. I had the tool made of about one-quarter more convexity than the required concavity of the speculum, and the latter having been partly hollowed out by the

FIG. 2.

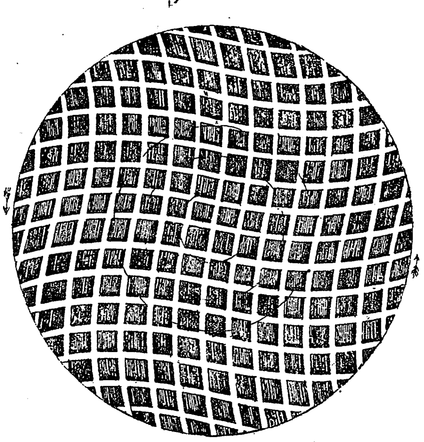


use of a leaden weight and rough emery, the two (tool and glass) having been ground together, soon formed themselves into perfect spherical surfaces, and very nearly of the proper curvature.

Where many specula are to be produced upon the same tool, iron may be preferable on account of its surface becoming extremely hard; but I have with one of glass ground or rather refined the speculum during three hours, without producing so much as 1in. alteration in the focal length.

During the course of my earlier attempts with

Fig: 3.



Radius of Curves equal to Radius of Circle.

smaller glasses, much time was lost in the polishing, the smoothing process not having been sufficiently carried out with the finest grade of emery; but with the two under consideration to-night this was guarded against, and no polishing was begun until the mirror was bright enough to reflect the image of the sun at an almost perpendicular incidence.

In one instance, to ascertain the exact form of the surface given to the speculum by the glass tool, I endeavoured to render it thereby reflective enough without polishing for a preliminary examination at the centre of curvature. In this I did not quite succeed, but with 5m. polishing it reflected the light from a very small pinhole, and when thus examined I was delighted to find that it presented a true and regular surface, slightly inclining from the spherical towards the spheroidal form, and that irregularities of more than $\frac{1}{30000}$in. (probably much less) had no existence.

This proved beyond doubt that the class of tool I had used left nothing to be desired. The speculum having, then, at this stage of the process an absolutely true curve, the polishing was proceeded with in the usual manner with rouge upon pitch (the speculum being uppermost), so well described by the late Dr. Draper, Mr. Wassell (ENGLISH MECHANIC), and others, until no emery holes or scratches could be seen by looking in an oblique direction at the reflected image of the sun near the focus.

In all cases, however, that I have seen described, the pitch polisher has been directed to be graduated into squares as in Fig. 2, where it will be seen that the circles described from the centre will all intersect the squares at nearly the same angle. I have read that Lord Rosse, Dr. Draper, and others, had to add an extra motion (side motion) to the speculum to avoid concentric grooves or rings; but it seems to me that a polisher graduated as shown would naturally produce such, if the glass continually moved in the same track. I also found that when the pitch was very hard, the glass would move more easily along the grooves than in any other direction; and, therefore, I graduated mine as shown (Fig. 3), where it will be found that these defects are obliterated, and I may state that I have, without side motion, polished (by hand) for hours continually without producing as much as a trace of a ring.

The polishing for this size of speculum (by hand) usually occupies about seven or eight hours, but in the one before us to-night it was accomplished in five hours thirty minutes; after which it was tested and found to have retained its original shape, slightly inclined to the spheroid. (This, however, may have been changed often during the polishing.)

As shown hereafter in my method of figuring, or in converting the surface into a paraboloid of revolution, the spheroidal form would be as good to start from as spherical; but it must not be forgotten that the spherical form is the only state in which almost infinitesimal irregularities can be observed, except by varying the distance of the luminous point. In fact, so delicate is the Foucault test of a true spherical surface at the centre of curvature, that variations of 0·000001in. (as is proved hereafter) can be noticed. Supposing, however, that a true spherical surface has been obtained, the most delicate part of the process commences—viz., to change it into a paraboloid of revolution, or what is the same, to correct the spherical aberration.

Some opticians have attained great success in this operation, and there can be no doubt that a similar effect can be produced more or less favourably in several ways. I will here enumerate some of them:

1. By making the polisher a little larger than the speculum (Herschel), or by making it of an elliptical form, axis as 10 to 9 (Short's process). Without doubt this will lengthen the outside rays, but the regularity of the curve from the centre seems to me doubtful.
2. By gradually lengthening the strokes (Dr. Draper); not tried.
3. By raising the temperature of both glass and polisher, and before the pitch becomes of its usual hardness to use a few long strokes (half-strokes), afterwards gradually decreasing them to nothing. This I have tried with partial success.
4. By local polishing, as adopted by Lassell; perhaps the one now mostly used, and the process by which the greatest success has been obtained. Its defect is that small irregularities are almost impossible to avoid.
5. By graduating the pitch polisher, which, in my experiments, seems to be the process most certain of success; yet in large surfaces, where a considerable amount of correction is to be performed, great care is necessary to avoid it running into an irregular curve.

As in this process the main point to be considered is the correct system of graduations to be used, I began by inquiring into the form of the solid interposed between the sphere and paraboloid of the same curvature at the point of contact, seeking thus to combine theory and practice.

The general equation to this solid becomes complicated; but as it was only required to know the variation in the thickness of a section from centre to edge by combining the equations of the circle and parabola, I deduced an approximate expression (correct for the usual shallow curves to eight places of decimals) thus:—

Equation to parabola origin A is—

$$x^1 = \frac{(y^1)^2}{4f} = \frac{(y^1)}{2r.}$$

" circle— $x = r - \sqrt{r^2 - y^2}$

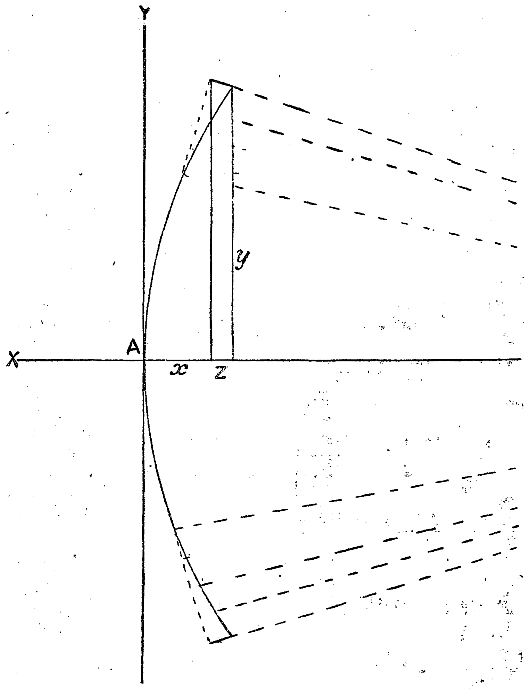
which, being expressed in series, is—

$$x = \frac{y^2}{2r} + \frac{y^4}{8r^3} + \frac{y^6}{16r^6}\ldots\ldots$$

Let now $y^1 = y$, and neglecting higher powers of y than the fourth, we have by subtraction $(x - x^1)$ $= z$ equal to thickness for any value of $y = \frac{y^4}{8r^3}$ and supposing r constant, it is seen that such varies as fourth power of semi-diameter.

Let now z be calculated for intervals of 1in. in the length of y with radius $(r) = 320$in. as in the speculum under consideration, and as has been done in the subjoined table, the section will be

* A paper read before the Royal Society of N.S.W., July 7, 1886.



y in ins.	$\frac{y^4}{8r^3}$	$\frac{y^4}{8r^3}$ in millionth parts of an inch.	$\frac{y^2}{r}$ aberration at centre.	Approx. fractions.
1	0·000000025	$\frac{1}{250}$	0·003	$\frac{1}{320}$
2	0·00000016	$\frac{1}{16}$	0·0125	$\frac{1}{80}$
3	0·0000003	$\frac{1}{3}$	0·0281	$\frac{1}{36}$
4	0·000001	1	0·05	$\frac{1}{20}$
5	0·00000244	$2\frac{1}{2}$	0·078	$\frac{1}{13}$
6	0·00000496	5	0·1125	$\frac{1}{9}$
7	0·00000916	9	0·153	$\frac{10}{65}$
8	0·0000156	$15\frac{1}{2}$	0·2000	$\frac{1}{5}$
9	0·000025	25	0·2531	$\frac{1}{4}$

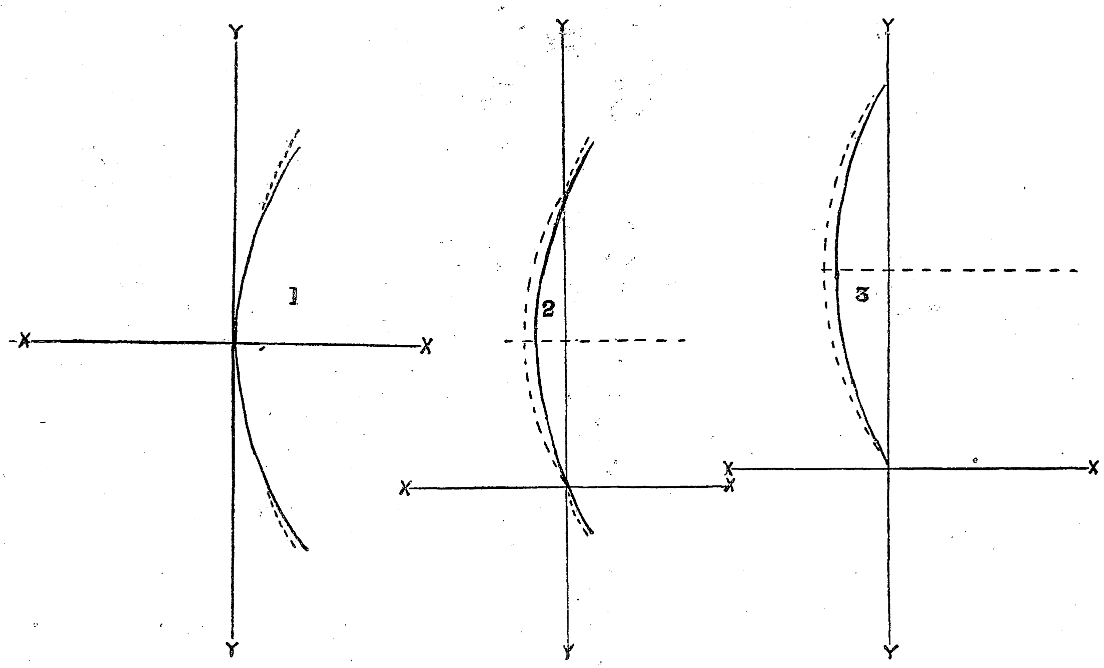
represented by the above diagram (in which the solid line represents a section of the spherical surface, and the dotted line the corresponding parabola).

In this table the first column gives the length from centre of semi-diameter (y) in inches; the second and third, the corresponding magnitude of ($x - x^1$) or z, or the amount of abrasion required to change the section of a sphere into that of a paraboloid of revolution, and the fourth and fifth columns, the longitudinal aberration of the latter curve existing at the centre of its main or rather least curvature; calculated from the formula $\frac{y^2}{r}$ (approximately), and this is known to be four times the amount the same speculum would show (if spherical) in the telescope at its focus.

Although in this case the relative length of focus to diameter is not by any means an unusually long one, yet, by examining this table, some startling truths are revealed.

In the first place, it seems wonderful that the deviation in a ray of light should become perceptible by the variation in the reflecting surface of one-millionth part of an inch, which is actually the case.

At 4in. from the centre the distance from the two curves is only that amount, and yet this produces $\frac{1}{20}$in. longitudinal aberration at the centre of



curvature, which, under favourable circumstances, can easily be perceived; but, on the other hand, as this small variation might be produced by three strokes of the polisher, or by the smallest irregularity in temperature, it shows that practically the curve for the central 8in. should be spherical, and that, with mirrors having very shallow curves as 12in. diameter to 20ft. focus, such a form is as good if not better than any other.

In the above calculations the point of contact (also origin of co-ordinates) of the two curves has been supposed to be at the extremity of their axes of revolution; but, as in the paraboloid the curvature increases continuously from centre to edge in the given ratio, other points might be selected either at the edge or at intermediate places, and the three cases would be as shown in 1, 2, and 3.

(*To be concluded.*)

MIRROR - PAINTING.

THE first step in mirror-painting is to decide upon the design. If this is but a copy, take a tracing of it off upon ordinary tracing-paper; if it is to be an original, arrange the selected flowers in a good position, exclude all but the north light, and draw them to size upon drawing-paper, and tint them with water-colours to indicate their colouring, where the deepest shadows should fall, and where the reflected lights thrown from a transparent leaf or petal on to another part of the design appear. By thus obtaining permanent directions as to the management of these important details, the worker can rearrange the real flowers daily, so that the same effect is produced throughout the painting, and she will not be worried by finding that, at a second sitting, all her flowers that were in full shadow are now in light Take a tracing of the chief outlines of this sketch, rub the glass quite clean with a chamois leather, and lay the tracing-paper upon it, with a sheet of red carbonised paper between the glass and the paper; with the point of a hard pencil go over the traced lines steadily, and remove both papers, when the outline will be clearly seen on the glass. Mix a little flake-white with medium, add to it a colour that matches one of the flower tints, and secure their outlines by going over them with this colour in a fine brush. Match one of the shades of the leaves, and work in leaves and stems with the green mixture, but work in the first painting of the flowers before the outline has dried and before the leaf-outline is secured. Work in the deepest shadows first, then the half-tints, and lastly the high lights. Mix all these shades on the palette with the medium, apply them with an even hand, and soften and run their edges into each other with a clean and dry brush. Use as little paint as possible; put it on with but few touches, and be careful that the outline of each petal is clear and not ragged-looking. Having toned in the chief petals, work at the under petals, and imitate the transparent look of the natural under part of a petal through which the light is passing by a soft gradation from dark to light, making the tone lighter than nature, and running the paint together with a fitch brush, whose hairs are softer than sables. While the paint is drying, outline the leaves and fill in their shadows, medium, reflected, and high lights, and leave the work until dry, when re-paint the flowers and leaves, softening the

colour, but bringing it up to its natural tones, deepening such shadows as lie close to the high or reflected lights, and blending together crude masses of colouring. In the final painting add the peculiar markings of the flowers, vein the leaves, and lightly apply washes of transparent colour where the colours require warming up or toning down.—*Lady's World.*

PHOTOGRAPHIC LENSES.—II.*

By J. TRAILL TAYLOR.

WIDE-ANGLE, non-distorting objectives are a great power in the hands of a photographer who knows how to use them aright. Among the earliest of these was the American globe lens, so termed from the outer surfaces forming part of a globe or sphere. From the example now shown, it will be observed that each lens (the combination is symmetrical) is formed of a meniscus crown with the shorter radius from the optical centre, cemented to a concavo-convex flint. The construction of this lens favoured the formation of a flare spot, or ghost, in the centre of a picture, which would have disappeared had the maker departed from his globular idea, and brought the lenses a little closer together.

In 1864, Ross took the matter up and brought out a doublet free from the shortcomings of the globe. It was unsymmetrical in internal structure, being composed of a bi-convex and a bi-concave cemented front, and a concavo-convex and meniscus back combination. The lighter element, as you see, is to the outside of the front and the denser element to the outside of the back. Soon after this, Zentmayer introduced a ratio lens, one in which the front and back elements were of dissimilar diameter and focus, the diaphragm being placed in the optical not the mechanical centre. The objective was composed of two single or non-achromatised meniscus lenses of very deep curvature, and included a very wide angle. A feature by which it was distinguished consisted in a series of lenses of different foci all screwing into one mount under such circumstances as to retain the diaphragm in the correct position for all of them. This was improved upon by Dallmeyer, who made a wide-angle rectilinear lens in which the lenses are each achromatised.

A wide-angle lens much used in America, made by Morrison, consists of a very deep achromatic front lens and a single or non-achromatic crown meniscus as a back lens, of rather flatter form than the front. This, presumably owing to slight over-correction of the front, aided by the well-known adaptability of the deep meniscus form, defines sharply over an extended field.

In 1866, Steinheil introduced a lens formed of two cemented combinations, adapted for covering a moderately large field with an aperture of a seventh of its focus. Instead of forming it of flint and crown glass, which would not admit of such an aperture being employed, he used two kinds of flint glass, one possessing a higher index of refraction and dispersion than the other. From their wide aperture they were designated *aplanats.*

Numerous makers took the matter up, some by servile imitation, others by making departures more or less slight. This objective, which is more or less good according to the skill of the optician by whom it is made, is, for all-round work, one of the greatest possible value, for in a fairly good light it acts as a portrait and group lens; it is sufficiently rapid to enable the photographer to secure horses, even railway trains, in motion; it is orthoscopic, or rectilinear, hence can be employed for copying, and provided care in this respect has been bestowed upon its construction, it serves as a landscape lens, in giving no ghost or flare. But it is unfortunate that some makers, in their efforts to render it otherwise perfect, do not realise the importance of providing against the defect named. The lenses are separated so far as to hit a happy medium between flatness of field and astigmatism, and this is not unfrequently attended with flare. I have invariably found that this defect may be cured by bringing the lenses a little closer together in the mount. Even so little as the width of two threads of the screw has served to dissipate the flare spot, which in many cases consists of an image of the diaphragm, which has a relation of conjugate focus to the back lens when internal reflections form a factor in its production, although it is sometimes occasioned by reflections from the front lens.

In the course of the discussion which followed Mr. J. Mayall, jun., said he noticed, in the early part of the paper, a reference to the term aplanatism, but it appeared to him that the expression was perfectly well defined by the classical writers on optics. Coddington, the well-known inventor of the lens which bore his name, in a treatise on the "Reflection and Refraction of Light" in 1829, defined it as meaning freedom from spherical aberration; and that definition was adopted by Sir John Herschel in his famous treatise on "Light" in the "Encyclopædia Metropolitana." He could not but think that if in the description of photographic lenses it was used in any different sense—for instance, as Mr. Taylor employed it, as meaning the angular aperture of a lens—it was an extraordinary misapplication of the term. Of course he did not attribute the origination of that idea to Mr. Taylor, because it had been more or less used in popular treatises on photographic lenses, and even in Monkhoven's work on photographic optics. Mr. Taylor had referred to a great number of lenses of the old type, many of which were quite obsolete and of no use whatever. On the other hand, he had touched on certain lenses recognised throughout Europe, as showing the highest point of excellence which had yet been reached. He took it that since the application of the dry-plate process, the old Petzval form, in which an extraordinary aperture was given in relation to the focal length, was practically useless, and everyone now used lenses having much less aperature, but where the aplanatism was infinitely more perfect. Reference had been made to the lenses made by Steinheil, in which flint glass was used for the external lenses. That point was taken up by a distinguished mathematician in Paris, some ten years ago, M. Prazmowski, the partner of Hartnack, the eminent microscope optician, and it led him not only to utilising flint glass for the external lenses, but also to combining different kinds of flint glass, and he had a very distinct aim, viz., to get rid, in portrait lenses, of the separation in the back combination, which he obtained by using two different kinds of flint glass for each combination, and thus produced a lens with a very short focus, with each combination cemented, so that the reflection given by the surfaces being exposed to the air was got rid of. One of the first lenses thus made, was made for him, as the result of a long discussion with Prazmowski, and having brought it to London, he thought it would be interesting to Mr. Dallmeyer to see it. He remained about an hour while he tested it; but he was surprised to find that, although he was known to have considerable technical knowledge, he had not the slightest conception of the nature of the combination, how the problem of getting rid of the separation of the back lenses was solved, or that the lenses were constructed wholly of different kinds of flint glass, no crown being used. He must confess that even that was now a thing of the past, because it dealt with lenses of the Petzval construction, with great aperture and short focal length, which might now practically be looked upon as out of date. With regard to new kinds of glass for use in lenses, Mr. Taylor seemed to think it was too soon to deal with that question, but he should like to say a word or two on the optics of the future, as they might be developed by new kinds of glass which had lately come into the market. It was perfectly well known in the microscopical world that, some time ago, one of the most distinguished mathematicians in Europe, who had paid special attention to practical optics, Professor Abbe, of Jena, and his friend, Dr. Schott, had worked out an immense number of experiments with the purpose of providing new of lines in the spectrum than had been hitherto kinds of glass which would combine a greater number combined. Of course, that in itself was old, some of our most able mathematicians, such as Professor Stokes, Mr. Grubb, and the late Dr. Robinson, having applied themselves to the problem, any time during the last thirty years; but, unfortunately, their experiments had not ended in any practical result. In this case, however, Prof. Abbe being the theorist, and Dr. Schott a practical man, there was a combination which led to a much more exhaustive series of experiments, and the result was that new kinds of glass were really discovered. The earlier experiments they made were not very remunerative: they took a deal of time, and did not lead to any commercial result; but the German Government generously came forward, and voted a large sum of money in order that the experiments might be continued. The practical result, so far, had been shown in two ways. First of all, telescopes of considerable aperture had been made by Bamberg, of Berlin, as high as eight inches of clear aperture; and as regards achromatism there could be no doubt he had reached a point which had never been attained before. That, of course, would be shown in practical results by the extremely convenient use of deep eyepieces. It was well known that when these were used with a telescope in which the chromatism was imperfect, a flare of clouded fringes was produced; but with the new glass the chromatic aberration appeared to be more highly corrected. Turning to a point more interesting to himself, this glass had been used for the improvement of microscopic lenses, and a new series had been manufactured by the well-known optician, Zeiss, of Jena, and there could be no doubt that he had attained more perfect corrections through a larger extent of aperture than in any of his objectives of previous construction; these objectives were therefore aplanatic in the sense in which the term was used by our classical writers on optics. As regards achromatism, the superiority over lenses manufactured with the older media was unmistakable. Seeing these results, he could not help thinking that photographic lenses also might be much improved by the use of this Jena glass. He thought photographers had a right to expect from opticians that the necessary energy should be devoted to the problem of endeavouring to utilise these new kinds of glass, and to attaining results in photographic lenses comparable with those which had been obtained in the microscope. He was informed by Prof. Abbe that Steinheil had had a good many samples of this glass, and that he had seen his way at any rate to improved forms, and before long he believed there would be an issue of new lenses by Steinheil, made of this material, in which a higher degree of achromatism would be attained with larger and flatter field. If English opticians did not follow in the same path, they would not deserve the support they had hitherto had in England and abroad, where their reputation stood very high indeed. In France, Germany, and Italy, photographers, both amateur and professional, spoke of the quality of English lenses with great respect, and referred to them as being of a somewhat higher standard in the matter of workmanship than almost any produced on the Continent, not in the mere technical execution, but in evenness of quality, so that if a foreigner gave an order to an English firm, he would be almost certain to get a lens of a high standard of excellence. Many people here who had obtained lenses from abroad had not been so successful, and he might say that he had burned his fingers more than once. If you sent for a lens to Paris, you might get a good one, but the chances were you did not.

Mr. Debenham said he thought justice should be done to the memory of Petzval, and he was sorry to hear his lenses referred to by Mr. Mayall as things of the past, and to hear it said that they were infinitely behind newer combinations in aplanatism. According to Mr. Mayall's view, they were the only truly aplanatic lenses, because by his definition such a lens was one free from spherical aberration; and the peculiar characteristic of Petzval's lens which stamped it as the work of a great genius was the freedom of spherical aberration.

Mr. Werge said he should be glad if Mr. Taylor could tell him how to determine the focus of a pin-hole, as pictures of large and small size could be produced thereby.

Mr. Traill Taylor, in reply, said Mr. Werge was very well aware that, according to the distance of the pin-hole from the screen on which the image was received, so would be the magnitude of the image. If it were six feet away it would be large, if only six inches it would be small. The object of the pin-hole was to produce an image of the same dimensions as that given by the lens in question, and that could be done by moving the pin-hole backwards and forwards until the two images coincided. That was all that was wanted. He made no mention of the focus of a pin-hole. Continuing his reply, he said the best lens for a short studio was a short focus lens, and you should get the camera as far away from the object as possible. With regard to lenses for optical lanterns, according to Mr. Mayall there were none, because it was a thing of the past; but he really thought he could not have been mixing so freely in the photographic world as he ought, or he would know that the Petzval was *the* lens *par excellence*—the only thing which could be employed for an optical lantern, either for projecting or enlarging, owing to its adaptability. Petzval's portrait lens was the one for the lantern; it was used in the lantern that evening and everywhere else, and he was a little surprised to hear Mr. Mayall say that it was a thing of the past. The most eminent opticians in the world were making them constantly. They might call them universal lens, or the A, B, C, or D lens, or any name they liked, but they were all Petzval lenses, and they were in constant use. The same gentleman had referred to a cemented back. Among the first lenses that emanated from the factory of Voigtlander were lenses with cemented backs; they were triple compound lenses of enormous aperture and very short focus, capable of working, as was facetiously said, in a coal-cellar. Voigtlander took out a patent for that again a few years ago, and portrait lenses with cemented backs were things of the present day. Mr. Mayall had also referred to lenses being made wholly of flint. When he described Steinheil's invention, he characterised it as being made of two kinds of flint glass, the denser element outside; and all the lenses of the present day characterised by the term "rapid," with the exception of the one he had spoken of as being American in inception, were made with two kinds of flint glass, the denser element outside.

* Abstract of a paper read before the Society of Arts.

A BORE-HOLE in search of coal, said to be the deepest in existence, which the Prussian Government had commenced in the Canton of Merseburg (Saxony), after having reached a depth of 1,738 mètres—therefore more than a mile—has had to be abandoned, as it had come upon porphyry rock.

SCIENTIFIC NEWS.

FROM Dun Echt Circular, No. 134, we learn that elements and ephemeris of Comet B, 1887 (Brooks') have been calculated by Prof. L. Boss, from observations made on Jan. 24, 26, and 29: T = 1887, March 7·95 G.M.T.; π − ☊ 150° 33′; ☊ 276° 38′; i 106° 3′; log. q. 0·23545. The ephemeris for Greenwich midnight reads Feb. 14, R.A. 1h. 47m. 56s.; N. Dec. 73° 27′; brightness slowly increasing. Elements and ephemeris of Comet C, 1887 (Barnard) have been computed by Mr. H. V. Egbert, Albany, N.Y., from observations made on Jan. 23, 24, and 25: T = 1886 Dec. 2·09 G.M.T., π − ☊ 35° 7′; ☊ 258° 52′; i 85° 46′; log. q. 0·17970. The ephemeris for Greenwich midnight reads, Feb. 14, R.A. 20h. 11m. 4s.; N. Dec., 38° 48′; brightness decreasing.

The large southern comet discovered by Mr. Thome at Cordoba on Jan. 18 will probably become visible in Europe, but as its perihelion passage most likely was on Jan. 11, and its brightness has been diminishing since, it is doubtful whether it will be visible to the naked eye, or will long remain within the power of telescopes. According to Dr. Kreutz, of Kiel, the orbit is similar to the orbits of comets 1843 A, 1880 A, and 1882 B, thus supporting an hypothesis that these comets form a sort of system, of which the lately-discovered body is another member.

According to Circular No. 14 of the Liverpool Astronomical Society, the red star Espin No. 142 = 47° No. 194, R.A. 0h. 39m. 55s., N. Dec. 47° 37·6′ [1885], was observed 1886 Nov. 30th to be 8·5. Last night (Feb. 6th) it was only 9·9. It is therefore *var.* The neighbouring star 47°, No. 187, 30s. *s.p.* 1·2′ S. may also be *var.*, as it is now 8·2, while on Nov. 30th it was estimated as 9·2. The red star lies 1m. 34s. *f.* 0° 1·6′ S. of Omicron Cassiopeiæ.

Mr. C. E. Peek, M.A., has issued a brief circular report of the work done at his Rousdon Observatory, Lyme Regis, from which we learn that during 1886 there were 146 nights available, the best month being December, and the worst February. The great nebula in Andromeda (31 M) has been kept under regular observation, and systematic work has been done on a select list of long period variables with the 6·4in. equatoreal. Comets D and E, 1885, A, B, C, E, F, 1886, have also been observed since his last report.

The *Journal* of the Liverpool Astronomical Society for February contains no fewer than thirteen notes on astronominal subjects of interest to observers, including a list of unpublished red stars detected by the late Rev. T. W. Webb.

The death is announced of General Hazen, chief signal officer of the United States.

Col. Sir John Bateman-Champain, R.E., died last week at San Remo, at the comparatively early age of 51. He was at one time director in chief of the Indo-European Telegraph System, having previously assisted in the construction of the land line from Bushire to Teheran, and from the latter place to Bagdad. The deceased officer was, in fact, one of the pioneers of telegraphy, and in 1879 was elected President of the Society of Telegraph Engineers and Electricians.

The Council of the Royal Meteorological Society have arranged to hold at 25, Great George-street, S.W., on March 15th to 18th next, an exhibition of marine meteorological instruments and apparatus. The committee wish to obtain a large collection of such instruments, and will also be glad to show any new meteorological instruments or apparatus invented or first constructed since last March, as well as photographs and drawings possessing meteorological interest.

The Council of the Geological Society have awarded the medals to be given at the anniversary meeting of the society next Friday as follows: The Wollaston gold medal to Mr. J. W. Hulke, the Murchison medal to the Rev. P. B. Brodie, the Lyell medal to Mr. S. Allport, and the Bigsby gold medal to Prof. C. Lapworth. The balances of the funds at the disposal of the society are awarded as follows: The Wollaston Fund to Mr. B. N. Peach the Murchison Fund to Mr. R. Kidston, and the Lyell Fund to the Rev. Osmond Fisher.

In a paper contributed to the Royal Society of Dublin, Professor W. F. Barrett gives an account of his investigations into the physical properties of manganese steel. The makers, Messrs. Hadfield, sent him two wires of No. 19 standard gauge (1 millimètre; ·040in.), one left hard, the other softened by cooling (a special property of this alloy). The wire was found to have an electrical resistance of about 1 ohm per mètre, and the specific resistance in C.G.S. units was 77,000 for a cubic mètre. The susceptibility of the alloy to induced magnetism was only 300, while that of iron is 100,000; and the tenacity of the hard wire was found to reach a maximum of 100 tons per square inch, that of the softened wire being 48 tons. These figures show that the manganese steel should be useful as wire in resistance coils, and as plates in the construction of ships, dynamos, &c.

The judgment of the Court of Appeal in the case of the incandescent lamps with "filaments" leaves the monopoly in the hands of the company who own the Edison and Swan patents; but a final definition of "filament" has yet to be given. One of the judges dissented from the views of the other two, and Prof. Silvanus P. Thompson asks the following question in a letter addressed to the *Times*:—"We may thank Lord Justice Cotton for his timely protest; but what are we to say of the state of things which permits two Lord Justices of Appeal to hand over gratuitously to an inventor that which he does not claim to have invented, and which is not his, and which, if it has not been appropriated by other inventors, certainly belongs to the public?"

The new incandescent method of burning gas, to which we referred in an article on p. 446, has been exhibited at the Marlborough Gallery, 53, Pall Mall, S.W., where 56 burners having the Auer (or Dr. Auer von Welsbach's) cap are arranged in two rows along the centre of the room. A slightly modified form of the Auer cap, or mantle, is being made, we believe, by Mr. A. Paget, of Loughborough, and will shortly be on the market. Laboratory experiments show that the life of the caps can be safely estimated at one thousand hours; but as they are extremely fragile after once being raised to incandescence, care must be taken to preserve them from draughts and from careless handling. In the experiments at the Marlborough Gallery an efficiency of seven and a half candles per cubic foot of gas has been obtained—a very high rate, which if it can be shown in ordinary practice will speedily lead to the general adoption of Dr. Auer von Welsbach's "mantles," or of some similar device. An efficiency of 10 candles per cubic foot was claimed for the Clamond "magnesia basket" (p. 444, Vol. XXXVI.), but in that case it was necessary to provide a blast of air, and the machinery required to produce that would effectually prevent the general adoption of the Clamond system for domestic purposes.

The great dynamo machine known as the "Colossus" has now been running for some months at the Cowles Works, Lockport, N.Y., for at least 20 hours per day, and no accident or stoppage has occurred—a remarkable performance for a machine of the size.

In New York one of the tramway companies has reluctantly abandoned all idea of electricity and resolved to adopt the cable system. In Boston another company which proposed to use the cable has determined to adopt electricity, as it has such "undeniable superiority."

At Maryport recently a remarkable and highly interesting entertainment was given by Mr. F. F. Bennett, the National Telephone Company's manager in West Cumberland. The subject of the lecture was the "Telephone and its Applications," and subsequently a "telephone concert" was given. Wires had been brought into the hall of the Scientific Institution from the central station in Maryport, and a number of telephones were distributed amongst the audience, through which they heard the voice of a young lady singing at Cleator Moor (17 miles away), accompanied on the piano by another young lady at Workington (6 miles distant). Then a cornet solo at Paton (12 miles off) was given, and several pianoforte solos from various places. Similar experiments were made last week between Brussels and Paris, when the Queen of the Belgians listened to the opera in Paris.

M. Hospitalier has been making experiments with electric lights at his private house, using primary batteries (bichromates) to charge secondaries continuously. The bichromate battery is fitted with siphons to secure an automatic change of the liquid; but the cost comes out at 2d. per hour for a 10-candle-power lamp, and that at wholesale prices—viz., 3·75d. per lb. for bichromate of soda, ·65d. per lb. for sulphuric acid, and 3·4d. per lb. for zinc.

At the meeting of the Institution of Mechanical Engineers last week, it was stated that there was a net gain of 34 members, while the capital now amounts to over £18,000. The experiments on riveted joints have been delayed, owing to the non-completion of the testing machine. Fresh apparatus is being constructed for further experiments on friction, and another committee has been appointed to thoroughly investigate the question of the steam jacket, under the presidency of Mr. Davey, of Leeds. Prof. Kennedy is president of another committee, which will draw up a standard system for conducting the trials of marine engines.

The *Lancet* says that "it is very strange that the repeatedly-urged proposal to warm railway carriages by a complete system of pipes heated with the waste steam and the hot air from the engine has not been carried into effect. There would be no serious difficulty and comparatively little expense in putting this plan in operation." Probably the locomotive superintendents would express a different opinion—at all events as to the advisability of adopting that method of warming carriages in express trains.

Preparations are being made at Milan for the International Exhibition of machinery for grinding corn and making bread. This exhibition is of great importance, both from a social and humanitarian point of view. Opportunities will be afforded of examining every mode of bread-making.

Arrangements are being made to hold an international industrial exhibition at Brussels in 1888. The site chosen is that of the 1880 Exhibition, and will include 40 acres of gardens, to be illuminated at night by the electric light, and to contain cafés and concert-halls, besides reproductions of famous ancient buildings.

The Horse-power of a Whale's Tail.—Sir William Turner, the eminent Professor of Anatomy in the University of Edinburgh, recently delivered a lecture to the members of the Philosophical Institution of that city on "Whales: their Structure and Habits," in the course of which he referred to a point of considerable interest to engineers, which was the horse-power exerted by the tail of a large whale. Regarding the length of full-grown whales, Prof. Turner remarked that the porpoise was 4ft. or 5ft. long, whereas the Greenland right whale was from 50ft. to 60ft. long, and he said that the great finner-whale, which frequently visited the British seas, reached the length of 80ft., or even more. An animal of the latter sort was stranded at Longniddry some years ago. After speaking at some length on the structure of whales, the lecturer made some remarks on the rate of speed at which they travelled. It had been estimated, he said, that the Greenland whale could attain a speed of nine or ten miles an hour, and that the finner-whales attained even a greater speed. In all probability the Longniddry whale could propel itself through the water at the rate of twelve miles an hour, and the sperm whale was said to be capable of driving itself along at the same rate of speed. He had asked Mr. John Henderson, of Glasgow, the well-known builder of the Anchor liners, to assist him in arriving at the horse-power which must be exercised by one of these great whales so as to acquire a speed of twelve miles an hour, and he put the case of the Longniddry whale before him. It was 80ft. long, weighed about 74 tons, and had a tail 18ft. to 20ft. across from the extreme ends of its flanges. With these data Mr. Henderson calculated that a whale of the dimensions mentioned, in order to attain a speed of twelve miles an hour, would require to exercise a propelling force of 145 horse-power.—*Engineering.*

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

FINDING THE DISTANCE OF A MOUNTAIN AT SEA — THE RINGS OF SATURN — "ET CREDIS CINERES CURARE SEPULTOS?"— CELESTIAL PHOTOGRAPHY—THE NEW DIALYTE — THE DIAMETERS OF STAR-DISCS AND THE UNDULATORY THEORY OF LIGHT—ROAD REFORM—TO THE INHABITANT OF A VITREOUS STRUCTURE — EYEPIECES FOR A 3½in. TELESCOPE—CLOCK AND SUNDIAL—GRAVITATION — THE ANNUAIRE OF THE BRUSSELS OBSERVATORY — PUBLICATIONS OF THE LIVERPOOL ASTRONOMICAL SOCIETY'S OBSERVATORY—DENT'S MERIDIAN INSTRUMENT.

[26807.]—SHOULD this meet the eye of Mr. Shearer (reply 60092, p. 415), it has just struck me that the following formula (in which account is taken of the curvature of the earth and refraction) may prove useful to him, as affording a very tolerable approximation to accuracy. If we call the height of any distant mountain in feet D, and suppose we are in a boat close to the surface of the sea, and can just see the top of the mountain above the horizon, we may use $\frac{2}{3}$ D² as the correction for curvature, and take $\frac{1}{7}$th of this for refraction. Hence, we get D², and extracting the square root, obtain the distance of the mountain in miles. For example, the Peak of Teneriffe is 16,000ft. high; how far is it off, when, from the sea-level, we can just see the top of it on the horizon? Here

$$\tfrac{2}{3} D^2 = 16,000 \therefore D^2 = 24,000.$$

Taking $\frac{1}{7}$th of this, and adding it for refraction, we get for distance² 28,000, and extracting the square root of this, 167½ miles.

Discussing, in letter 26685 (p. 429), the observations of the planet Saturn, which have been carried on for some years by Professor G. Davidson, of the U.S. Court Survey, I threw out the suggestion that the anomalous mark on Ring A, known among astronomers as "Encke's division," might be variable. I have since been reading a short notice of some observations made during the last two or three months at the Lick Observatory on Mount Hamilton, in California, with the 12in. equatoreal, which is doing duty there until its mighty successor shall be set up and in working order. Captain Floyd and Mr. Keelar, the observers, say, with reference to the ring system of the planet: "The stripe on the outer ring of Saturn, known as Encke's division, appears as a barely perceptible, ill-defined shade, and is certainly not at present so conspicuous as it is represented in drawings made a few years ago. The inner edge of the inner ring, on the contrary, appears to be more sharply defined than formerly; and the contrast between it and the gauze ring is greater." We know, of course, for dynamical reasons, that the rings of Saturn cannot be solid, and if we admit them to consist of discrete masses or particles, disturbances *inter se*, might quite possibly produce such a segregation of those particles as should lead to gaps, permanent or temporary, in their seemingly continuous surface.

The mention of the Lick observatory suggests to me to say something of what seems to me a very singular proceeding in connection with that Institution: I mean the removal thither on January 8th of all that is mortal of its most munificent founder, and the entombment of his remains on the succeeding day in the pier of the great equatoreal. From a newspaper kindly forwarded to me by a friend, it would seem that the custody of the body was formally transferred to the trustees on the Saturday evening, that the coffin remained in a room in the observatory that night, and that on Sunday, after an address from Mr. Floyd, the president, it was lowered into a cavity in the foundation pier of the great telescope, and permanently built in. I cannot but feel that were I observing alone under the mighty dome, which will so soon roof in the spot where James Lick lies, there would be something eerie in the thought that he, to whose more than princely liberality everything round owed its existence, lay still and cold within a few feet of me. It may be that this absolutely unique interment was carried out by the special wish and direction of the subject of it; but on this point I have no information.

I am sure that "Pynx," and everyone else, must be indebted to Mr. Espin for the admirably clear and apprehensible description of the method of taking stellar photographs which he gives in letter 26757, on p. 475. It contains a quantity of detail, which cannot fail to be useful to everyone interested in this latest method of investigating the structure of the visible universe.

And I am glad, too, to find that another "sprat" which I threw out in letter 26685 (p. 429) has caught such a "whale" as the valuable contribution of "Orderic Vital" to the discussion of the construction of the new form of dialyte contained in letter 26759 (p. 476). With reference, however, to the paragraph with which "O. V." concludes, I should like to say that I cannot admit that anything which can be legitimately regarded as a "discrepancy" does exist "between the theoretical star-discs calculated by Airy's undulatory theory, and those measured in practice"; for the simple reason that the apparent disc has no very accurately measurable boundary. "Orderic Vital" will remember that Sir George Airy showed that if e be the radius of the aperture of a telescope in inches, the extreme diameter of a star-disc in seconds to the first black ring will be $\frac{2 \cdot 76}{e}$. Now, nearly twenty years ago that well-known double-star observer, Mr. George Knott, F.R.A.S., made a series of measures to test experimentally the amount of agreement between theory and observation in this matter, with the results which appear below in a tabular form.

Aperture of Telescope.	Diameter of Disc Calculated.	Diameter of Disc Observed.
Inches.	"	"
7·33	0·752	0·693
6·00	0·920	0·870
4·95	1·113	1.120
4·00	1·380	1·437
3·00	1·840	1·862
2·00	2·760	2·572

Now, in considering this table we must bear in mind what the actual visual aspect of a star is as viewed with adequate magnifying power in a first-class telescope. Imprimis, we have a disc brilliant in the middle, but rapidly degrading into an absolutely black ring; then comes a brilliant ring, then another absolutely black one, and so on; the maxima degrading with such rapidity that at the first, second, and third we have the $\frac{1}{57}$th, $\frac{1}{240}$th, and $\frac{1}{620}$th of the illumination at the true centre of the disc. The very way in which this disc itself degrades towards its edge renders that edge itself almost impossible to define with rigid accuracy. I wish that "Orderic Vital" would test this for himself with any form of micrometer he may prefer. If he will, I think he will agree with me that the agreement between the calculated and observed diameters of the discs in Mr. Knott's measures is quite close enough to confirm, rather than to throw doubt upon, the undulatory theory of light as developed by Airy.

Has "Norfolk" (letter 26767, p. 477) ever had anything practically to do with road-making in his life? I ask this question because, while he is careful to calculate the weight to be raised annually at (what he calls) "the public expense," he wholly omits to make the slightest estimate of the cost of levelling his "five hills and four vales, each hill averaging fifteen yards in altitude," which, instead of falling upon those only who contribute to the traffic, really would have to be effected at the public expense. Let him inquire of some competent civil engineer, and publish the result in these columns. Having done this for his hypothetical five miles of road, let him go on to compute how many millions it would require to materially alter the gradients in the two counties of Devon and Cornwall alone; and finally, perhaps, he would not mind mentioning, confidentially, where the money is to come from. Burdens on land at present are just about as much as it can bear; and it is the proverbial last straw that breaks the camel's back. Road surveyors, quarry owners, quarrymen, navvies, carters, and roadmen wholly refuse to accept remuneration in the shape of "*foot-pounds.*" They have a prejudice, well or ill-founded, in favour of the twenty-shilling article; and in this form, malgré "Norfolk's" elaborate calculations, they would insist on having it.

I am very sorry that I have innocently wounded the susceptibilities of "Another Fellow of the Royal Astronomical Society" (letter 26782, p. 480) by my comments on the absurd nonsense talked about Mr. Roberts's discovery of 20 planetoids in Orion! Even your correspondent, though, is now driven to speak of Sir R. Ball's encouragement of Mr. Roberts's delusion as unfortunate laudation. I was not criticising Mr. Roberts's photograph, save in this connection, and am quite content to admit that it shows more detail than others previously taken of the same region. But Mr. Common and the MM. Henry *frères* (to say nothing of others) had shown Mr. Roberts the way; and, after all, it is only a question of protracted exposure. I know, of course, in common with every working astronomer, that refraction distorts the sun's image, converting it into a quasi-ellipse, with, by the bye, its major axis horizontal. I have further seen a cognate effect produced upon Jupiter when near the horizon; but that stars whose discs subtend an angle of 0·276" should be converted into perceptible ellipses (with *their* major axes lying in the wrong direction!) is "rather a large order." But one lives and learns. One word as to my "pungent personalities." I must be curiously constituted indeed to indulge in them in connection with anyone whom, as in the case of Mr. Roberts, I should not even know by sight if I met him; while as for the effect predicated of them by my confrère in his concluding sentence, I can only conceive it to be produced in those who have some friend or friends engaged in picking the public pocket in what has been recently termed (in a gush of advertising penny-a-lining) "our national institution at South Kensington, the too modest home of British science"!

Since the above was written (and quite possibly in type) I have seen the letter (26788) of "A Third F.R.A.S." on p. 499. What I described—and must persist in regarding—as the "imperfect astronomical experience" of the gentleman who could for an instant believe that he had photographed 20 new planetoids in and about 42 M Orionis (!) is spoken of in very much less euphemistic language by this fresh interlocutor; who whoever he may be, can obviously speak with an amount of personal knowledge and authority to which I have no claim. When Mr. Roberts sees what letter 26782 has elicited, he may, I think, well be tempted to exclaim, "Save me from my friends!"

If "Inquirer" (query 61505, p. 486) is limited to three eyepieces for his 3½in. telescope, he should obtain them of powers of, or about, 40, 120, and 250. The longer the focus of any telescope the better, so long as it does not become unwieldy.

I do not possess the work quoted by Mr. Godden in query 61542 (p. 487), and hence have no means of reference to the context; but as a mere statement of fact, the quotation he gives is simply absurd. The earth was in perihelion, and hence moving at her greatest speed in her orbit at 8 p.m. on January 2nd. At noon on that day at Greenwich the clock was 4m. 14·88s. before the sundial; and it was not until 4m. 14·88s. after the clock marked noon that the shadow of the gnomon fell on the meridian line. So much for the condition of things in perigee. When, though, we come to July 2, at 9 a.m. on which day the sun was in apogee, and when, according to the "Astronomy" the clock should be before the dial, we find that its author has stumbled into a correct assertion, for at noon on that day the sun does not south until 3m. 41·88s. after clock noon, or the clock shows noon 3m. 41·88s. before the dial does. Possibly the book goes on to explain how part of the equation of time is due to the inclination of the sun's apparent path (the Ecliptic) to the Equator; but taking the isolated sentence as quoted by your correspondent, the first half has obviously been incorrectly copied by the compiler of the volume whence it was derived.

I may tell "W. T. N." (query 61561, p. 487) that, if not absolutely instantaneous, the velocity of the influence of gravitation must be sensibly or practically so. A very little consideration will show him why. Light takes some eight minutes and a quarter to come from the sun to the earth. Suppose for a moment that gravity acted at the same rate: then, of course, the earth would feel the pull of the sun eight minutes and a quarter after she had quitted the place where the sun began to exert it; so that it would not be in the line connecting the earth and sun when the influence reached the former, but in the line joining them eight and a quarter minutes before. By the familiar diagram of the resolution of forces, this diagonal pull may be resolved into two, one attracting the earth to the sun, and the other hastening her in her path. But hastening her in her path means enlarging her orbit, lengthening the year, and so forth: nothing of which, as we well know, has happened. Hence gravitation must traverse space millions of times more swiftly than light. It has been calculated that the earth's pull on the moon must operate in less than 1-50,000,000th part of a second!

I have just received a copy of the *Annuaire* of the Brussels Observatory for 1887, and, I am

bound to say, a mass of the most valuable information it contains. Many pages are devoted to tables of physical units and constants, a detailed account of absolute physical measures, &c. There is also much of interest and use to the geodesist, while the ephemerides and details of the Solar System are excellent. Of course, a good deal of the work is taken up with matters geographical, topographical, and meteorological of purely local interest; but the larger proportion is adapted to the wants of every astronomer and man of science. The Abbé Spée continues to defend Secchi's theories against all comers, and repeats some of the "common forms" of the Solar Physics ring in this country. As, however, this will take in but few people indeed nowadays, his paper may be read with advantage. The work concludes with M. Lancaster's list of observatories, astronomers, and instrument makers, carefully revised and brought down to the present day. This is a real addition to the volume. In fine, the chief fault to be found with the present issue is that M. Folie repeats his ridiculous innovation of last year, and fills his monthly ephemerides with the name of a saint for every day in the year. I must venture humbly to reiterate my opinion, that in a purely scientific annual the columns given up to SS. Ludger, Agapet, Waudru, Clet, Pacôme, Zéphirin, Mummolin, and the rest of them, are very indefensibly wasted.

I see that the observatory of the Liverpool Astronomical Society has begun to issue its own publications, in addition to that capital general *Journal* of the Society, with which we are all familiar. The first number of this fresh issue lies before me as I write. It consists of two divisions: the first devoted to photographic stellar photometry, and the second to spectroscopic observations of stars. The photographic part gives the magnitudes (photographic as well as ocular) of 1376 of the D.M. stars, and must of necessity prove most valuable for comparison in future years with photographs of the same objects. It is instructive to note that here is work being done—and well done—by private enterprise, for which it was attempted, not so long since, to obtain a genteel form of outdoor relief from the national Exchequer for a person at Brompton.

"Hermes" (query 61577, p. 508) will find a description of Dent's meridian instrument (which was called a dipleidoscope) in several of your back volumes. For example, he may consult Vol. XXIV. pp. 429, 462, 510, and 555, to begin with.

A Fellow of the Royal Astronomical Society.

ALPHA FORNACIS (Herschel 3555).

[26808.]—THE pair α Fornacis (or 12 Eridani, as it is sometimes termed) is included in the double-star catalogues of Messrs. Flammarion and Gledhill as a probable binary, owing to supposed changes in its angle and distance. As the two stars are animated by a large common proper motion amounting, according to Argelander, to 0·707″ in the direction of 27·2° annually, there can be little question as to the actual physical connection of the components, but the micrometrical measures are somewhat discrepant. The principal ones are as follows:—

H_2—

306·1° : 3″ ± : 1835·87 (1 night) 20ft. reflector.
310·7° : 5·30 : 1836·40 (2 nights) 5in. refractor.

Jacob—

309·9° : 4·09 : 1847·05 (10 obsns.) 3¾in. refractor.
308·3° : 3·39 : 1851·09 ? 6·2in. refractor.
309·8° : 3·29 : 1852·99 ? 6·2in. refractor.
310·0° : 3·31 : 1856·16 (21 obsns.) 6·2in. refractor.

C.O.—

316·0° : 2·44 : 1877·81 (3 nights) 11·2in. refractor.

Hall—

311·7° : 2·60 : 1879·53 (4 nights) 26in. refractor.

β—

318·2° :ntgvn: 1879·68 (1 night) 6in. refractor.

Hall—

311·5° : 2·60 : 1880·25 (3 nights) 26in. refractor.

It seems probable that the apparent diminution in the distance is due to personal and instrumental causes. Sir J. Herschel remarks that, owing to the faulty micrometer, very little weight indeed can be attached to his measures of distance with the 5in. Tulley at the Cape; in fact, they are little better than estimations. The large star is No. 84 of Gore's "Catalogue of Suspected Variables." There are some curious discordances in the magnitudes of the small star also: Herschel, Jacob, and Stone call it 7 magnitude, Hall 8 magnitude, while Burnham, at Mt. Hamilton, rated it as low as 10·5 magnitude in Struve's scale. Gore failed to see it with a 3in. achromatic in the Punjaub in 1875.

H. Sadler.

Might I ask "A Third F.R.A.S." (letter 26788, p. 499) what learned society in England was made a laughing-stock to the world by Mr. Roberts's wild theory of the discovery (?) of the planetoids in the nebula of Orion? Not the R.A.S. certainly, as Mr. Roberts's paper on the subject was, of course, not read, nor was his photograph handed round at the meeting. Presumably, if someone chose to present us with a photograph of, say, the Rumtifoozle, we should be obliged to accept it, though it would not be hung up in the library or meeting-room. I am bound to say that I have seen far worse astronomical photographs than those of Mr. Roberts's—of portions of Cygnus, for instance. As his photographs of the nebulæ in the Pleiades agree *inter se*, though they were taken at different dates, and as they show the nebulæ discovered by MM. Henry, as well as a considerable amount of nebulosity not shown by them, as their telescope is inferior in light-grasping power to Mr. Roberts's, I do not think that there can be much doubt as to the actual existence of the nebulæ in question. Of course, the star discs are far inferior to those on MM. Henry's photographs, as, no doubt, those members of the L.A.S. who inspected my collection at the last meeting of that society will have noticed.

H. S.

STAR PHOTOGRAPHS—COMES TO POLARIS AND ALDEBARAN.

[26809.]—MR. ROBERTS is quite entitled to use his own discretion as to whether or not he should reply to the criticisms of "F. R. A. S."; but it is difficult to see why those criticisms should be made a peg upon which to hang the offensively personal remarks of "A Third F.R.A.S.," on page 499. This letter reminds me of a "coloured" preacher whom I once heard, who prefaced his sermon by announcing that "he would take a text, that he might be free." I think "A Third F.R.A.S." would have done well to imitate the candour of the Ethiopian in question. Pray, what interest is it to know who it was that instructed Mr. Roberts in the method of developing his dry plates? Men are not born in these days with a complete knowledge of such a technical subject as photography, and must perforce have assistance or instruction from some external source. I fail also to see wherein Mr. Roberts has shown any discourtesy in not announcing to whom he is indebted for the essential instruction in the photographic process to which "A Third F.R.A.S." makes allusion. Surely a successful artist is not thought to be discourteous because he omits to announce the name of the teacher under whom he studied every time he exhibits a work, neither do I see what useful object is served by parading the shortness of the time during which Mr. Roberts's name is said to have been before the astronomical world. It would be well if every astronomer could show such results as Mr. Roberts has been able to do in so short a period.

I may add that I have no personal acquaintance with Mr. Roberts, and that my knowledge of astronomical photography is of the smallest; but having seen some of the photographs of stars and nebulæ at a recent meeting of the R.A.S. when Mr. Roberts exhibited them in connection with his paper then read, I think his work quite deserving of the warm commendations then passed upon them by Mr. A. A. Common and others then present. I think he is to be congratulated on being able to produce star photographs comparing, as they do, very favourably with those of MM. Henry, and with apparatus which he then readily admitted to be capable of much improvement. If I were to conclude my letter by following the example of "A Third F.R.A.S.," I should, I suppose, have to subscribe myself "A Fourth F.R.A.S.," but for the obvious reason that I have nothing to say requiring the concealment of one's personality under a *nom de plume*, I shall abstain from doing so.

With reference to Mr. Gemmill's remarks (letter 26789, page 499), respecting the discrepancies in the comparative magnitudes of the *comes* of Polaris and of Aldebaran I can fully endorse all he says.

The *comes* of Rigel also seems considerably underrated when compared with the *comes* of Polaris and of Aldebaran; perhaps its alleged duplicity may have some slight influence upon its magnitude.

I called attention to the obvious differences in the real magnitudes of the *comes* to these three stars, as compared with those given in "Cel. Objects," in a letter to the "E. M." some time ago. (Vol. XXVIII. p. 541.) **W. Goodacre.**

Forest Gate, Feb. 5.

THE NEW BROOKS COMET.

[26810.]—WHILE sweeping the northern heavens on Saturday evening, January 22, with the 9in. silver-on-glass reflector, I discovered a new comet in the constellation Draco, approximate R.A., 18h. 0m. + 71°. I was soon enabled to detect motion, which was in a north-east direction. Telegraphic announcement was made by 9 o'clock, and it was cabled to Europe the same night. I secured another observation of it on my return from the telegraph office. Sunday night was cloudy; but last evening, January 24th, it was beautifully clear, and the observation was very satisfactory. The comet was then about one degree nearly north of Chi Draconis, and in the same low-power field. The same night the comet was observed at the Rochester, Albany, Cambridge, and Washington Observatories. Dr. Swift, at the Warner Observatory, Rochester, made its position at 7.30, January 24th, R.A., 18h. 20m. 28s., + 73° 36′ 34″. Comet is of moderate size, round, with slight central condensation, and visible in moderate apertures. **William. R. Brooks.**

Red House Observatory, Phelps, N.Y., U.S.A., Jan. 25.

COMES TO POLARIS.

[26811.]—IN reference to the question of variability of the *comes* to Polaris (letter 26789, p. 499), I append the following notes made in observing Polaris with a 2⅝in. refractor, power 68.

1875, March 27.—Studied Polaris very hard tonight, and found it tolerably difficult to see the companion. Webb calls it a "common test," but I did not find it so, although I generally agree with what Webb says.

May 22.—*Comes* seen very well.

July 18.—Just detected in bright twilight.

1876, May 7.—Saw the *comes* nicely in a bright sunset sky.

1877, June 3.—*Comes* of Polaris seen most distinctly—in fact, no difficulty with it at all; A whitish, B bluish.

Although the above are somewhat spasmodic, the remark against 27th March, 1875, shows that it was not so easy to be seen on this occasion as on others. **E. E. M.**

BLAIR'S NATURAL PHILOSOPHY—DIPSOMANIA.

[26812.]—I HAVE been looking through "Blair's Grammar of Natural and Experimental Philosophy," and on page 117 it states that "the sun's diameter being on the 31st December 31′ 45″, and on the 2nd July 32′ 45″, or nearly one-thirtieth longer, and consequently so much nearer, and increasing and decreasing gradually, it is evident the orbit of the earth is an ellipsis. Newton found the mean diameter of the sun to be 32′ 12″, but, as above, it is 32′ 15″. In January, therefore, the earth is in perihelion, and in July in its aphelion, and having a smaller circle to traverse in its perihelion half than in its aphelion half, it is eight days longer in performing the aphelion half of its orbit than the perihelion half."

Should not the apparent diameter of the sun seem larger when the earth is in perihelion? and how can the earth be in aphelion in July, if, as it states there, we are so much nearer?

On page 144 of the same book, in treating of the moon, it says: "To Dr. Herschel we are also indebted for an account of several burning volcanoes, which he saw at different times in the moon. In Vol. LXXVII. of the *Phil. Trans.*, he says: 'I perceive three volcanoes in different places of the dark part of the new moon. Two of them are nearly extinct, or, otherwise, in a state of going to break out. The third showed an actual eruption of fire, or of luminous matter.' On the next night Dr. Herschel saw the volcanoes burn with greater violence than on the preceding evening."

Has any observer of the moon seen anything of the same kind lately? Perhaps Mr. Elger could enlighten me?

I have been anxiously looking forward for the results of Mr. Edge's case. Can he, or "Garrison Gunner" give us further particulars? If "Garrison Gunner" will extend to me the same offer he made to Mr. Edge, I will advertise my address, as I would give much to reclaim a near and dear friend, who is fast becoming a confirmed drunkard.

T. C. H.

ELECTRIC LIGHTING BY LECLANCHES.

[26813.]—IT is quite possible, as Mr. Conry states, to light incandescent lamps by means of Leclanché cells. I have employed this method for the past seven months, and can recommend the Leclanché as the cheapest battery for the purpose where a temporary light only is required.

My battery consists of 27 No. 1 cells, arranged in three rows of nine, and I use 5c.p. (nominal) lamps. Only one lamp is used at a time; one is in my bedroom, another in w.c. When this installation was new, the battery kept a lamp glowing brightly without any perceptible diminution of light for ten minutes or more. I did not test its capability in this direction, as I did not want to waste power. One day a switch was accidentally turned on and the battery ran down. Since that time the light given by the lamp falls off rapidly in use; however, the light given is ample for the purpose required. I can turn on a lamp at any time during the night without getting out of bed, and can see the time by the clock from which the lamp is distant about 6ft. Another lamp in the cellar enables me to draw a glass of beer without the trouble of carrying a lamp, and the nuisance of having it blown out by the draught up the cellar stairs. Another lamp on the staircase affords suffi-

cient illumination when going to bed after turning out the gas downstairs. Twenty-seven cells is the minimum quantity that will work my lamps effectively; thirty-six would be better. Of course much depends upon the lamp. I tried various combinations of cells to get the best results.

A. Percy Smith, Rugby.

ELECTRIC LOCKING FOR RAILWAY SIGNALS.

[26814.]—IF you will be good enough to insert the inclosed description of my system, I think it will answer the letters which appeared in your last number, and explain the system, which does not appear to be properly understood by your correspondents.

First I will take a double line of railway, and three stations — A, B, C. For simplicity "up" trains only, as the same system of working applies to "down" trains. Conditions at each station:—Levers of starting signals locked, indicator over lever showing "lock on." Instrument at B and C showing last train arrived:—A green disc, with "train arrived" on it. If this system is worked by, and in connection with, the block telegraph instrument, then the discs or needles of the block instrument show the indications instead of special or separate discs.

A has a train to leave his station: his starting signal lever being locked, he cannot lower it. A then sends a bell code (as arranged) to B, who, seeing by his instrument that the previous train has arrived (and by its arrival the instrument has been rendered capable of being again worked), sends a current by key or plunger, and takes the lock off of starting signal at A. The signalman at A can then lower the signal, and the train leaves. On A putting the lever back, it is mechanically, not electrically, locked again by a catch lock. When B sent the current to A, his instrument indicated the same by a white disc "line clear," howing him that he had given "line clear" to A and taken his lock off. When A received the current, and his lock was taken off, the lock itself sent a current working the indicator to "lock off," and as soon as the lever is put back, the indicator shows "lock on." On the train's departure A gave the bell signal "train on line" on the red key of his instrument, which brings up a red disc "train on line going" on his instrument, and rings the bell at B, and drops a red disc at B's instrument showing "train on line coming." Now A cannot move his lever again till B unlocks it, and B cannot unlock it (his key or plunger being locked up) till the train that has been allowed to come on by B has passed over the treadle, which action causes a green disc in his instrument to drop showing "train arrived," and resets the instrument, which is, until then, locked up by the action of taking the lock off of A's signal for the train to come on, and the same process is carried on from B to C and forward throughout the line. Now if, say, B does not put his lever back after the train has gone on to C, the signal would be down, and no danger can arise from this, as when A asked B to unlock his signal for another train, B's signal lever not having been put back by B to danger renders it impossible for B to take the lock off the lever at A for the following train to come on, because the wire by which he sends the current to A is severed, and it is only joined again when B's lever is put back and locked, so that he must put it back before he can take A's lock off again, and in putting it back, it is again mechanically locked, and must be unlocked again from C before he can lower the signal again; the same arrangement is made at every station. If A, being a terminal station, does not put his lever back, the ordinary interlocking system would necessitate his having to do so in order to set the road for the next train or engine to shunt into the station, when it would be locked by the act of putting it back. If the terminal station has one or more platforms from which a train can start, the signals for the platforms are interlocked mechanically, and one must be put back before the other is lowered, and with my electrical locking attached to these, after one signal is lowered no other can be until the train is out of the first section and the lever has been put back and locked; and this can also be otherwise arranged, if this is not considered sufficient.

For single lines the system is the same, with the addition that when a lock has been taken off for a train to proceed, not only cannot another follow, but one cannot leave in the opposite direction. Should it be necessary from any cause to cancel a signal, the lever which has been unlocked must be moved and replaced before the signalman can take off the lock for a train to come in the opposite direction. If the instrument fails, it fails on the side of safety by locking all up; but provision is made until it is put right, so that it can be worked in such cases under special directions, so as not to upset the regularity of the traffic. I am aware some are of opinion that the train should put the signal to danger as it leaves the station automatically. Some years ago I thought this a good plan, and with my electric signal I arranged an entirely automatic system, that the train itself should, on leaving B, ring a bell to C, put up a signal to danger at B to protect itself till it got to C, at the same time take down the signal it put up when leaving A. But I have somewhat altered my views, and prefer two strings to my bow: one that there should be retained all the intelligence that can be obtained from human agency—the signalman, and that if he should go wrong, it should be mechanically impossible for him to do so. From the correspondence that has passed, it seems to be thought that the signal is locked by the electric current from the other end. This is not so. It is only unlocked by current, and is mechanically locked by a catch lock on being put back. The aim is safety. Quibbles may be raised as to the lever not being put back in order to lock it; but if a second train cannot come from the stations in the rear until it is put back and locked, I maintain most emphatically that the system is absolutely safe, and meets all requirements.

In my system one line wire only is required between stations for sending all the necessary signals for the bell, lock, and indications, and at a junction one instrument is sufficient for working any number of lines approaching it; but only one train can be allowed to come on, and a second one cannot follow until the first has cleared the junction and passed the clearing point authorised by the traffic managers. It is also well adapted for intermediate sidings between stations, and much time is saved by its use.

C. E. Spagnoletti.

The Poplars, Aberdeen-place, London, N.W., Feb. 1st.

DEPOSITION OF ALUMINIUM.

[26815.]—A MISTAKE is made in reference to Mr. J. Baynes Thompson's process for the deposition of aluminium. The reduction was not at 500° Fahr., but from 120° to 150°. The solution was of aluminate of soda, and the intensity of the current about 6 volts. The reaction is not electrolytic, but secondary and chemical by nascent hydrogen.

Mr. Thompson has for long deposited aluminium from aluminate of soda. Some years ago I read in the *Chemical News* that aluminium could not be thus deposited. In reply, I left with the editor a strip of copper with half of its surface coated with aluminium. No notice was taken, however, of this practical correction.

Wm. White.

The Laurels, Cheshunt, Herts, Feb. 1.

IRON v. STEEL.

[26816.]—OF late years steel has been rapidly taking the place of iron for all structures of strength, especially so in rails, bridges, and ships. The chief advantages of steel are lightness, strength, and durability. For instance, in the case of steel rails, it has been found by experiment that a steel rail will last out sixteen or eighteen iron ones, because the iron one does not wear uniformly, but gets into a series of hills and hollows, which soon render it useless, while the steel one wears gradually and uniformly its whole length.

It has further been found that it requires 30,000,000 tons to wear $\frac{1}{16}$in. off a steel rail. In fact, we could not do with iron rails at the present day, as the enormous amount of traffic on our railways would render them comparatively useless in so short a time that they would constantly require to be relaid, thus hindering the traffic to a great extent.

The width of the table of double-headed steel rails is $2\frac{1}{4}$in., and is curved to a radius of $5\frac{1}{4}$in.—the depth of the rail. The web is $\frac{5}{8}$in. thick. The shoulders are inclined at an inclination of one in two.

The great durability of steel rails is due to the fact that steel is homogeneous and fibreless, and therefore it lasts, or rather holds together, as long as there is any of it left.

In the construction of bridges and ships and other structures requiring great strength, steel is preferable to iron, especially so in swing bridges and ships, as it combines strength and lightness. By the use of steel, structures may be lightened 23 per cent. By the regulations of the Board of Trade the greatest stress per square inch is not to exceed $6\frac{1}{2}$ tons, and for iron 5 tons per square inch. At the Forth Bridge at Queensferry the amount of steel required for the two main spans alone has been estimated at 42,000 tons. If the bridge were of iron, the weight would be increased by nearly 10,000 tons (adding 23 per cent. on).

Would it have been more economical to use iron, or would the extra cost of the steel be more than that of 10,000 tons of iron?

Boilers are now being made of steel, which reduces the weight about 10 per cent., and the thickness of the plates by 20 per cent.

The tensile strength of steel is about 29 tons per square inch, and an elastic force of 11 to 16 tons per square inch. Drilling the holes does not seem to weaken the plates; but punching the rivet holes weakens the metal by about 30 per cent. If the plates are annealed, however, the strength is restored again.

The use of steel for ships has proved most satisfactory. On several occasions, where vessels went ashore, or came in collision, the sides of the vessels were merely bent in, but not broken. A saving of 20 per cent. in the weight has been effected by the use of steel plates, combined with a strength 30 per cent. superior to that of iron. Let us take an example:—An iron girder has to bear a strain on the top and bottom flanges of 650 tons, then the area of the top flange (taking 5 tons per square inch as the compressive strength) would equal $\frac{650}{5} = 130$sq.in.; but suppose the girder were of steel, then (taking $6\frac{1}{2}$ tons as the compressive strength for steel) we have $\frac{650}{6{\cdot}5} = 100$sq.in. Thus the area is reduced by 30 per cent. by substituting steel for iron.

In the manufacture of steel there are three processes—viz., Bessemer, Siemens, and Thomas-Gilchrist.

The chief point in the Bessemer process is forcing air through the molten metal in a large converter. The oxygen in the air burns and produces an intense heat, and a chemical change takes place which separates the carbon and other impurities from the molten metal. The time required for the "blow," as it is termed, is about 20 minutes.

The Siemens, or open hearth, process takes about four hours; but by this process the metal can be examined from time to time, so as to ascertain its condition.

Large quantities of steel are now made from ore not formerly suitable for steel, by the Thomas-Gilchrist process, which is merely an extension of Bessemer's. The main difference is in the lining of the converter.

Steel is now largely used for castings, in preference to iron. Lately, however, castings have been made from malleable iron by the "Mitis" process. Malleable iron, when heated to melting point, does not run freely into the mould. It has, therefore, to be heated a little above that point; but when it reaches so high a temperature, it is found to absorb gases which produce flaws and cavities in the castings, thereby rendering them useless. In the "Mitis" process a small amount of aluminium is added to the iron, which causes it to melt at a much lower temperature; it therefore does not absorb the gases, but produces a good sound casting, free from all flaws and defects.

Portobello, N.B. James G. Shepherd.

BURNT AIR.

[26817.]—IT is a pity that some correspondents (see letter 26792) do not take to heart the editorial heading to the correspondence column, and *write what they know*. It is doubtless true that steam may be decomposed when passed through a *red hot* iron tube; but that the aqueous vapour in the air suffers the same change by contact with a hot stove is an absurdity. The most probable explanation of the difficulty is that the organic matter in the air is burnt, with the formation of a small quantity of ammonia. A. P. S.

SUNDIAL TO SHOW MEAN TIME.—TO "E.L.G."

[26818.]—SOME years ago "E.L.G." gave, I think, as a sort of challenge or crux to the scientifically-inclined of our contributors, the construction of a sundial to show mean time all the year round. Might I ask him, as no one has taken it up, will he supply the answer himself if such a dial be a possibility.

Windmills.—I am glad to see Mr. Vallance defending his windmill, as he is well able to do, against all comers. He may remember writing me privately an account of its results and construction, which so convinced me of its practicability for the purpose he recommended it for—viz., ploughing a steep hillside—that I commenced the construction of a mill; but circumstances prevented my ever completing it.

Some short time ago I saw in your periodical an illustration of a horizontal mill, which it seems to me would be very effective, and well designed for a small motive power, very simply and easily constructed. If any one is interested, I might be able to look it up and send illustration.

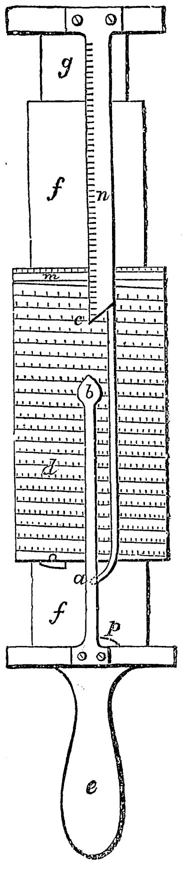
Lathe Construction.—Might I ask "F.A.M.," if he has it still, could he return me a very rough sketch of my method of fitting the guide-screw nut on front-slide lathe? I sent it to him in reply to his challenge to prove that the form and fitting of the bed proposed by me was not what he called a "paper bed." I do not know whether it is my plan he has adopted in his article on the subject which appeared some time ago. I have been working at the subject on my own lines, and my sketch of this

has gone astray, which is my excuse for troubling him or writing anything on lathe matters in the "E.M." **Fred. Carre.**

PROF. FULLER'S SLIDE-RULE.

[26819.]—YOUR correspondent Raymond (26804) has given a very brief description of Prof. Fuller's slide rule. I think it would be of interest to many of your readers to have a fuller description of this excellent rule, which is becoming very popular where there is much calculation being done. I therefore inclose a good illustration by Prof. Fuller with his description.

Its range is greater than most arithmetical machines, as, besides the operations of multiplication and division which many instruments can only perform, results requiring the reciprocals, powers, roots, or logarithms of numbers, can be quickly and easily obtained by its use.



The rule consists of a cylinder *d* that can be moved up and down upon, and turned round, an axis *f*, which is held by a handle *e*. Upon this cylinder is wound in a spiral a single logarithmic scale. Fixed to the handle is an index *b*. Two other indices *c* and *a*, whose distance apart is the axial length of the complete spiral, are fixed to the cylinder *g*. This cylinder slides in *f* like a telescope tube, and thus enables the operator to place these indices in any required position relative to *d*. Two stops *o* and *p* are so fixed that when they are brought in contact, the index *b* points to the commencement of the scale. *n* and *m* are two scales, the one on the piece carrying the movable indices, the other on the cylinder *d*.

The use of slide-rules has been confined to roughly approximate calculations, as the length of scale hitherto made was sufficient only for about 160 divisions. In the new rule the length of scale is 500in. and the number of divisions 7,250, consequently the approximation obtained by its use is sufficient for most of the calculations required by engineers and architects, and for many of those required by actuaries.

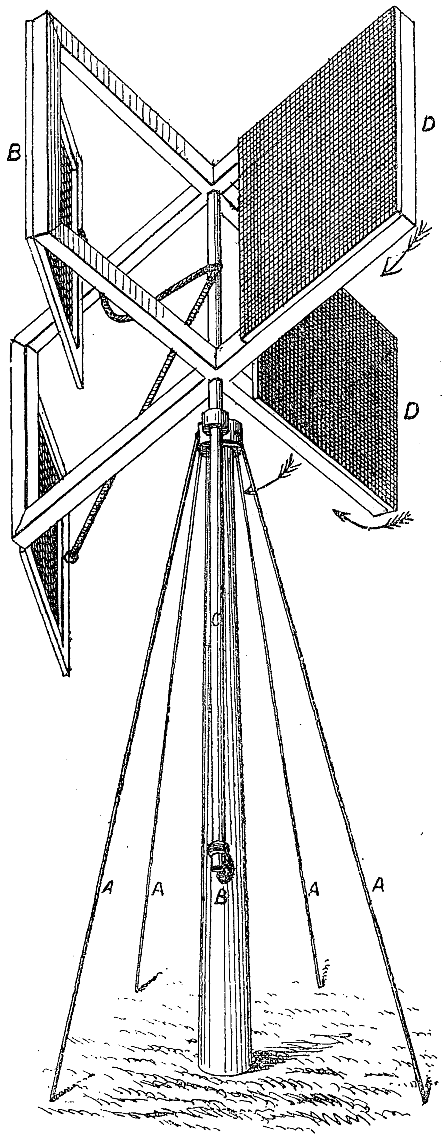
For taking out bills of quantities this rule will be found of especial value, as by its aid the squaring and cubing of quantities is easily and quickly performed. **W. F. Stanley.**

HORIZONTAL WIND POWER.

[26820.]—MY model being constructed on a scale of 1½in. to a foot, or one-eighth of the intended full size, I find, with a fair breeze of wind, it gives me the following results: It lifts a 4lb. weight perpendicularly one foot in one minute; but my trials having been made in a walled garden, near trees, I feel certain the little motor will give much better results when I can find a free current of air without eddies, in which to make a further trial.

My idea of a full-sized machine is two 20ft. crossbeams 11in. deep and 3in. thick, giving 4 arms, each 10ft. long; 4 spars 2½in. diam. at the centre, 20ft. long, 10ft. being above and 10ft. below the crossbeams; with sails 20ft. high lashed to masts, and extending 8 or 9ft. to the sheets. I hope ere long to give better accounts; but I could not well keep silent after promising to give results. I think I have too many powers on, having a screw on upright shaft working in a wheel, with pinion in second wheel with barrel. I shall try more direct results next week. **Wm. Hosken.**

[26821.]—I HAVE read with great pleasure the discussion going on in "Ours" on the above subject, as it is a subject that I take a great interest in. Inclosed is a very rough sketch of a horizontal windmill, which has occupied my "odd thoughts"



for this last two years, which, with your permission, Mr. Editor, I submit to the friendly criticism of your readers.

The sails, D D D D, are made of sailcloth tacked on to a wooden frame, which is hinged to the arms of the mill. The post B is a scaffold-pole of the height required, braced with iron rods fixed into the ground, and fitted with tightening screws similar to those attached to telegraph posts.

The power is communicated by means of a pair of bevel cogs to a heavy flywheel running on a stud fixed at B, one of the cogs fixed to the lower end of the rod C, and the other fixed to the flywheel. I think the sketch will explain the rest; if not, I shall be glad to give any further information in my power.

Walsall. **F. Russell.**

[26822.]—OUR thanks are due to Mr. Boothroyd for the information which he supplies in his last letter (No. 26,760). It will assist those who are interested in this matter in arriving at some conclusion, at least, so far as Southport is concerned. Though the average seems low (18⅔ miles per hour being the highest for one day), I think it can be shown that it is sufficient for the purpose of electric lighting. Of course, this would not be the highest speed attained during the day; it is the average for twenty-four hours. It is highly probable that during some parts of the day the speed attained would be from 30 to 40 miles per hour, and during other parts would fall to 12 or 8 miles per hour. We know that the speed of the wind varies considerably during each day, and if the hourly variations could be ascertained during the seventeen weeks, our way would be much clearer. But as the returns do not show the hourly variations, I think we may venture to make an estimate of the probable variations. For this purpose I divide the day of twenty-four hours into four divisions of six hours each, and assume that the wind varies in its velocity during each of these divisions. The figures which I give, when added together, amount to the same as those given by Mr. Boothroyd for a day of twenty-four hours. I have adopted Mr. B.'s American wheel to base my calculation as to power developed. Taking week ending June 25th, and the day of greatest velocity during that week equals 448 miles, or an average of 18⅔ miles per hour, I will assume that the speed during that day would show the following variations:—

	Velocity per hour.		Pressure.	Power.
6 hours	36 miles	= 216	6lb.	6H.P.
6 „	18 „	= 108	2 „	2 „
6 „	12 „	= 72	¾ „	¾ „
6 „	8⅔ „	= 52	⅜ „	⅜ „
		448		

Taking again week ending Oct. 15th, which stands midway between the weeks of greatest and least velocity, I apply the same test to it:

6 hours	24 miles	= 144	3lb.	3H.P.
6 „	12 „	= 72	¾ „	¾ „
6 „	8 „	= 48	⅛ „	—
6 „	3⅓ „	= 20	—	—
		284		

The same principle applied to week ending Nov. 26th, which is the week showing the least velocity of the seventeen weeks, I get ½H.P. for six hours only.

It will be seen that if my assumptions are correct, or something approaching to correctness, that we may get a power equal to 3H.P. for six hours out of the 24 hours, at least during one day in each week at an average. The other days in the week will vary, of course, between the day of greatest velocity and the day of least velocity during the week. I think that we may fairly assume that during three days at an average in each week, there would be sufficient pressure to develop a power of from 1H.P. to 3H.P. for six to eight hours daily.

Of course, there will occasionally be a week with very little wind, as for instance, week ending Nov. 26th; but it will be seen that the week preceding, and the week following, show a very high average velocity. So that with storage sufficient for a week's consumption, electric lighting by wind power may succeed at Southport. **Gwalia.**

[26823.]—IN your impression of 21st Jan., "A., Liverpool" (26755, p. 456), for whose judgment I have much respect, states that the vertical windmill "is infinitely superior in power to any horizontal," in which I agree with him; though that is not the whole question, and when he adds that "it would not require nearly so strong a framework to resist storms," I am entirely at variance with him, unless he limits his comparison to "such a cumbrous, and top-heavy concern" as that of Mr. Vallance, which he apparently had in his mind when he used the expression.

The old English windmill, of full power, was always understood to require a conical tower to be built for its support: only smaller ones, perhaps 10ft. shorter in the arms, were erected as post-mills—and when we consider that whatever the power of the wind on the sails may be, its first impact is against the tower itself, and in fact so continues throughout, we can understand how great the strain must be when equal to eight or perhaps ten horses pulling with all their strength at its apex, to overturn the structure. Now a well constructed horizontal wind-engine, something on Samuel Miller's plan, (see his patent of 1777), need not be of any considerable weight, and would need no more support than sufficient to resist the absolute power given out by the machine at its best, which might be one or two horse perhaps, within the moderate and manageable compass of 12ft. arms or so, giving a diameter of 24ft. over all. The vertical windmill, on the American plan, can be set up almost anywhere; but it has this disadvantage—that however high you have to go to get the true breeze, clear of surrounding objects, you must go as much higher above your platform as the radius of the wind motor at the very least, which necessarily limits it to small power, better and easier obtained, per-

No.	Fabrication Number or Brand.	Designation.	Refrctive. Index for Line D.	Mean Dispersion C and F.	$v = \frac{n-1}{\triangle n}$	Partial Dispersion.			Specific Gravity.	Remarks.
						A′ and D.	D and F.	F and G′.		
1	O. 225	*Light Phosphat Crown*	1·5159	0·00737	70·0	0·00485 0·658	0·00515 0·698	0·00407 0·552	2·58	Colourless.
2	S. 40	*Medium Phosphat Crown*	1·5590	0·00835	66·9	0·00546 0·654	0·00587 0·702	0·00466 0·557	3·07	The same.
3	S. 30	*Dense Barium Phosphat Crown*	1·5760	0·00884	65·2	0·00570 0·644	0·00622 0·703	0·00500 0·565	3·35	Comparatively not of great hardness.
4	S. 15	*Densest Barium Phosphat Crown*	1·5906	0·00922	64·1	0·00591 0·641	0·00648 0·703	0·00521 0·565	3·66	Of little hardness, only to be used in protected or dry places
5	O. 144	*Boro-Silicat Crown*	1·5100	0·00797	64·0	0·00519 0·651	0·00559 0·701	0·00446 0·559	2·47	Of exceptionally higher mechanical hardness: very colourless.
6	O. 57	Light Silicat Crown	1·5086	0·00823	61·8	0·00530 0·643	0·00578 0·702	0·00464 0·564	2·46	
7	O. 40	Silicat Crown	1·5166	0·00849	60·9	0·00545 0·643	0·00596 0·702	0·00479 0·564	2·49	
8	O. 60	Kalk Silicat Crown	1·5179	0·00860	60·2	0·00553 0·643	0·00605 0·703	0·00487 0·566	2·49	Accurately identical with the hard crown of Chance, Bros.
9	O. 138	Silicat Crown (higher Ref.)	1·5258	0·00872	60·2	0·00560 0·642	0·00614 0·704	0·00494 0·566	2·53	
10	S. 52	*Light Borat Crown*	1·5047	0·00840	60·0	0·00560 0·667	0·00587 0·700	0·00466 0·555	2·24	Only to be employed in protected places.
11	O. 20	Silicat Crown (lower Ref.)	1·5019	0·00842	59 6	0·00543 0·645	0·00592 0·703	0·00478 0·567	2·47	
12	O. 227	*Barium Silicat Crown*	1·5399	0·00909	59·4	0·00582 0·640	0·00639 0·703	0·00514 0·566	2·73	Very colourless.
13	O. 203	Ordinary Silicat Crown	1·5175	0·00877	59·0	0·00563 0·642	0·00616 0·702	0·00499 0·568	2·54	
14	O. 13	Kali-Silicat Crown	1·5228	0·00901	58·0	0·00572 0·635	0·00637 0·707	0·00515 0·572	2·53	This crown glass has a more favourable range of dispersion than the usual silicate crown.
15	O. 15	Zink-Silicat Crown	1·5308	0·00915	58·0	0·00587 0·642	0·00644 0·704	0·00520 0·568	3·33	
16	O. 211	*Dense Barium Silicat Crown*	1·5726	0·00995	57·5	0·00630 0·633	0·00702 0·706	0·00568 0·571	3.21	Colourless.
17	O. 153	Silicat Crown Glass	1·5160	0·00904	57·2	0·00576 0·638	0·00637 0·705	0·00516 0·571	2·53	
18	O. 114	Soft Silicat Crown	1·5151	0·00910	56·6	0·00577 0·634	0·00642 0·705	0·00521 0·572	2·55	Same as the soft crown of Chance, Brothers.
19	O. 197	*Boro-Silicat Glass*	1·5250	0·00929	56·5	0·00599 0·645	0·00654 0·704	0·00531 0·572	2·64	
20	O. 202	*Densest Barium Silicat Crown*	1·6040	0·01092	55·3	0·00690 0·632	0·00771 0·706	0·00626 0·573	3·58	Soft: cannot be kept free from some bubbles.
21	S. 35	*Borat Flint*	1·5503	0·00996	55·2	0·00654 0·656	0·00699 0·702	0·00561 0·563	2·56	To be used where there is no dmpnss. nor contct. with water
22	O. 252	*Borat Flint*	1·5521	0·01026	53·8	0·00667 0·650	0·00722 0·703	0·00582 0·567	2·57	To be used only in such dry places.

haps, and certainly much cheaper, by a horizontal machine of a light construction.

The lofty Toronto mill, at the exhibition, had what a mechanic termed "a ghastly look, and no one but a steeple-jack would like to ascend it."

Q. E. D.

MESSRS. SCHOTT AND CO.'S NEW OPTICAL GLASS.

[26824.]—THE new list* of glasses for optical purposes, issued by Messrs. Schott and Co., of Jena, is a very comprehensive one, embracing glasses of a very wide range in refraction and dispersion. I am induced to send the list to these columns because I feel assured that numbers of opticians, amateur and professional, both at home and abroad, will desire to obtain and to experiment with this glass. For telescopic, microscopic, photographic, and spectroscopic purposes, in each and all, I believe it will prove of essential service. For microscopes its success seems to be proved; while for telescopes, although we do not yet hear of a double objective made of the new glass, without doubt such will be done before long. In the latter case, it is not so easy to experiment as in the former; for, in addition to the greater expense, and the larger amount of material to be manipulated, there is another matter which needs careful attention. However rational may be the spectra furnished by two different kinds of glass, it is equally necessary that there shall be considerable difference in their absolute dispersive powers. The minimum difference practically allowable is a point which, so far as I am aware, has not yet been settled. For the dense flint glass, a focal proportion of about 3 to 5 is a common one; or for the lighter kinds, about 3 to 4. The question is how much lower than 4 can the second number be?

The new list contains forty-four glasses; twenty of these belong to the crown, and twenty-four to the flint variety. Of course, very many are of the ordinary kind, and demand no special notice; but nineteen are of essentially new composition. Ten of these are crown, and the remainder flint glasses. The refraction varies from 1·5047 to 1·604, and the dispersion from $\frac{1}{70}$ to $\frac{1}{55{\cdot}3}$ in the crown; and from 1·5503 to 1·9626, and from $\frac{1}{55{\cdot}2}$ to $\frac{1}{19{\cdot}7}$ in the flint. There is thus a very wide range of refraction and dispersion in both varieties. A low refraction does not necessarily always accompany a low dispersion; neither does a higher dispersion necessitate a proportionately higher refraction. Some of the glasses seem very remarkable in this respect. For instance, there are two crown glasses of practically equal dispersive power, while the index of refraction in the first is 1·5100 and in the second 1·5906. And in a pair of crown and flint, with indices of 1·57, their dispersive powers are nearly as 4 to 5. Several other peculiarities will also call for notice as we proceed; but for the present these few preliminary remarks will be sufficient. I shall divide the list into two parts, one of which accompanies the present paper; the other will follow, with the necessary explanatory remarks, next week. The names of those glasses of essentially new composition are printed in italics.

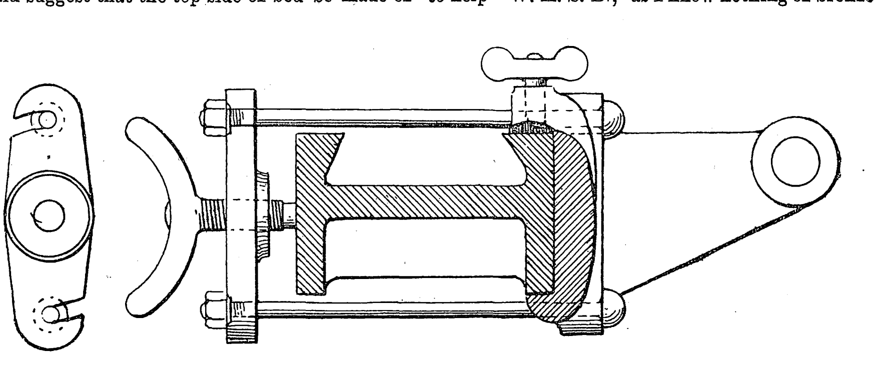
Orderic Vital.

(*To be continued.*)

* This list as sent to me is in German. I am not aware whether an English edition has been published; but in the present case, through the kindness of a friend who takes great interest in optical and astronomical matters, I have been able to get the explanation of the tables "done into Inglysshe."

"F.A.M.'s" LATHE DESIGN.

[26825.]—I THINK an alteration in the section of bed shown in No. 1124 would be advisable. I would suggest that the top side of bed be made of



the same general form as the lower. This would result in several advantages: the top V of apron could be raised, the vertical front being also raised on each side of seat of traverse slide till near top of bed. With the high centres, this gain would be valuable. The heads would have a broader base —they seem rather narrow now—and would be more easily fitted, the bed also requiring less planing and getting up. The heads could be aligned from the back of the lathe, where the surface would be larger, and rather easier, if anything, to align to front than the V in front. To allow the saddle to pass the fast head, the flange on far side could be drilled, and two $\frac{5}{16}$in. screws put in to pull it up to edge; the bolt shown in first drawing would hold it well down. A convenient fastening could be made for loose head as shown in sketch. The apron could not be racked past it; but as it could be instantly lifted off bed, that is not a great disadvantage. The loose head could be very firmly held and readily pulled to alignment. It could also be made to set over for turning taper to some extent if that was required. The fastening would clear till the loose head was close to traverse slide, and would be firmer than simply tightening into V's.

The increased clearance for the clasp-nut would also be a gain, and the top of bed would be a better surface for odd purposes. I am still unreconciled to the top rest, and would prefer to use a stepped block for drill-spindle.

Vulcan.

LATHE MATTERS.

[26826.]—I SEE that I am not likely to be able to help "W. A. S. B.," as I know nothing of bronze or spun work. Will he not send the accurate drawing of the candlestick, even without the details?

Referring to Mr. Alf. Hartley's letter, would it not be well if he would give a short account of the contents of his father's book? I understand it contains *working* drawings of the geometrical chuck, of the mandrel lathe, and of the medallion apparatus; if so, it would be a thousand pities it

should be lost to the world. Until Holtzapffel's Vol. VI. appears we have no full description of rose-engine work that I am aware of.

"Vulcan's" chuck attachment is very ingenious; but, alas, how much more complex than the well-known screw! My chief difficulty in making it would be to get the points of the screws to enter fairly and bear correctly in the coned holes of mandrel. I don't feel that I could trust those two points with all the holding and driving, as they would only touch at a point each, not bear all along like the wedge; but then the wedge stops the hole in a bored mandrel. **F. A. M.**

RADIAL DRILLING OF DIVISION PLATE.

[26827.]—THIS plan has been several times advocated in the ENGLISH MECHANIC; it does not, however, appear to have been noticed that the plan is of no real advantage for use with an *adjustable* index. For if, with one particular length of index the various zero holes are on the circle whose radius is the index, then the shortening or lengthening of the index will nullify this; consequently, unless the index is always used at exactly the same length as it was when the holes were originally drilled, we shall not be able to shift from one zero hole to another without rotating the mandrel. **C. W. Bourne.**

ROAD REFORM.

[26828.]—I MUST apologise to "G. F. F." for not having replied sooner, but have been very busy. He says in letter 26751 that the traffic on turnpike roads has increased tenfold since Macadam's time. I certainly doubt whether the increment is so considerable—at all events, on country highways, which one often finds, except near towns or other sources of local traffic, almost deserted. As an instance, I may mention the Great North Road. I should be glad to know whether any figures are available giving the average weekly traffic, both now and in Macadam's time, on country roads in different districts, for they, of course, would settle the point.

The other question, as to the efficiency of small and large stones for bearing heavy loads, such as traction engines, seems to me to depend for solution on the breadth of tire of the weight-carrying wheels. If this be adequate—and I believe a certain legal standard exists—the passage of a traction engine will injure the road no more than will that of any other vehicle.

Though identical with "B. B.," I am compelled to sign differently, owing to the author of query 61478 having assumed those initials.

Bertram Blount.

[26829.]—I AM afraid no general measure of alteration of gradients and consequent deviation from the present sites of the roads throughout the country is likely to be undertaken at present; but I think very great improvement may be made in a short time, and at a comparatively small first outlay.

In the first place, I think all roads should be thoroughly underdrained, so as to insure a dry bed of at least 4ft. deep. This may be accomplished in most cases by a 4in. or 5in. pipe drain up the centre, or in some cases one up each side of the road. All other improvements should be preceded by this measure. Then the surface water should be got away from the road in the shortest possible way, and not allowed to run down the sides, as is very usual, for long distances, and in many cases land drains have been allowed to be emptied on the side of the road, thus ruining the foundations of the road.

Having got a dry bed, the next business should be to form the road to a proper transverse section, viz:—of a gradient of 1 in 30 from the centre to each side, and this should be rigidly enforced so as to allow the traffic to use the entire width instead of only 4ft. or so of the centre. Having got the road into proper form, the next step should be proper metalling, and this should be done from side to side, making the sides as strong as the crown. Now there are two opinions as to whether a rigid or a flexible road should be aimed at. If the former the road should be carefully pitched and then metalled; but if a flexible one, the metal should all be broken to the same size. From my experience of country roads, I certainly prefer the flexible, as I have seen a road on drained clay with metal broken to go through a 2in. ring, stand the heavy traffic of traction engines without breaking up. All metal used should be granite or greenstone broken to a 2in. gauge and screened free from sand, &c.

We now come to the maintenance, and in this I think the greatest improvement could be made as follows. The greatest obstacle to rapid and economical communication in the interior of the country is the obstruction caused by loose, broken stones put on the roads for their repair in the autumn especially: this at once increases the draught to such a degree as often to bring carts laden to a complete standstill, to say nothing of the danger and annoyonce of riding and driving over such surfaces. The road sides during the year are dotted with heaps of broken and unbroken stone. I think all this could be cheaply overcome if each Highway Board provided itself with a steam-roller, and when new stone was laid, that the road should be rolled smooth and firm, thus providing a good and safe travelling surface and at the same time a surface from which the wet would escape with the least chance of sinking into the foundation and making it like a wet sponge.

If the Society for the Prevention of Cruelty to Animals would take up this question, it would save many a poor horse from sore shoulders and broken knees, and many a poor traveller from a broken neck. **R. P.**

THE COLD IN CANADA.

[26830.]—I NOTICE in the MECHANIC for March 26th, 1886, "Inventions and Discoveries" (25514), page 84. I have seen here at Swift Current, and more frequently in Manitoba, some 300 miles east of this point, icicles from 6in. to 1ft. long hanging from the nose of an ox when on the trail. That is not at all unusual when the thermometer registers from 35° to 55° below zero (Fahrenheit). Of course, any person who might be exposed for any length of time to such extreme cold, if not properly clad, would be frozen to death.

I have, however, travelled hundreds of miles when the temperature has been between 30° and 50° below zero without any ill effects whatever—in fact, on account of the exceeding dryness of the atmosphere, it makes one feel "good," as we say in this country—i.e., exhilarated.

When the temperature has been about 45° below zero, I have thrown a cup of boiling water in the air, and it has descended upon a board in the shape of small ice crystals, without wetting the board in the slightest degree. As to the ink freezing on the pen while writing, that is quite a common occurrence; this ink was quite solid until thawed out this morning, and if I was to attempt to write away from a fire, say, in my bedroom, it would immediately freeze on the pen and stop my scribing.

I bring new milk home to my family wrapped up in a piece of paper in a solid lump frequently, and it will remain perfectly new and fresh until wanted.

I have a wish to try some thermo-electrical experiment, by making use of this extremely low temperature, but do not know how to proceed.

W. G. Knight, Meteorological Observatory.
Swift Current, N.W. Territories, Canada,
Jan. 21.

MR. HIGGS' COIL.

[26831.]—AT the request of Mr. Boothroyd (letter 26636) and those of your readers who have not been fully replied to by post, I beg to hand you the required details of my coil.

The Core: $14 \times 1\frac{1}{4}$, No. 20 B.W.G. soft iron wire, known in Birmingham as winding wire, not subsequently annealed.

The Primary: 3 layers No. 12 double cotton-covered copper, the whole finally immersed in melted paraffin and placed in ebonite tube $\frac{1}{4}$in. thick.

The Secondary: 14lb. No. 36, 2lb. No. 35 double silk-covered, in all about $14\frac{3}{4}$ miles, wound in 52 discs; outer diameter, $5\frac{1}{2}$in. at middle, decreasing to $3\frac{1}{4}$in. at ends; inner diameter, $2\frac{3}{8}$in. at middle, increasing to $2\frac{7}{8}$in. at ends; length of body, 11in.; terminals $10\frac{1}{16}$in. apart; insulation between discs, from 3 to 6 thicknesses paraffined blotting-paper, varying as the differences of potential between the parts of any two adjoining discs.

The Condensers: 3 in number; 40, 30, and 20 sheets of tinfoil $10 \times 7\frac{1}{2}$; the sheets of each half were all soldered between copper strips $\frac{1}{2}$in. broad; connections from primary to condensers are copper bands 1in. broad.

The Contact Breaker: A slight modification of the ordinary vibrating spring pattern.

Results: $9\frac{1}{2}$ to $10\frac{1}{16}$in. spark with one quart bichromate cell, single zinc 6×3in.

Should any further explanation of a specific nature be required, such will be most willingly replied to in its proper place. Moreover, those of your readers who can make it convenient, particularly those who know what a spark really is, are cordially invited to inspect the coil. No kind of weather interferes with the above-named results.

George Higgs.

THE LUMINIFEROUS ETHER (OR ABARON?)

[26832.]—SUPPOSE your room nearly filled by a cage or frame, bearing a million compass pivots, or 100 layers, each containing 100 in length and 100 in breadth. On these place 1,000,000 equally magnetised needles; or better, only 500,000, omitting half the pivots, that each may be equidistant from its 12 nearest neighbours. When all are at rest, the repulsion of similar poles keeps them all parallel. Now let an insect set one near the centre swinging. Every swing will be imitated, and travel outward in a spherical wave-surface that enlarges till embracing the whole roomful; and whatever the number of swings, that number of waves will spread all with one and the same velocity, like sound-waves in air, or circles from a stone in water. Now that is a parallel whereby we may figure to ourselves a propagation having all the known properties of light, plane-polarised, circularly or elliptically polarised, &c., without any "jelly," the inventor of which, known or unknown, I look on as a supreme—well, calves' foot possessor.

Of course, as Mr. Grey tells "Sigma," our knowledge by no means stops at there being "something" to convey light. Nor does it stop at the rate of travelling, some 120,000 times what gaseous elasticity can insure for sound; nor yet at the knowledge how many vibrations per second each ether particle has to make; as, for red light a billion to each single vibration of the note F^1, or for blue a billion during one vibration of B^2. The main distinction from sound is known to be that, whereas particles of air, in propagating sound, are displaced, or perform excursions, and approach or recede from each other, light is all propagated by luminifers that keep their places, neither approach nor recede; but each only swings on its own centre. No condensations and rarefactions, like those in sound-waves, are here supposable.

Not only is the ether or sky-stuff as likely to be atomic as other things; but it is the sole thing that we are compelled to regard as formed of atoms. All weight stuff of the chemist we are at liberty to suppose, if we will, infinitely divisible, provided only the skystuff, caloric, "abaron," electric fluid, or whatever we may call it, permeating all the weight stuffs, be in atoms. Moreover, we are not obliged to think the atoms nearer in a compressed gas, or less numerous in rare air than in dense, or even in planetary space than in glass or gold. The difference may not be in number of atoms, but only that those in the planetary space are free, while those in the gold are each loaded with a definite load of weight-stuff. Again, we are not bound to suppose that any weighty body moving displaces any sky-stuff. The heaviest and swiftest planets may be passing through it as a net through water. Even a meteoric pebble that dashes into our upper air with such velocity as to displace a million times its own bulk or weight, and drag after it a vacuum as big as a balloon, with its air-skin heated to vivid whiteness, may not displace any sky-stuff. Though we can hardly doubt electricity and magnetic action to involve displacements of sky-stuff, mechanical motions may not involve any. We can hardly doubt that the force whereby each luminifer atom, when set wagging, causes the next to wag, is the very same whereby the primary current in a "dynamo" excites the secondary, or a magnet magnetises its approaching or receding keeper. Hence, for above a generation, at least ever since Faraday's optical experiments in the magnet's field, the "electro-magnetic theory of light" has been most tenable and attractive, whether Maxwell worked at it or not; though not only "A. X.," but the oracular editor of *Knowledge*, has lately so ignored as to sneer at the very mention of any so called.

As for "Abergwili," and what he fancies he was taught at school (p. 451), he must have deserved the dunce's cap there. Long before our time, all schoolbooks had told that five miles was the height, not that our atmosphere *has*, but that it *would have* if all compressed to the same density as at sea-level. Also that about 50 was the least it can actually have (to account for the twilight), but it *might* be several times this. Observations of meteors now indicate about twice. The idea of its universal extension is utterly untenable, because we can receive and measure star rays that have passed nearer to Jupiter or Saturn than the distances at which their attraction would make such air far denser than what we breathe. Indeed, there would be enough near Jupiter to bring his inner satellite to rest in very little time.

The absurd dragging in of "old Hebrew writings"—no, of versions from them—as if capable by themselves of teaching points of science, as I complained at p. 264 and 284 (Nos. 1130, 1131), always brings out such an error as Mr. Grey's, p. 451, that the Hebrew writings have not the "slightest bearing on any questions of science." They will always have immense bearing on some, and we never can tell on what questions.

Nothing in this century's discoveries will be so memorable as the unexpected ways they have constantly been illustrating old Hebrew writings. Hardly till yesterday did science suspect, though now pretty certain, that this earth was ages older than the sun. Hardly till this generation was it certain that there are many worlds having time marked by days, evenings, and mornings, though without a sun as yet. But Hebrew writings had always told of our earth as having had days before a sun existed to rule them; and had continually

been laughed at therefor. Again, look at the present geology's attempts at explaining the most recent changes, how the Glacial age passed into the present (man being in both, as Boucher de Perthes was led, only by his Bible, to discover in gravel; and yet the hugest and most abundant animals of the Glacial age having vanished from every continent when most swarming, and in all lands disconnected from Asia, the merest fragments of the former found, and not of "the fittest," but some of the *unfittest*, species alone surviving). Much of Lyellism and Darwinism will doubtless be kept to a sort of penal immortality of ridicule, being more laughable than aught in Scripture became at any time. And all the while, Hebrew writings had given the perfect clue to the whole enigma. About 50 centuries ago there was a day that a fresh sea fell from the sky. It fell the same day on all the continents and islands of both hemispheres; the quantity, as dredgings have apparently shown, such as to raise the ocean level about 600ft. That bears precisely on all questions respecting the Glacial age ending and this one beginning, and exactly meets every fact of them. E. L. G.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61084.] — **Fireclay.**—See my letter inserted in December or January. I now see that No. 1 is called a clay (see Vale of Neath clay). Bloxam says, "It is locally known as clay"; but it is not really a clay. I was not, I admit, quite right in all that I said; but I have not been set down as I requested if I was wrong. A better heat-resisting furnace is wanted for Fletcher's furnace burners. What?—R. S. T.

[61131.]—**Electric Cautery.**—From what has already been published regarding this particular cautery in my possession, "Ohm" cannot but be aware that the data required for the employment of the formula supplied by Mr. Conry never having been known to me, it is impossible to comply with his request to demonstrate the same. My remark that "I was perfectly able to use the formula" could not, and did not, apply to my own cautery, although "Ohm" makes it do so. Nothing more than mere ability to make use of the formulæ was claimed—the data as usual being supposed to be known—a point which I was under the impression (a mistake I now see) "Ohm" had denied. I would prefer an instrument to record the current; but if a formula is considered to be the better way I am able to use it. In this connection I may be allowed to say that I have accepted Mr. Bottone's kind offer of one of his 5s. ammeters to test and report. Let me add, in case "Ohm" thinks I am shirking the point, that I sent a concise answer to query 60892. The question addressed to me—not directly, but as an aside—in a third party's reply, I left unanswered, because, in my judgment, it had no bearing on the original query.—A. DUNLOP STEWART, M.B.

[61131.] — **Electric Cautery.** — TO MR. DUNLOP STEWART.—I have made the test of Mr. Bottone's ammeters to which he invited me, and am pleased to say that it was quite successful. I had to go down to Sutton on business, and on the way back called in at Mr. B.'s place. He showed me the ammeters, the scale of which is graduated to tenths of an ampère; I connected to the terminals a rough single-couple "thermopile," made of two bits of wire, respectively No. 16 copper and No. 20 German silver, about 4in. long, and soldered together, and applied to the soldered joint the flame of a small-spirit lamp. Having had a little experience in the making of thermopiles of various sorts, I knew that the utmost current that any heat short of melting the solder would get out of such a couple as the above would certainly not exceed one-tenth ampère. After about two seconds' heating the needle moved, and in about five moved across the scaled space of one-tenth of an ampère, going back with the same regularity as the wire cooled when the flame was removed. I tested several and found the results similar. This, considering that the price is only 5s., is very good indeed, and I can certainly advise you to use these instruments if one-tenth of an ampère is a sufficiently near measurement for your wishes. Your easiest way would be to make up some battery that will heat the cautery to rather over the degree you require, having one of these ammeters in circuit (they are practically of no resistance—about ·00 something of an ohm), and gradually lower the battery plates into the solution till you get the cautery right, and then note the current drawn by the ammeter.—EDWARD CONRY.

[61145.]—**Does It Boil?**—I have to correct a clerical error in my last—*more* rapidly, in the ninth line, should be *less* rapidly. Certainly my desire to help "Weald" has been rewarded by a better grasp of the subject, consequent on the study of various standard books. "Weald's" last contribution affords ample proof that I was right. The atmosphere can exert no direct pressure on vapour, and its action is wholly different from that of a pump plunger or a column of mercury. No; vapour filling a flask at 20° C. at a pressure less than standard will not collapse into water when the flask is opened to natural air. The air does not diminish the space available for vapour. If, on the other hand, the space in the flask were diminished, say by pouring in mercury, the temperature remaining constant, condensation would ensue. The vapour tension proper to 20° C. is nearly 0·7in. of mercury. Now, if water be introduced into a receiver exhausted to, say, 1in. of mercury, the pressure will instantly rise to 1·7in. If the receiver contain dry air at a pressure of 30in. the introduction of water will cause the pressure to rise more slowly to 30·7in. of mercury. Does "Weald" attribute this rise of pressure to solvent action? Again, 100° C. is the temperature, not of boiling water, but of steam at standard pressure, for boiling water is always hotter than its vapour. Water gives off vapour from its surface until the space above it is full of vapour at a pressure which increases with the temperature. The pressure of the atmosphere is powerless to prevent it; the only thing that can prevent evaporation is the presence of the full amount of its own vapour. Now, suppose a vessel of water heated from below attains the temperature of 100° C.; the vapour rising from the surface is of standard pressure; but since the pressure within the liquid is greater than standard pressure by the amount of the surface tension of the liquid, and the head of water above any given portion, no vapour can be evolved except at the free surface, and any bubbles that are formed where the heat is stringent will collapse as they rise through the water; this is simmering or parboiling; a little more heat, and the temperature throughout the mass is sufficient for vaporisation.—W. A. S. B.

[61190.] — **Differential Feed.**—I am glad another correspondent has taken up this; but he says I have answered one question incompletely. I reply—Which? As regards his strictures, I would point out that wheels 128 and 80 give a pitch of ·15, and wheels 130 and 80, which I suggested as perhaps near enough, give ·155, not ·15626 as "R. T. S." says. I have endeavoured, in replying to this, to use only the ordinary change wheels, which all practical men prefer to use, in preference to cutting a wheel, if it can possibly be avoided, and to avoid compound gearing.—T. C., Bristol.

[61255.] — **Embrocation.** — At the time of writing this query, I was under medical treatment; but it was to no practical purpose. I managed to get over the attack, but no thanks to the doctor for it. I have studied diet, and also consulted four medical men during the last five years. These latter did no good, and only caused me to become an unbeliever in doctors altogether. — A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[61283.] — **Hot-Air Engine.** — This querist might be referred appropriately enough to your back numbers; for instance, No. 1099, p. 148. The displacer is almost necessarily of larger area than the working cylinder.—E. G. M.

[61291.]—**Ageing Wood Carvings.**—I have to thank Messrs. Bretton and Bottone for their kind replies in your issue of the 7th Jan. Whether it is that cypress wood is not affected by the fumes of ammonia, or that my ammonia is not sufficiently pungent, I cannot say; but the results are not at all satisfactory. It is impossible for me to employ stains, as such an application would injure those parts affixed by glue, such as the shavings and chips that form border traceries.—NAWS.

[61294.]—**Octave Coupler.**—"T. D." will find a diagram that will assist him in No. 953, or perhaps a more specially useful illustration in No. 528. The only practically useful method is the duplication of the backfalls—putting the coupler backfalls on the skew. I have not heard that anyone has invented a device which takes less space.—ORGANON.

[61300.] — **Saccharine.** — Most hydrocarbons like saccharine are known to be both antifermentive and antiseptic; but what is it "R. S. T." wishes to know. The authorities have been given in the various articles on the subject published in your columns, and your correspondent can scarcely mean to assert that because saccharine passes through the organism "unchanged" it can have no effect. Mercury is a typical instance of a substance which passes through the organism unchanged, and there are many others.—F. I. C.

[61303.]—**Boiler Water.**—This query is headed "Chemical"; but I have taken the liberty to alter it, as the querist wishes to know what is the matter with the water he draws from his kitchen boiler. It is rain-water, taken from a galvanised iron tank, and conveyed by iron and lead piping. Being water practically free from lime, while charged with more or less chlorine, it no doubt dissolves the zinc from the coating of the tank, and is, perhaps, further contaminated by the piping. Perhaps a remedy might be found by making the water artificially hard, and so getting an incrustation on the tank, &c.—NUN. DOR.

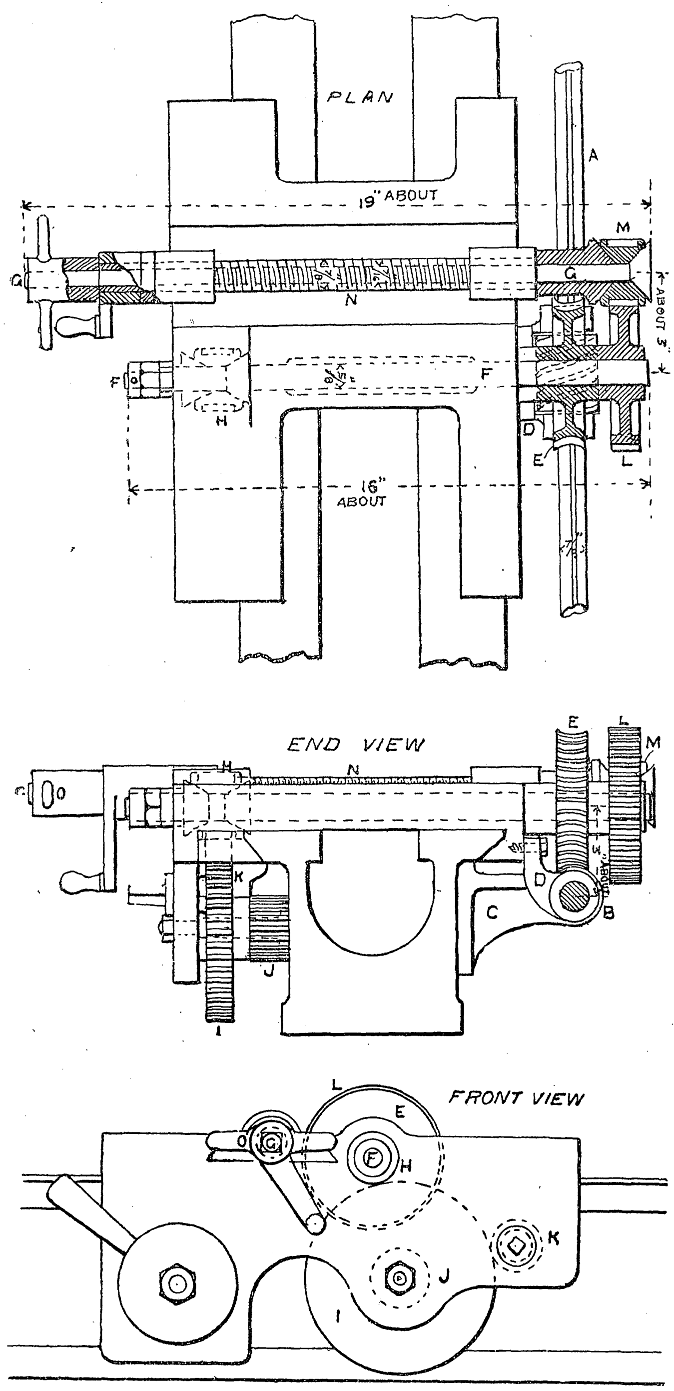
[61307.]—**Occultation of Aldebaran.**—I am obliged to your correspondents for the information given me. My object is to obtain true time, and the calculation of occultations for this purpose are evidently too laborious. I now propose to use a plumb-line and small aperture, about 4ft. away from it, as a rough transit instrument. Will some of your readers who may have tried this plan, say the size of aperture and of wire best suited for the purpose; also distance horizontally between aperture and wire?—A. WEST.

[61409.]—**Coating Steel Springs.**—The reply of "Canadian" on p. 483 is one of a class which is becoming too frequent; but happily most people know what to expect when "information" cannot be made public, and the querist is asked to advertise his address. It so happens that I have had a good deal of American coppered wire through my hands, and I have no hesitation in asserting that the copper does not last long if handled—and that is what the querist does not want. There is plenty of coppered wire used in this country, and there is no secret in its preparation; but unless electroplated, it will not stand handling. Some firms adopt one process, some another; but all are to be found in your back volumes, in Watt, or in Gore. "Canadian's" "fear" is misplaced.—NUN. DOR.

[61420.] — **Loco. Fire-Grates.** — The figures given by your correspondent "Amateur" in answer to this question do not seem to agree with modern practice. He states that—1, there should be "about 80sq.ft." of heating surface "to each sq. ft. of grate bars"; 2, "upon each sq. ft. of grate about 1cwt. of fuel should be burned per hour"; 3, from 8lb. to 11lb. of coal are consumed in evaporating 1c.ft. of water—i.e., 1lb. of coal evaporates from 5·71b. to 7·81b. of water. 1. Now, in the Dreadnought the ratio of heating surface to grate area is 68·4 to 1; in the Gladstone, 72·25 to 1; in the new C. R. single bogie, 62·36 to 1; in the new C. R. coupled bogie, 62·1 to 1. 2. If the Gladstone were to burn 1cwt. of coal per hour on each sq. ft. of grate with the 5 p.m. train *ex* London Bridge, its fuel consumption would be 49·61b. per mile! 3. The Gladstone evaporates about 12·95lb. of water per pound of coal consumed, and the Dreadnought 9·491b.—A. W. BURCHELL.

[61438.] — **Measuring Cloth.** — Yes, truly; when the first term of the series is $12 + d$, then the common difference will be $\frac{60}{199}$, and in this case the sum of the series, or the length of the cloth $= \frac{199}{120} c^2 + \frac{c}{2} - 244\frac{4}{5}$; from which formula a table may be computed, which would include the numbers given by "Workman" at p. 504.—MILVERTON.

[61442.]—**Weight of Moist Air.**—I can sympathise very much with "W. S. A." in his efforts to explain the seeming paradox that is involved in his question, and for the purpose of making the matter as clear as possible I have examined the weights he has given me. The weight of a cubic foot of vapour at the given pressure I found to be sufficiently correct; but the other two weights seem to have been interchanged—that is, the weight of the dry air given to the moist, and conversely, for it will be observed that the weight of a cubic foot of dry air is greater than that of a cubic foot of moist air. I was, therefore, induced to recompute the weight of a cubic foot of dry air by an independent method, and at the given temperature and pressure I found it to be 488·71 grains. Now, to ascertain the actual amount of the discrepancy between the two formulæ, in order that I might show what it is owing to, I took the weight thus found for dry air as the given quantity, and computed from Watts's formula the weight of a cubic foot of moist air, and found it to be 478·02gr. Then, taking this as a given quantity of moist air, I computed from the second formula the weight it gave for a cubic foot of dry air, and this I found to be 489·94gr. Now, had the two formulæ been equivalent, I ought to have got 488·71gr., the weight I began with for dry air; but there is a discrepancy of 1·23gr. to be accounted for. Now, referring back to page 484, and to the manner in which the third formula was deduced, it will be seen that V″ was made equal to V. In this case, since the volume of dry air is taken at one cubic foot, the volume of moist air would be $\frac{p}{p - E}$c.ft., or 1·0639c.ft., and since the volume of vapour was made the same, there would be an excess of ·0639c.ft. vapour beyond a cubic foot. Now, multiplying this by 19·84, the weight of a cubic foot of vapour, we find that the second formula gives an excess of vapour equal to 1·267gr.,



and this will account for the discrepancy between the two formulæ. It is scarcely fair to deal with the formulæ (2) and (3) at p. 484 as if we were dealing with weights, from the first of which Watts's formula has been derived by making s equal to unity and the unit of weight equal to the weight of a cubic foot of dry air, the second formula referring the specific gravities to dry air as the standard fluid, and the third to moist air as the standard fluid.—MILVERTON.

[61323.]—**Back Shaft for Sliding and Surfacing.**—The arrangement for self-acting, sliding, and surfacing by means of a back shaft is shown in the accompanying figures. A is the back shaft, $\frac{7}{8}$in. in diameter, which is driven by reversing motion like that described on p. 416 of the present volume, the direction of revolution of the shaft for up and down sliding being changed by the reversing gear. The shaft is carried in suitable brackets C, bolted close to the ends of the bed. The shaft is grooved throughout its length, and carries a worm, B, of about $\frac{1}{2}$in. or $\frac{5}{8}$in. pitch, and say $2\frac{1}{2}$in. long, keyed upon it, not fast, but making a sliding fit, the bearing D of the worm being screwed to the back of the saddle. As the shaft revolves the worm is bound to revolve with it, because of the key, but is not constrained endways excepting by its own bearing D, between whose bosses it is embraced. As the worm revolves it drives the worm wheel E, and this again gives motion to shaft F for "sliding," and shaft C for "surfacing." Taking shaft F first, the wheel E is keyed upon it, and therefore always turns the shaft. The pinion H at the other end is not keyed, but is a loose fi but can be tightened instantly by the nut and cones. Being tightened, H drives I and J, the latter being the rack pinion. K is simply a pinion gearing with I to effect the racking by hand. For surfacing, the wheel L, keyed on the same shaft as the worm wheel, drives the pinion M, which is tightened between cones similarly to H. The screw N of the cross slide is therefore hollow to allow the spindle C, which tightens the cone, to pass through to the front of the lathe, where it is embraced by the nut O. Either spindle can, therefore, by tightening or slackening its nut and cone, be immediately put into or out of gear. Not having a plan view of your saddle, I cannot put in many dimensions; but these you could soon fill in as most suitable. I rather doubt if you could apply so much gear to an ordinary saddle made for sliding only, since, having an extra spindle F, you want increased width, and, properly, more thickness if this spindle goes, as it should, through the body of the metal, a chambered hole being first cast through. The position of your leading screw is not figured; but, from its appearance, I think it would be fouled by wheel I, and in that case the face of the saddle would have to be brought out farther from the lathe bed, or a saddle of a different form substituted. There are other methods in use to effect the automatic motion of the two shafts—as friction discs applied to the faces of the pinions, and sometimes small clutches. This is more suitable, however, for a 6in. lathe.—J. H.

[61452.]—**Electrical Apparatus.**—Many thanks to Mr. Conry for his help. What is his opinion as to charging secondaries by any primary battery? I have little time to clean and recharge a dozen or so large cells every second or third night; but if once a week would do, I would try it. My experience of primary batteries is that they are not to be relied on for electric lighting except on a very small scale, and where they will get almost unlimited attention. Four lamps of 5c.p., taking 2 ampères each for four hours a night, would suit my purpose splendidly. I have never yet seen or heard of an installation depending on primary batteries alone, and a permanent job being practically worked for over a week or two. If any one has details of domestic lighting by primary batteries to show, I am sure it would interest more than—ELECTRICAL STUDENT NO. 2.

[61450.]—**Engine Details.**—ERRATUM.—Connecting-rod, 18in. between centres; not 9in. as printed on p. 484.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[61485.]—**Steel Spiral Springs.**—It is rather difficult to gather from "Spring's" letter what he wishes to accomplish; but the following formulæ will give him the means of ascertaining the stiffness of any given spiral spring in pounds per inch (by which is meant the weight that will deflect it 1in.), and also the maximum safe load that may be put upon it:—

Let D = Diameter of wire.
R = Radius of coils (centre to centre of wire).
n = Number of coils.
W = Weight in pounds that will deflect the spring 1in.
M = Maximum safe load in pounds

$$\text{Then } W = \frac{180{,}000 \times D^4}{n \times R^3} \quad \ldots\ldots\ldots\ldots (a)$$

$$\text{And } M = \frac{12{,}000 \times D^3}{R} \quad \ldots\ldots\ldots\ldots (b)$$

Let us work this out by an example, taking some of the data given in "Spring's" letter. As his tube is ·625 inside diameter, the spring itself must not exceed ·6 outside diameter, as it must play freely even under a load, which tends to enlarge the coils. As, furthermore, the length of the spring when open is to be 10in., probably 40 coils would be a convenient number. To complete the data, let us assume that the wire is exactly $\frac{1}{10}$in. in diameter; we have, therefore—

$$D = \cdot 1 \qquad R = \cdot 25 \qquad n = 40$$

and we require W and M. By the formula (a)—

$$W = \frac{180{,}000 \times \cdot 1^4}{40 \times \cdot 25^3} = 28{\cdot}8$$

that is, the spring will compress at the rate of 28·8lb. per inch. As spiral springs deflect equally for equal increments of pressure, the weight that will deflect it any other distance is easily found. Thus: 14·4lb. will deflect it $\frac{1}{2}$in., and 57·6lb. 2in. But now let us apply formula (b) and see how far we may go in compressing our spring—

$$M = \frac{12{,}000 \times \cdot 1^3}{\cdot 25} = 48$$

that is to say, 48lb., corresponding to a deflection of 1·66in., is the most we should put on the spring. A heavier wire would give a greater stiffness; but the spring would have less range, other things remaining as they were.—W. J. R.

[61463.]—**Propulsion of Weight.**—I am afraid it is out of my power to give "W. G. G." all the information he wants. But to find the power necessary to propel a bird through the air we had better make a model and find the resistance of the air at different speeds (just the same as for a balloon shaped like a bird), and the power required will, of course, be proportional to the resistance. As to what power a man and horse use to propel themselves without doing other work, I think that can hardly be calculated, because they have to overcome the resistance of the air and the friction of their joints under the weight of their bodies (the latter is, of course, indeterminable).—ELAG.

[61464.]—**Iodine.**—The following is the process generally employed for the extraction of iodine from seaweed. Seaweed, when dried and ignited, yields an ash termed technically "kelp" (all the soda of commerce was previously obtained from this), from which the iodine is obtained. The sun-dried seaweed is incinerated (reduced to ashes by combustion) in shallow excavations at a low temperature, for, if the temperature was allowed to rise too high, a considerable quantity of iodide of sodium would be lost by volatilisation. The half-fused ashes or kelp which remains is broken into fragments and treated with boiling water, which dissolves about one-half of the ash. The liquid thus obtained is evaporated, when, on cooling, the more crystallisable salts separate—viz., sulphate and carbonate of soda, with some chloride of potassium. The mother-liquor still contains the iodide of sodium, sulphide of sodium, and some carbonate of soda. This liquor is then mixed with about one-eighth of its bulk of sulphuric

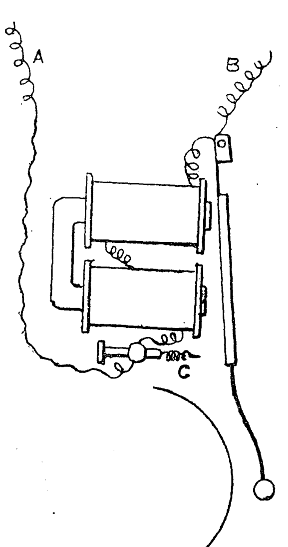
acid, and allowed to stand for twenty-four hours; carbonic and sulphurous acid, and sulphuretted hydrogen gases escape, a fresh quantity of sulphate of soda crystallising out, mixed with a precipitate of sulphur. The supernatant (that which floats on the surface) acid liquor is then transferred to a leaden still, to which is adapted a double tubulated leaden head, luted on with pipeclay; it is then heated to 140° Fahr., when binoxide of manganese is added. The temperature may be gently raised to 212° Fahr., but not higher, as some chlorine would come over and combine with some of the iodine, forming chloride of iodine. The iodine is condensed in spherical glass condensers, each having two mouths opposite to each other, and inserted the one into the other, the end one being fitted to the neck of the leaden head. The iodine is purified by sublimation, heated into a state of vapour, which on cooling returns again to the solid state. The above is an extract from Ure's "Dict. of Arts, &c." I would recommend "Jona" to read the article in extenso. I would further advise him to consult Watts' "Dict. of Chem.," Vols. III., VI., VII., and VIII. The latter part of his query I must leave to someone else.—WILHELM HEINRICH KOPE, Birmingham.

[61468.]—**Brass Surface.**—Perhaps the following may solve the above query:—After the article you wish to "cloud" has been finished, go over it with a piece of water-of-Ayr stone, in order to effectually remove any scratches which may be left from the emery or file, and it serves to dull the surface of the brass. Now procure a piece of cutting charcoal, and file one end flat, dip into water, and by curling it round and round in all directions, the clouded surface is produced. The next thing to be used is a piece of slate-pencil brought to a point. This must also be used with water, to make it cut, and is made to produce a series of small rings, which must not be done with any regularity, but indiscriminately in all directions. This done, then lacquer according to taste.—C. MC J. VILLA RUPRECHT.

[61474.]—**Silver Cell.**—Chloride of silver cells give very little current when first set up. The reason of this is because the chloride has so high a resistance. In action the chloride is reduced to metallic silver, and until a thin film is formed the current is very small. Previous to connecting up just short-circuit for ten minutes. E. Conry is totally wrong when he talks of chloride of zinc being "useless because it has taken up all the zinc it can hold." This is so stupidly absurd it scarcely requires contradiction. If sal-ammoniac is used it should be exceedingly weak. It is not at all necessary to fuse the chloride of silver, it can be used in a powder just as well.—C. D. R.

[61499.]—**Storage.**—Mr. Conry has, I am afraid, mistaken my query. At any rate, his answer wanders a little from the point. If he will be good enough to read it again, I think he will see his mistake.—IOTA.

[61504.]—**Double Electric Bells.**—TO MR. R. T. LEWIS.—It is probably obvious to the querist that the instructions so frequently given as to wiring electric bells so as to ring two or more



simultaneously from the same push, refer solely to those of ordinary construction, in which the line circuit is completely broken at every stroke of the hammer; but in the case of bells made to work without breaking the main circuit it is, no doubt, equally clear that the proper method of wiring must be in series. It is easy to adjust the double bells in this way by setting the contact springs so that they shall always touch either one side or the other. How many of them will then ring together in series is only a question of sufficient battery power to overcome the resistance interposed by the fineness and combined length of the wire upon their coils. I have not had the advantage of seeing the description of the bell to which you refer; but I send herewith an outline sketch of a very simple arrangement devised about the year 1871 by Mr. Moseley which appears to meet your requirement for "ordinary trembling bells which will work together in series." In this bell, supposing the current to enter at A, it would pass through the bobbin coils with usual effect, regaining the line at B. But the armature, on being attracted by the electro-magnet, comes into contact with the point of the coiled spring at C, causing the current to be short-circuited through the armature; thus, although it is by this means cut off from the coils, it is not interrupted in the main circuit. These bells were used for working in series with vibrating indicators of precisely similar construction; but from conversation with Mr. Moseley at the time, I found that the chief object he had in view was the elimination of the induced currents which traverse the wires at every make and break of the circuit, and he argued that if he could produce a bell which would vibrate effectively whilst maintaining an unbroken current in the line wire, he should get rid of these induction effects, which occur twice during every stroke of the ordinary bell hammer. I remember that I was not able to recognise any practical disadvantage arising from induced currents in a well platinised bell, neither could I agree entirely with him that they were due to the making and breaking of the circuit apart from the magnetisation and demagnetisation of the cores (which took place also in his own bells); but for all this I must confess that on experimenting with one of his bells at the time, and also again to-day, I was unable to detect the least sign of an induction spark at the point C, where I should expect to see it every time the current was shunted to and from the coils.—R. T. LEWIS.

[61511.]—**Dynamo.**—1st. It would light six 10c.p. lamps of 40 volts and 1 ampère, the leads generally absorbing the extra E.M.F. 2nd. A gas-engine of 5 or 6 man-power would work your machine if it has a high efficiency; but you would do better with a 1H.P. gas-engine. 3rd. Attach a fly-wheel as heavy as possible to the gas-engine to avoid fluctuation of the lights.—IOTA.

[61511.]—**Dynamo.**—(1) The number, &c., of lamps that your dynamo will light depends on the sorts of lamps. It will light one 100c.p. at 45v. and 6 amps, or four 20c.p. at 45 volts., arranged in parallel, or four pairs of 20v. 10c.p. lamps, each pair being in series, and the 4 pairs in parallel, or 4 lines, each of four 10v. 5c.p. lamps, each line being in series, and the 4 lines in parallel; but you would find the second or third arrangements the only ones of practical utility, because 100c.p. lamps, unless in peculiar positions, waste part of their light by too much concentration, and, on the other hand, putting more than two incandescent lamps in series means, generally, laying up a store of vexation and expense for the future. Even the 2in. series arrangement is distinctly inferior in general utility to the unmixed parallel. (2) The smallest gas-engine made would do for you, as you would only require ½H.P. on the crank-shaft or pulley, or flywheel of the engine. (3) A flywheel is not usually put on dynamos, "discs" being more in use for these. A flywheel on your engine, however, would be eminently desirable, and the larger and heavier the better, for of all engines the gas-engine is the most irregular in its impulses. Even though the additional power required for a fly-wheel should make a sensible difference in the coal bill (and only a ponderous flywheel will do this, for the extra power required by a flywheel is much less than most people imagine), such extra cost will be more than compensated for by the longer life your lamps will have if you use the flywheel, not to mention the much better appearance of the steadier light. "Jumping" incandescent lamps are very trying to the eyes of anyone reading or writing, or doing fine work by their light. The cost of a single lamp would be more than the cost of the extra power required by even an unusually heavy flywheel in three months. (4) and (5) I must answer through the post.—EDWARD CONRY.

[61514.]—**Lining for Accumulators.**—Marine glue applied hot. As good a way as any is to melt the glue and thoroughly warm the cells, pour the glue into them, and empty it out again, leaving a coating of about $\frac{1}{16}$in. inside. There is not the slightest occasion for you to write to E. Conry or anyone else. If, as he says, he is unable to answer through these columns, he certainly cannot do so by letter. The query columns are not intended for gratuitous advertisements, but for general information, and if replies will not bear scrutiny, they are not worth much.—C. D. R.

[61518.]—**Gas-Engine.**—The statements made in the book as quoted in this query are quite correct. The author is describing a type of engine working between fixed limits, where the hotter the sides of the cylinder the greater heat would the gases have at the moment of opening the exhaust valve, and a greater quantity of heat would be rejected in the discharged gases. The sides of the cylinders are much hotter than the temperature of the discharged water, and 100° C. is not too high a temperature to assume considering that in some gas-engines the temperature of the gases at the opening of the exhaust is as high as 1,000° C. The higher the temperature of the water leaving the cylinder jacket the greater the economy in gas consumption. D. Clerk found in his experiments with an Otto engine an economy of 10 per cent. with the water being discharged from the jacket at the boiling point, compared with a quantity run through and the cylinder kept cold. It is better to pay reduced gas bills than increased charges for water, as suggested by E. Conry; and I am yet to learn that gas-engines are usually made lighter than steam-engines; was under the impression that it was the opposite way.—R. A.

[61519.]—**Mechanical Piano-Playing.**—"H. S. M." wishes to make an instrument to play the piano with paper bands. I will send instructions how to make one to fix under the keys permanently, so that it will not have to be taken away when you want to play yourself.—SANDERSON.

[61523.]—**Bell Circuit.**—Yes, earth can be used as return if good connection is made. The best way is either to solder a wire to the gas or water-pipes at each end, or to bury two copper plates of about 4ft. square in coke and damp earth, one at each end, and take an insulated wire to bell. The plates at each end must be made of the same material. For long circuits, however, a return wire should be used, unless battery power is plentiful; but the return need not be insulated, as bare No. 16 works well as earth.—IOTA.

[61527.]—**Agar-Agar Cell.**—I do not know if the Agar-Agar cell has been described before; but if not, perhaps querist may find following useful. The cell consists of a porcelain or glass tray about 1in. deep, having a sheet of silver lying at the bottom, and a copper wire riveted to it as an electrode; above this some lumps of silver chloride are placed, and then a paste of Ceylon moss containing 2½ per cent. of NH_4Cl is put on top of the AgCl. On the top of this again rests a cast zinc plate, unamalgamated, with an electrode. A pile of these cells makes a convenient testing, or, as it is called, potential battery. If made larger, they will work a small lamp; but the capacity in ampère hours is generally rather small. About 1¾ ampère is the heaviest current even a large Agar cell can yield.—IOTA.

[61528.]—**Seeds for Micro. Objects.**—"ERRATUM."—The first name given in my list should be Collomia, not *Collinsia*.—S. BOTTONE.

[61529.]—**Mathematical—Measurement of Drums.**—In working out the formulæ relating to drums, I now find that I made a mistake in considering the number of turns of rope in each layer $= \frac{h}{t}$. Except when there is but one turn in a layer (which is never the case with an ordinary drum) the number of turns $= \frac{h}{t} - \frac{1}{2}$. The following are the corrected equations:—

$$l = \pi \cdot \frac{2h - t}{8t^2}(e - d)(e + d - 2t) \quad \ldots\ldots\ldots\ldots (1)$$

$$e = t + \sqrt{(d - t)^2 + \frac{8t^2 l}{\pi(2h - t)}} \quad \ldots\ldots\ldots\ldots (2)$$

$$h = \frac{t}{2} + \frac{4t^2 l}{\pi(e - d)(e + d - 2t)} \quad \ldots\ldots\ldots\ldots (3)$$

As the centre-line of the rope really lies in a helix, and not in a series of circles round the barrel, the exact value of l is a trifle greater than that here given. In the values of e and h, the errors resulting from considering (for simplicity) each turn to be a circle are generally inappreciable.—J. R. CAMPBELL, Charing, Kent.

[61533.]—**Speed Wheels.**—In Germany makers supply their lathes with a table of all the threads possible with the change-wheels given. Could not English makers do the same? It saves a world of trouble.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[61541.]—**Brush Polish**—Should be made with French polish and best brown hard spirit varnish. Apply with a camel-hair brush, evenly, avoiding going back over the work, and it should be done in a warm and dry atmosphere or it will become "milky."—T. R. H. S.

[61542.]—**Clock and Sundial.**—Taking the advice of "H. A.," which I find I needed more than the querist, instead of finding "Lockyer to be right," I have to retract the admission that his first clause was true. If fairly quoted, it is the exact reverse. Instead of the dial gaining most on the clock when the sun is in perigee, that season

(or our mid-winter, when he is at the southern tropic) is just when it loses most. At our mid-summer (near apogee) it also loses, but less, and during fewer days; and during more than three months of spring, and more than three of autumn, it gains. I hurriedly trusted Lockyer to begin right in my reply p. 506; but after the word "true" (which should have been the opposite), all my later terms need reversing. The causes of "equation of time" (or difference between dial and clock) are two. The chief or more efficient is the obliquity of the equator to the ecliptic, which, acting alone, would make a half-yearly inequality, or one repeating all its changes twice a year. The other cause, the orbit's eccentricity, has a less effect, but whose period is annual. Lockyer, if rightly quoted, sought to simplify by omitting one of these; but omits the larger, the half-yearly, and not only confines his explanation to the smaller, but inverts the effect of that! The fact of the sun's eastward motion along the ecliptic being fastest in January, makes his westward passage relatively to the dial then slowest, even slower than at the opposite season, July. But because a degree of the ecliptic near either tropic tells for more than a degree of R.A., the solar hours must, at either of them, be longer than average ones. The excess of a solar over a sidereal hour must plainly be greatest then, and be smallest at the equinoxes, where those degrees of the ecliptic that cross the equator tell for less than degrees of R.A. In all states of the orbit, and even if it were circular, the dial must gain in spring and autumn and lose in summer and winter.—E. L. G.

[61548.]—**Ship-Building.**—No; my query was not intended to be funny, by any means. Indeed, had I not known the "E.M." was not a comic paper, I should have thought that "Video" was the man in motley trying to make a ponderous joke. I allude, of course, to the boring out of stern-tube previous to insertion of tail shaft, and immediate preparations for launching of an iron or steel steamer of, say, 3,000 tons—though why size or material should be specified, unless different systems are adopted for every size and material, I fail to see. To a man capable of answering the question, my query contained all that was necessary. —NOVICE.

[61550.]—**Interest.**—The formula in this question ought to be—

$$P = A \cdot \frac{R^n - 1}{(R-1)R^n}$$

and then we have the general equation—

$$R^{n+1} - \frac{A+P}{P} \cdot R^n + \frac{A}{P} = 0 \ldots\ldots\ldots\ldots \quad (1)$$

in which R is the unknown quantity, and being of the $n + 1$th degree there is no known direct method of solution; but we may approximate to the value of R by adopting suitable formulæ. For a first approximation, assume—

$$R_1 = 1 + \frac{A}{P}\left\{1 - \left(\frac{P}{A+P}\right)^n\right\}$$

$$\text{or—} \quad r_1 = \frac{A}{P}\left\{1 - \left(\frac{P}{A+P}\right)^n\right\} \ldots\ldots \quad (2)$$

Then equation (2) gives a fair approximation to the rate. Formulæ, however, could be given if necessary for a nearer approximation; but the labour involved would be about double that which is required in this. For a numerical solution, taking the numbers given in the question—namely, $P = 100$, $A = 7$, and $n = 40$, equation (1) becomes—

$$R^{41} - 1{\cdot}07\,R^{40} + {\cdot}07 = 0 \ldots\ldots\ldots\ldots \quad (3)$$

From eqn. (2) $\dfrac{P}{A+P} = \dfrac{100}{107}$

$$\therefore \text{Log.} \left(\frac{P}{A+P}\right)^n = 40\,(\text{log. } 100 - \text{log. } 107)$$
$$= 40\,(2 - 2{\cdot}029383)$$
$$= \bar{2}{\cdot}824648$$
$$= \text{log. } {\cdot}06678$$

$$\therefore 1 - \left(\frac{P}{A+A}\right)^n = 1 - {\cdot}06678 = {\cdot}93322$$

$$\text{and } \frac{A}{P}\left\{1 - \left(\frac{P}{A+P}\right)^n\right\} = {\cdot}07 \times {\cdot}93322$$

$$\therefore r_1 = 0{\cdot}0653247$$

and 1·0653247 substituted in (3), for R ought to satisfy that equation. Computing from this the powers of R we have—

$$(1{\cdot}0653247)^{41} = 13{\cdot}389$$
$$(1{\cdot}0653247)^{40} = 12{\cdot}584$$

$\cdot07 \times (1{\cdot}0653247)^{40} = 13{\cdot}46488$, and eqn. (3) then becomes—

$$13{\cdot}389 - 13{\cdot}46488 + {\cdot}07 = -{\cdot}00588$$

hence the required interest will be 6·53247 per cent.—MILVERTON.

[61551.]—**Flow of Water through Pipes.**—Thanks to "Elag" for his formula, which, however, scarcely seems to answer my question, for applying his rule to the case given—viz., a 24in. pipe 100 yards long, inclination 1 in 100. For an inclination of 1 in 20, a pipe $3\frac{1}{2}$in. diam. would be required to take the same water, which scarcely seems possible. If I am wrong in my application of his rule, will "Elag" kindly work out my given instance fully?—ST. GEORGE.

[61560.]—**Engineering.**—One would require to be intimately acquainted with the whole circumstances before expressing a very decided opinion. It is possible to be too harsh with pupils, but, speaking generally, I should say that those who are anxious to learn will always have abundant facilities for learning, not by making themselves busybodies and hindrances about the works, but by getting information through the proper channels. I have often had to order pupils to their benches, not because they were trying to obtain information, but because while ostensibly so doing they were idling their own time, and hindering workmen as well, yet I dare say they have thought themselves harshly dealt with. Many pupils are a nuisance and a plague in the shops. The mere premium is as nothing in comparison with the disorganisation, trouble, and waste which they might cause if allowed to do as they please. My idea of pupils is that in every case they should have no privileges above those of the apprentices who pay little or nothing, save that of going through all the departments in turn, which is privilege amply sufficient. I very much doubt if any pupil is much benefited by making notes while in the shops. He who works hardest, keeps his time, chips, files, and turns, educates his eyes and hands to the best of his ability, and gives his whole attention to the department in which he happens to be at the time, is the one who makes his mark afterwards. A pupil, like an apprentice, has golden opportunities before him, and if he does rough, and dirty, and distasteful work well, he is certain to get the best work in time, for the simple reason that it pays to give the best work to those who can do it best. The shop training is the most important part of the pupils' work, affording opportunities which, if wasted, never return again. There are plenty of employers, plenty of draughtsmen, who daily regret having missed the opportunity of knowledge afforded by the work of the shops. Even if rules and regulations do sometimes appear harsh to those newly entering a factory, it should be remembered that only by a system of discipline can the work of a large factory be carried on. The interests at stake are too heavy to allow of their being affected by the recognition of a privileged section, whose only claim is that of being gentlemen. There is no room for gentlemen, in the sense of non-workers, in a factory.—J. H.

[61562.]—**Mechanics.**—Momentum of one body $= 4 \times 12 = 48$, and of body moving in opposite direction $= 8 \times 4 = 32$. Momentum lost by first body at end of compression $= 48 - 32$, and the common velocity at that time would be $\dfrac{48-32}{4+8} = \frac{4}{3}$ in same direction of fastest moving body, which has, therefore lost $4 \times 10\frac{2}{3}$ of momentum. The coefficient of elasticity being 0·5, the whole momentum it loses is $\frac{3}{2} \times 4 \times \frac{32}{3} = 64$; $\therefore \dfrac{48-64}{4} = -4$ its velocity; that is, it rebounds with a velocity of 4. The momentum lost is imparted to the body which has a momentum of -32; $\therefore -32 + 64 = 32$, and $32 \div 8 = 4$; that is, a rebound with a velocity also $= 4$, as (its velocity being in opposite direction to the other body before impact) its first velocity had a negative sign.—T. C., Bristol.

[61562.]—**Mechanics.**—Let the velocities of the two bodies at the end of the impact be v_1 and v_2, the velocities before impact being 12 and 4, and their masses 4 and 8 respectively. Then the velocity lost by the first will be $12 - v_1$, and that gained by the second will be $v_2 - 4$. Hence, the momentum lost by the first will be $4\,(12 - v_1)$, and that gained by the second will be $8\,(v_2 - 4)$. But in direct impact the momentum lost by one body will be equal to the momentum gained by the other.

$$\therefore 8\,(v_2 - 4) = 4\,(12 - v_1).$$

Or—

$$v_1 + 2v_2 = 20 \ldots\ldots\ldots\ldots (1).$$

Again, since the relative velocity of the two bodies before impact is $12 - 4$, and that after impact is $v_2 - v_1$. And since by experiment it is found that in direct impact the relative velocity of two imperfectly elastic bodies after impact bears to the relative velocity before impact a constant ratio, called the coefficient of restitution, in this case equal to ·5, we have—

$$\frac{v_2 - v_1}{8} = {\cdot}5$$

Or—

$$v_2 - v_1 = 4 \ldots\ldots\ldots\ldots (2).$$

Therefore, from (1) and (2),

$$v_1 = 4, \text{ and } v_2 = 8.$$

Or the bodies will be moving in the same direction with their velocities interchanged. But if the bodies meet each other in opposite directions, by a similar method it will be found that

$$v_1 = -4 \text{ and } v_2 = 4,$$

or each of the bodies after impact will have changed their directions, and will be moving with equal velocities.—MILVERTON.

[61563.] — **Torricelli's Theorem.** — In my answer in your last issue I took in mistake Q = amount of discharge per sec., instead of per minute, as the other amounts were expressed. The following is correct:—

$$A = \frac{Q}{E} = \frac{{\cdot}133}{963 \times {\cdot}62} = \frac{{\cdot}133}{597{\cdot}06} = {\cdot}00022 \text{ sq. feet.}$$
$$= {\cdot}03168 \text{ sq. inch}$$
$$\therefore \text{Dia.}^2 = {\cdot}0403 \text{ inch}$$
$$\text{Dia.} = {\cdot}2007 \text{ inch.}$$

—ELAG.

[61563.] — **Torricelli's Theorem.** — In the answer I gave to this question, by some mistake the flow has been taken for three minutes instead of for thirty minutes. For thirty minutes the equation would be—

$$1{,}800\ V\ A = 4 \text{ cubic feet.}$$
$$\text{or} \quad A = \frac{4}{16 \times 1{,}800} \text{ square feet.}$$
$$\therefore \quad A = {\cdot}02 \text{ square inch.}$$

and the area of the orifice would be ·032 square inch.—MILVERTON.

[61565.]—**Daniell's Battery.**—I can ring two bells in parallel for nearly an hour twice a day with four No. 1 Leclanchés in series. It is true a Daniell beats a Leclanché for constancy; but even Leclanchés can keep a bell ringing for a long time, if properly attended to. The principal fault in the Daniell's battery is the amount of attention required; but the porous pot can be prevented from becoming so brittle by means of paraffin wax. If the top for about 2in. be steeped in boiling paraffin wax, the crystals stop forming round the edge. The principal cure is plenty of attention, and keeping them in a cool, dry place.—IOTA.

[61569.]—**Violin-Maker.**—Grand-Gerard was a maker who worked in the Vosges about the end of the 18th and beginning of present century.— W. A. K.

[61574.]—**The Calculus.**—I have never seen Ritchie's book on the "Differential Calculus," but I venture to think "Tyro's" difficulty may be cleared up as follows: If u be a function of a variable quantity x, and x be supposed to increase, the rate of increase of u with respect to that of x is expressed by the differential coefficient $\dfrac{du}{dx}$. This important fact is explained in all modern works on the differential calculus. Now the area of a square is a function of the side, so that if the side $= x$ we may put $u = x^2$. But the differential coefficient of x^2 with respect to x is $2x$. This means that the area of the square increases $2x$ times as fast as the side x. The rate of increase varies with the value we choose to assign to x. When x = 10ft., the area is increasing at 20 times the rate x is increasing; and since x is increasing at the uniform rate of 3ft. per second, the area at the moment that x = 10ft. must be increasing at the rate of 20 times 3ft. per second, i.e., at 60sq.ft. per second.—J. R. CAMPBELL, Charing, Kent.

[61574.]—**The Calculus.**—I thank "Weald," "M.I.C.E.," and "M." very sincerely for the trouble they have kindly taken to remove my difficulty with respect to the fundamental idea of the calculus. If I could have found in any of my books the numerical illustrations they have given, I should have been saved immense trouble and loss of time. Most writers on the calculus warn their readers that they are about to enter on new lines of thought, and that they will meet with difficulties which they must not expect all at once to overcome. It surprises me that these authors do not endeavour, by means of familiar and numerical examples, to assist students to overcome the difficulties of the subject. Is it that these matters are left for the explanations of tutors? or is it that the writers have forgotten the steps by which "the rough places were made plain" to them? I have not the advantage of a tutor; but have all the aid which the possession of the best books on the subject, both English and American, can give. Yet I am often confronted with difficulties of which I find no notice in my books. As I said in my former communication, I accept what I cannot understand, and pass on, returning to the difficulty from time to time. But I am not content to accept without understanding. By repeatedly returning to a subject I sometimes find my way out of a difficulty which has long troubled me; but in some cases, even after long application, I have failed. As the same difficulties probably beset others, who, like myself, cannot consult a tutor, it may not be amiss if I give another example of these difficulties. In most treatises, after the rules for differentiating simple functions have been explained, the subject of successive differentiation and the development of functions into series is

introduced, and this without any preparation or explanation. The process of successive differentiation is simple enough. I do not think it would be difficult to construct a machine for effecting it; but the *meaning* of it I am afraid I have not succeeded in understanding. My difficulty is this. I will take a very simple example. Given $y = m x^2$ we have $\frac{dy}{dx} = 2 m x$, by which expression we virtually say that the rate of variation of the function y is to the rate of variation of the variable x as $2 m x$ is to unity. All this is clear enough, the function and variable are real or concrete quantities; but $2 m x$, the derivative or differential coefficient, is not a concrete quantity, but a ratio. We are directed to treat this ratio by differentiating it, and thereby obtain a new derivative or differential coefficient; and if x had appeared in the third, fourth, &c., power in the original derivative, we are directed to repeat the process until x disappears, and the expressions thus obtained are the second, third, &c., derivatives. I can understand treating a function by the process of differentiation, and thereby determinating the ratio which its change bears to the changed and the variable entering into it; but what the meaning is of treating the ratio again and again in the way in which we treated the original function I cannot understand. In other words, I can understand differentiating a real quantity (the function of a variable quantity); but I cannot understand the differentiating of an abstraction, that is a ratio. What I intended saying about series I will defer, and will conclude by again thanking the correspondents who replied to my last communication.—TYRO.

[61575.]—**Indicator.**—This engine appears to be working with a high grade of expansion, and therefore very subject to condensation. I would suggest that a portion of the steam is condensed, and so a larger quantity is required to do the same work, and some of it is turned into condenser as hot water, so raising the temperature of well. Could you not try the engine one day with jacket on and one day off, and notice quantity of feed-water and fuel supplied to boiler each day, and let us know the result?—T. C., Bristol.

[61577.]—**Meridian Instrument.**—TO "HERMES."—You should buy the book descriptive of the instrument at Dent's, 61, Strand, the price of which is 1s. or 1s. 6d. It must stand on a perfectly level plane, say of brass, cemented or run with lead on to a stone slab, and this plate need only be about 4in. square. Near one edge, which must point nearly or quite due north and south, is a strip of brass like a flat ruler, held down by two or three screws, and with a trifling range of adjustment, so that when the side of the instrument is merely placed in contact with the strip it is perfectly in position for all time, and does not require fixing at all. As to its use, read the book, and if there is anything that requires further explanation, I think I can tell you all you want. Baker, in Holborn, has, or had, some time since two or three more or less elaborate ones for sale second-hand. I knew of one of the universal pattern fitted with spirit-levels and telescope, and arranged to read at any hour from 9 a.m. to 3 p.m., that sold at Stevens's a few months ago for £1; but then that was a universal one, of use only to a traveller. I think plain ones second-hand would cost about as much as that. If you get one, do not take it to pieces to examine it, and you had better get it placed in position by the maker, as you will, or, at least, I did, find it almost a wearisome job getting it back into adjustment, and properly fixed as to the south point. Of course, you will fix it where you are most likely to be at noon to read it.—J. K. P.

[61581.]—**Telephone Switch.**—It can be done, I know, for it has been done in a particular installation with which I am acquainted; but it is a complicated and difficult arrangement. At the time a manager of a telephone company made a considerable bet that it could not be done, and lost. I think I have the diagrams somewhere, and will look them up and let you know next week.—EDWARD CONRY.

[61583.]—**Castings.**—The metal is only tin solder cast in iron or gun-metal moulds.—A. F. SHAKESPEAR, Lüttichaustr. 14, III., Dresden.

[61583.]—**Castings.**—The alloys used in making toys belong to the pewters and the type-metals, and therefore include those composed of tin and lead, and lead and antimony; of tin, lead, and antimony; lead, antimony, and bismuth, and Bibra metal, which is excellent for small casts, and consists of bismuth 6, tin 3, lead 13, but is too expensive for toys. The moulds are of plaster or iron.—SAML. RAY.

[61585.]—**Polishing Fretwork.**—There is just a possibility that the work appears cloudy from the presence of the oil, which can be removed with a few drops of spirits of wine on a clean rubber; or perhaps the first coating has been entirely absorbed by the wood. Be careful not to use too much oil. One drop at a time is sufficient, and that is to prevent the pad from "sticking."—W. HOLDER, Newport, Mon.

[61585.]—**Polishing Fretwork.**—For small work like this I find there is no better plan than to give a very slight coating of linseed oil, and then put on French polish (using a little oil on the face of the rubber) until the wood is filled, then let it stand till next day, when you can go over with a clean rubber and some good polish, finishing with a little methylated spirit to take up surplus oil, and so leave face of polish with good gloss. Be careful not to use more oil than is just necessary to make the rubber slide easily over face of work. I generally get the edges as clean cut as possible, and oil them only.—WOODWORKER.

[61586.]—**Waterwheel.**—The fall of 10ft. before it gets to the wheel is simply power lost. The power in wheel = 14 × 10 × 3 = 420ft.-lb. per minute gross, or, say, 300ft.-lb. effective per minute. Nett power required, 1,000 × 10 × 100 ÷ (24 × 60) = 700 per minute without friction of pumps and pipes. From this you will see you have only one-third the power required.—T. C., Bristol.

[61588.]—**Brass-Cleaning Composition.**—This is probably some composition containing oxalic acid, which is a well-known agent for cleaning brass. The following will clean either brass or copper:—Oxalic acid, 1oz.; rottenstone, 6oz.; gum arabic, ½oz.—all powdered up. Then 1oz. of sweet oil and sufficient water to make a paste. Apply a little, and rub dry with a piece of flannel or soft leather.—W. HOLDER, Newport, Mon.

[61589.]—**Coal Economy.**—I have by anticipation answered the query of "Cane Sugar," for all that can be said, unless specific questions are put, is that improved appliances for saving coal should be used. It is usual to call in a "consulting engineer," whose fee may range from five to fifty guineas; but if "Cane Sugar" will give me the requisite statement of conditions, I will endeavour to help him gratis. It is no use talking of "vials of contempt," whatever they may be; what is wanted are solid facts, and I cannot find one in your correspondent's remarks—not even a question on a matter of fact. He seems to adopt the statement that 900 tons of coal is a suitable quantity to use in refining 1,800 tons of sugar. If that is so, it is time it was altered. I have some knowledge of Christian-street, E., and the purlieus of the Commercial-road, and I know that in sugar refineries steam is used for other purposes than driving engines; but I do not gain much light from the solitary fact given by "Cane Sugar"—that he knows a refinery working about 400 tons weekly, in which 130H.P. is used. Presumably this is 400 tons of sugar; but how the 130H.P. is arrived at is not quite clear. Supposing, however, the 130H.P. represents machinery, that ought to be obtained at an expenditure of 4lb. of coal per I.H.P., so that one ton would yield the required H.P. for four hours (I use round figures, with every allowance), or 6 tons per day of 24 hours—i.e., 42 tons per week of 168 hours, and it is not easy to work more hours in a single week. "Cane Sugar" omits to give the quantity of coals consumed; but perhaps he will supply that and other interesting data. At all events, he must, before he can reasonably expect me to devote time in the endeavour (perhaps thankless) to show him and others how they may save money. He need not go far amongst makers of steam-engines and experts generally to learn that when anyone suggests to a manufacturer the advisability of adopting appliances more economical in fuel than the plant at work, the answer is usually, "Hang the coals; they are cheap enough. I am not going to lay out more capital in the hope of saving coals." I am sorry I cannot say anything more definite; but I think it will be tolerably obvious that each case must be taken on its merits with a full knowledge of the surrounding conditions. I have stated what "Cane Sugar" should get his 130H.P. for, and it remains for him to supply further data.—NUN. DOR.

[61595.]—**Lead Burning.**—If you are dexterous with the soldering iron you can do it with this. The usual way is with a blowpipe flame and a little hammer; but the operation requires considerable skill of hand.—EDWARD CONRY.

[61599.]—**Gunmetal.**—Melt separately 1lb. copper and 2oz. tin. When melted mix.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[61599.]—**Gunmetal.**—Tin 1, copper 8, and 1½lb. per cwt. of zinc added, and the alloy should be melted twice to insure sound castings. There are numerous other proportions.—W. HOLDER, Newport, Mon.

[61599.]—**Gunmetal.**—First melt the tin with twice its weight of copper, and then add it to the proper proportion of melted copper. Exclude oxygen as much as possible from the melted alloy, and well mix with a wooden stirrer, as gunmetal has a tendency to separate into two parts by reason of the very different specific gravities of the two metals. It should be run into the mould at a temperature as little above its melting point as possible, for the same reason. A little more tin than is necessary should be added to allow for the tin oxide which is sure to be formed in spite of every care, and should be skimmed off before casting. The addition of some old gunmetal aids the formation of the alloy.—M. ISADER, Lewes.

[61600.]—**Cone of Lathe.**—This is such a small affair that I would recommend querist to turn a cone of wood, say, 6in., 6½in., and 7in., and turn in position, if required, to suit tension of band on various speeds.—T. C., Bristol.

[61601.]—**Decomposition of Carbonates.**—Carbon would be formed by heating a carbonate to a moderately high temperature in hydrogen; but carbon and hydrogen only combine directly with one another at the extremely high temperature of the voltaic arc.—M. ISADER, Lewes.

[61603.]—**Reduction of Numbers.**—In dealing with large numbers, it is customary to use the index notation—that is, to use the first 4 or 5 figures, and multiply by the necessary power of 10. Thus, the velocity of light, 300,000,000 mètres per second, is written 3×10^8; the distance between earth and sun is $1{\cdot}487 \times 10^{13}$ centimètres, and so on. In the index notation it is usual to divide the number in such a way that the index of the 10 is the characteristic of the log. of the number. Of course, any large number may be reduced by dividing it; but I suppose this would not suit the querist. It is not easy to give a definite reply to this query in the absence of any information as to why logs. are not suitable. If "Reduction" will be more explicit perhaps some method of helping him might be devised—WM. JOHN GREY, F.C.S., Newcastle-on-Tyne.

[61604.]—**Chemical Equivalents.**—I do not know of any tables such as you want being published separately; but any good little book on chemistry, such as Roscoe's "Lessons on Elementary Chemistry," published by Macmillan and Co. at 4s. 6d., will answer your purpose.—M. ISADER, Lewes.

[61604.]—**Chemical Equivalents.**—I am not aware of any book which contains the molecular weights of compounds and water of crystallisation of salts in the form "Vulcanite" apparently requires. The atomic weights of the elements are always given in even the most elementary works on chemistry.—WM. JOHN GREY, F.C.S., Newcastle-on-Tyne.

[61606.]—**Railway Fish-plates.**—The system of uniting the ends of the rails by fish-plates was introduced in 1847. Previous to their introduction the rails were placed one against the other in a chair made of extra size for the purpose, called a "joint chair," there being no rigid connection between them. The advantage in having iron plates uniting the ends of the rails together, by being placed on each side of the web of rails and bolted firmly to them, is that it is impossible for the one rail to rise slightly above the other while a train is passing over them.—AMATEUR.

[61609.]—**Warming Railway Trains.**—On the Saxon Railway Line steam is used with considerable effect; in fact, one is nearly roasted. Formerly blocks of heated charcoal were used, but they caused danger from fire.—A. F. SHAKESPEAR, Lüttichaustr. 14, Dresden.

[61610.]—**Circular Saw.**—Do not think of an 8in. saw for such "things." Try a 3in. saw, and be contented with that to cut ⅜in. stuff slowly; or, better still, throw the gear away and fit up a proper saw bench as recently described in "Amateur Workshop."—T. C., Bristol.

[61613.]—**Dynamo and Continuous Current Battery.**—Yes, just the same; and if you have the necessary power to drive it, will be a great deal more convenient than the battery.—EDWARD CONRY.

[61613.]—**Dynamo and Continuous Current Battery.**—A well-constructed dynamo (not alternating) will produce precisely the same results.—S. BOTTONE.

[61613.]—**Dynamo and Continuous Current Battery.**—Yes; you can use this exactly in same way. When giving the current and E.M.F. you name, then carry your connections from the terminals of dynamo, and use same for medical work. I presume the dynamo will be shunt-wound.—OHM.

[61614.]—**Clutch.**—I suppose you mean the method of detaching nut from leading screw. If so, two illustrations have already been given—viz., in "F. A. M.'s" lathe, and in "Amateur Workshop." I have two lathes, in one of which a half-nut is moved back or forward by a half turn of a quick thread screw; and the other has a half-nut above and below, and these are caused to separate or approach by having pins on them which take in grooves in a cam plate rocking on a central stud.—T. C., Bristol.

[61615.]—**Porcelain Clay.**—Porcelain insulators can only be made in a porcelain manufactory, where the required machinery for preparing the clay and the necessary convenience for making and ovens for firing them is at hand. "H. T. C." had better make a drawing of what he requires, and send it to an insulator-maker or a porcelain manufacturer, and get them made for him.—O. B. O.

[61616.]—**Gramme Dynamo.**—If the fields be connected to the armature as a shunt machine, then about 8lb. No. 12 will be ample on the armature; but I am afraid you will not get 20 twenties out of the machine if you use a wire ring. I should strongly advise a Pacinotti ring laminated, with teeth.—S. BOTTONE.

[61616.]—**Gramme Dynamo.**—If you can run your dynamo to get 100 volts, then you will require 13 ampères; ·048in. wire will easily carry this on your armature, and you might wind it to a resistance of about ·5 ohm. This would be, say, 450ft. total length on armature; if you can work with a shorter length, then you will have higher efficiency.—OHM.

[61617.]—**Removing Ink Stains.**—A solution of chloride of lime will effect this.—W. HOLDER, Newport, Mon.

[61617.]—**Removing Ink Blots.**—I have not come across the fluid you mention for removing ink blots; but it's ten to one that it is a preparation of potassic oxalate ("salts of sorrel"), or oxalic acid, probably solution of the former.—R. A. R. BENNETT.

[61617.]—**Removing Ink Blots.**—This is probably some solution which slowly evolves chlorine gas. A solution of ordinary bleaching powder ("chloride of lime") in water will effectually remove ink marks from paper, but it must not be too strong, or it will act injuriously on the paper. Experiment will easily determine the proper strength to use.—REYMOND.

[61620.]—**Fixing Laminated Armature to Spindle.**—To S. BOTTONE.—Turn the spindle down, so as to leave a shoulder at the driving end. Run the punchings on the spindle, as shown at page 373 Vol. XLIV. of the ENGLISH MECHANIC. At the commutator end a thread must be cut in the spindle, on which is screwed a nut, which serves to clamp the laminations into their place.—S. BOTTONE.

[61622.]—**Planetary Drawings.**—Why not use black surface-paper, and draw thereon with Chinese white or white chalk?—SM.

[61622.]—**Planetary Drawings.**—I know nothing of the drawings you mention in this unastronomical corner of the world, but have seen very nice backgrounds made with Indian ink. The laying on is the secret. Is "Constant Reader" acquainted with the blue process described in back numbers (774 : 898)? It is said to give beautiful backgrounds, and is highly spoken of by Mr. Brashear.—ARTHUR MEE.

[61624.]—**Speculum.**—"Etanin" says "under the shadow test the curve is certainly parabolic"; but I may tell him the shadow test will not disclose whether it is certainly parabolic or not—in fact, I can assure "Etanin" that "figuring" is much too delicate to be detected by this test without very great experience and extreme patience, and cannot be determined in actual amount at all by the shadow test. The probability is there is too much correction, which would be fatal to good definition of stars and planets, and yet would define the moon very fairly. Such a curve would not, however, give perfect definition of the minute details with which the moon is covered, and which give the chief charm of observing it. "Etanin's" only course is to persevere, reduce the over-correction if possible, and, if not, to fine grind again and re-polish, hoping for better results.—J. C. LINSCOTT, Ramsgate.

[61626.]—**Assaying of Ores.**—If "Cymro" will call between 10 a.m. and 4 p.m. (Saturday before one o'clock), at the Metallurgical Laboratory of King's College, Strand, I or my assistant will be pleased to give him the information he requires. Students whose time is limited may specialise in any subject in this laboratory without being compelled to go through the whole of the usual course; special arrangements can be made as to times of attendance. For those engaged during the day the Laboratory is open on Friday evenings from seven to nine.—A. K. HUNTINGTON.

[61627.]—**Boring Hard Wood.**—I should certainly use a large, sharp twist drill. The centre-bit, though a good and quick tool for rough work, is not a particularly clean cutter, especially for large holes. I should use a twist-drill, and hold your hard wood down on a bit of soft board, so that you can carry the cut a little into the latter each time.—EDWARD CONRY.

[61627.]—**Boring Hard Wood.**—Your centre-bit will bore cleanly if: 1st, it runs true; 2nd, you back the piece being bored by another; 3rd, the thin clearing portion of the bit should be at least $\frac{1}{32}$in. longer than the extreme point of the cutting portion, so as to enter the wood in advance of the knife-edge and just behind the centre point. The effect of this will be to cut out a clean button piece at the end of the boring, and leave the edges smooth.—C. D. R.

[61630.]—**Loss of Power in Model.**—The ratio of power to resistance in crab $= 8 \times 43 \div 149 = 23.1$ nearly. A weight of $56 \div 23.1 = 2\frac{1}{2}$lb. nearly, should keep the weight balanced—more exactly 2·46lb. As it takes 3·1lb. to raise it, there is $3.1 - 2.46 = 0.64$lb. loss, or $0.6 \times 100 \div 3.1 = 21$ p.c. of total loss in friction nearly.—T. C. Bristol.

[61630.]—**Loss of Power in Model Lifting Crab.**—The winch handle has a power of 2·9 over the circumference of the drum, and the wheel work gives 8 to 1; therefore 3·1lb. on winch handle should raise $2.9 \times 8 \times 3.1$lb. on circumference of drum $= 71.92$lb. But it only lifts 56lb., or $\frac{56 \times 100}{71.92} = 79$ per cent. There is therefore a loss of 21 per cent.—ELAG.

[61630.]—**Loss of Power in Model Lifting Crab.**—The power 3·1lb. is applied at the end of a lever $\frac{43}{2\pi}$in. long (since radius = circumference $\div 2\pi$), and is to be multiplied by 8 on account of the wheel work. The weight is wound on a drum, the radius of which is $\frac{14.9}{2\pi}$; consequenly, the power, 3·1lb. should just raise $\frac{43 \times 8 \times 3.1}{2\pi} \div \frac{14.9}{2\pi} = \frac{1066.4}{2\pi} \times \frac{2\pi}{14.9} = \frac{1066.4}{14.9} = 71.5$lb. As, however, only 56lb. were actually raised, there remain 15·5lb. to be accounted for, giving a loss in friction, &c., of 21·7 per cent., or over one-fifth of the total power exerted.—REYMOND.

[61633.]—**Dynamo.**—TO MR. BOTTONE OR MR. CONRY.—You would do well to wind your fields with 30lb. of No. 22 if you desire to convert your machine into a shunt; but I am doubtful whether you will run eight 16c.p. lamps with No. 18 on the armature.—S. BOTTONE.

[61633.]—**Dynamo.**—TO MR. BOTTONE OR MR. CONRY.—Mr. Bottone can probably tell you better than myself what alterations to make, if any successful alteration is practicable with your machine; but I have seldom known any satisfaction got from altering to one purpose a dynamo made for another and entirely different one. I think I may say at once, however, that you cannot possibly with your castings get the machine to light eight 16c.p. lamps by any alteration of wiring. The machine and armature are not large enough; and without entering into calculations, I should certainly consider No. 18 wire far too small for an armature for a current of from 10 to 12 ampères. I think you had much better make up your mind at once to construct a new machine right out.—EDWARD CONRY.

[61634.]—**Will o' the Wisp.**—My mother, on being asked this question, assures me that she saw this phenomenon at the foot of Primrose-hill, London, in 1848.—S. BOTTONE.

[61634.]—**Will o' the Wisp.**—You could see many of them in certain parts of the Fen country (e.g., Lincolnshire), or on the Bog of Allen in Ireland. If I remember rightly, it is merely light sulphuretted hydrogen, and corresponds to the "St. Elmo's Fire" of the sailors that appears at the masthead in storms.—EDWARD CONRY.

[61634.]—**Will o' the Wisp.**—Relatives and friends of mine have seen this curious phenomenon, generally on marsh or moorland—a tiny star, rather than a flame, dancing along. See also Mrs. Watney's account, under heading "Welsh Superstitions," in December number of *Red Dragon*, the national magazine of Wales.—ARTHUR MEE.

[61634.]—**Will o' the Wisp.**—I saw this appearance myself one close, moonless night the summer before last. It was a blue, dancing flame (very much like what children call "Snapdragon"), hovering over a piece of wet ground close to the side of the railway along which I was slowly travelling. I should have thought it was common enough in fenny districts. I was sorry I could not go and examine it.—B. HARCOURT.

[61635.]—**Engine.**—The first thing is, will your work permit of a slightly jerky action of engine owing to the lower speed? If the flywheel is heavy, this would not be felt much. Then do you work the boiler at a good pressure and throttle the steam at the engine? If both cases are "yes," it would be some advantage to reduce speed and not throttle so much, or work at a higher pressure. The engine, however, is so much too large for its work that there would not, perhaps, be a great saving, unless you are using more than 30lb. coal per hour after steam is raised.—T. C., Bristol.

[61637.]—**Dewing of Object-Glass.**—By all means close the end of the dew-cap when work is over. This is best done with a plug made to fit tightly by means of flannel. The dew-cap should have a length three times its diameter, and should fit so tightly on the end of instrument that neither dust nor spiders can gain access. Our object-glass never becomes bedewed when thus shut up, but such an event has happened when observing in cold, damp weather. The moisture is best removed by gently blowing warm air from above a lighted spirit-lamp on to the lens. We always prevent deposition of moisture on metal-work during wet weather by the use of a gas stove.—A. PERCY SMITH, Temple Observatory, Rugby.

[61638.]—**Vertical Boiler.**—Your boiler should stand 80lb. safely, and I should work it at that. With a good draught it should give $\frac{1}{2}$H.P. Run the engine at 250 revs. at least, 300 would be better. Size of hole in safety-valve $\frac{1}{2}$in. diam. I should not have a lever, but a dead weight of 16lb. on valve, and you can proportion lever to give this if you prefer it—say, fulcrum to valve 1in., and total length equal 8in., requiring 2lb. nearly on end.—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

61059. Photography, 311.
61065. Electrical, 311.
61083. Axles Breaking. To Mr. Stretton, 311.

61289. Object-Glass. To "Prismatique," p. 399.
61312. Steel Furnaces, 399.
61116. Turning Bowls for Calenders, 399.
63318. Tricycle, 399.

Teaching a Poodle to Read.—Lecturing at Walsall the other day, Sir J. Lubbock, M.P., said: That the dog was a loyal, true, and affectionate friend must, he thought, be gratefully admitted; but when they came to consider the psychical nature of the animals, the limits of their knowledge were soon reached. He first began his experiments with a small terrier; but as these dogs were not accustomed to fetch and carry, and as fetching and carrying was part of the treatment, he found it better to find a dog that was accustomed to such work, and he selected a black poodle called "Van." First he took two pieces of cardboard, about ten inches by three inches, and had printed on the one the word "food" leaving the other blank. The card bearing the word "food" he placed over a saucer containing bread and milk, and put the blank card over an empty saucer. Van's attention was called to the saucers over and over again. In about ten days Van began to distinguish between the two cards. Then he put the two cards upon the floor, and signalled to Van to bring one of them, which he readily did. When he brought the blank card he (the lecturer) threw it back with a gesture of impatience; but when he brought the one with the word upon it he was given some bread and milk, and in a few days he distinguished between the two cards. Then he had some cards printed with the words "out," "tea," "bone," "water," printed upon them—others having other words placed upon them, to which he did not attach any importance, merely putting them in that he might have a certain number. Soon Van distinguished between the white and the printed cards, but it took him a long time to recognise the words "out," "bone," "tea," and so on; but at last, if asked if he would go out, he fished out the card with that word upon it from the lot placed higgledy-piggledy upon the floor, his behaviour showing that in bringing it he really was making a request. This was only the beginning, however; but it was suggestive, and might be carried further, although no doubt the limited senses of the dog constituted a difficulty in the case. His wife had a beautiful collie, which was generally in the room when Van was being fed, and who was anxious to be fed in the same way; but it never occurred to the collie, although he saw the operation thousands of times, to pick a card and bring it that it might be fed in the same manner. Then pairs of cards differently coloured were put before the dog, and, one being picked out, an attempt was made to induce the dog to bring the corresponding one, but although two lessons per day were given for three months the dog had no more idea of what he should do at the end than he had at the beginning.

THE capital of 100,000fl. required for the organisation of an International Food Exhibition at Amsterdam has been subscribed. The buildings will cover an area of 6,500 square mètres. An International Exhibition of Popular Food and Cookery will be opened at the end of the present month at Leipsic.

QUERIES.

[61639.]—**Dry-Rot.**—Can any of "ours" give practical advice for cure of dry-rot in interior door jambs and skirtings? House is about ten or twelve years old, and it is not the outer walls that are affected.—T. R. H. S.

[61640.]—**Battery.**—TO MR. CONRY.—I am constructing a large battery. The cells are 12 by 9 by 9, and hold over three gallons each. I intend using a nitrate of soda battery. There are four corrugated carbon plates, 10 by $1\frac{1}{2}$, in each porous pot. The zincs are 12 by 8. Are the proportions of the elements correct? How many ampères may I expect, and what size leads will be required to carry the current?—DENTIST.

[61641.]—**Dynamo.**—TO MR. CONRY.—I have a Siemens H armature dynamo made from Jones's castings. It is $6\frac{1}{2}$in. high; wire space, $3\frac{1}{2}$ by $3\frac{1}{2}$; armature, $3\frac{1}{2}$ by $1\frac{7}{8}$. The fields are wound with 3lb. 10oz. No. 20 d.c.c. wire. The machine is very strongly made. What size wire should the armature be wound with to get the best results as a motor for driving dental drills and burrs with a flexible shaft? Should it be connected shunt or series? I intend using with the above battery.—DENTIST.

[61642.]—**A Good Illuminant.**—Am interested in good lighting. Have seen in daily paper description of an illuminant tried at Marlborough Rooms, London, during past few days, which is called the "Welsbach" light. It is described thus: A special gas-burner, over which is hung, in an ordinary chimney glass, a specially-prepared material in the shape of a doll's skirt, composed of incombustible oxides. It is believed each "mantle" will last six months, and can be replaced for 1s. The incandescence of this "mantle" gives the light. It is described as whiter than ordinary gaslight, nearly as pure and blue as any produced by electricity, and far cheaper than any produced by ordinary gas-burner. Pictures seen as clear as by daylight, clearer than on some foggy afternoons. It is brighter than light of Argand burner, and nearly as cool as a candle. Reduces gas consumption nearly 75 per cent. Name of manufacturing firm not given. I live in country. Could some reader of "Ours" furnish name of firm, and express an opinion of same?—LIKE TO KNOW.

[61643.]—**Boiler Query.**—Of two steam boilers, one at 45lb. pressure and the other at 65lb., which would be the hottest? If a 2in. valve was opened into a cistern containing cold water, which would keep the water at the highest degree of heat?—ENQUIRER.

[61644.]—**Albategnius.**—Described by Webb (289) as "a walled plain, 64″ wide, very level." Will one of our friendly selenographers be good enough to inform me how many craterlets have been discovered on the floor of above?—JASON.

[61645.]—**Lime Light.**—Would some correspondent kindly give me a little information on the following subject? A friend of mine has a good oxy-hydrogen blowpipe, and he wants to fit it up as a lime light. If not asking too much, I should like a drawing of lamp, reflector, position of lime ball, quantity of gas necessary to use per hour to keep the light up, best kind of lime ball, &c.—J. L.

[61646.]—**Winding Rope.**—How can I find out whether a winding rope is made of charcoal iron, Bessemer steel, Siemens-Martin, or crucible steel wire? Also, where can I get a bit of honest charcoal iron wire?—W.

[61647.]—**American Organ.**—Will some one of our musical correspondents answer me the following? I intend making an American organ with one full row of 8ft., one full row of 4ft., three octaves of 16ft. in treble, and two and a half octaves of 8ft. in treble. The 8ft. and 4ft. rows will be in front, and the three and two and a half octaves at the back. There will be also two octaves of large scale for pedals. I want the 16ft. reeds voicing to imitate the violoncello (for solo playing), the lower half of 4ft. for principal, upper half for flute, bourdon for pedal reeds. Now what should the full row of 8ft. and the half row of 8ft. be voiced to, to give best results? It will be F scale, and have octave-coupler up and down. What size should bellows, wind-chest, &c., be? Do not pinch me for wind. Would it answer to have the 8ft. row of a soft quality tone, and make the two and a half octave 8ft. into three octaves of a very reedy character, as I should like an oboe or other reedy stop?—J. S.

[61648.]—**Battery for Lamp.**—What number of cells of following kind would be required to work one of Shippey Bros.' 8-volt (5c.p.) battery lamps? Outer cell, 7 by 5, with three carbons, each 5 by $1\frac{1}{4}$ by $1\frac{1}{4}$; porous cell, 6 by 3, with zinc rod 5 by $\frac{3}{4}$; charged as follows: outer cell, water, 3oz. bichromate potash, 4oz. sulphuric acid; inner cell, 2oz. mercury, $\frac{1}{2}$oz. sulphuric acid, water. In having a lifting arrangement, is it necessary to lift carbons as well as zincs? I want to fix lamp about 10yds. from battery. What should be smallest size (B.W.G.) of conductor, and would that length of wire necessitate any extra battery power? If so, how much?—AMBER.

[61649.]—**Defective Accumulator.**—I have made a 6-cell Planté accumulator, with two plates in each cell, each plate measuring 5 by 17. I soaked the plates first in nitric acid for about 14 hours, and then washed them thoroughly (I noticed they were slightly yellowish when dry). I then rolled them up with strips of thick felt in between, and put in the acid. I charged them in series from a small dynamo, reversing the current about ten times and charging for about a quarter of an hour each time. I only noticed one cell giving off gas. On testing at the end of that time, I found only the least indication of current from the 6in. series. Can anyone explain what is wrong? Also, I have heard that 5 per cent. alcohol in the acid assists the formation. Is this correct? I have taken out the acid, and am now anxiously awaiting a reply.—PLANTE PLATE.

[61650.]—**Micro. Object-Glasses.**—I should feel extremely obliged to Mr. E. M. Nelson if he would kindly advise as to what object-glasses are best suited for the study of the lower organisms, both animal and vegetable, cost being somewhat a consideration. I should at the same time be very glad to know what Mr. Nelson thinks of Zeiss' ordinary objectives, especially the high-power immersion ones—whether they are equal in performance to the corresponding powers of English makers.—J. H. ARTHUR.

[61651.]—**Induction Coil.**—Will one of our able correspondents kindly tell me how to test the continuity of the scondary wire of my coil, containing about $1\frac{1}{4}$ mile of No. 40 s.c. wire? I made it a few years ago. It has been knocked about a good deal, and I don't at present get as long a spark from it as I used to do. I think the secondary has parted somewhere.—J. P. AIGBURTH.

[61652.]—**Screw Cutting.**—Will an experienced hand kindly inform me how to cut an exact Whitworth thread, having $\frac{1}{6}$ rounded off top and bottom, without using a chaser? I have an ordinary V screw-cutting gauge; but when the tool is simply ground to this, I find it difficult to produce accurately-fitting male and female threads.—FOREMAN.

[61653.]—**Colliery Superstitions.**—Can any reader of the ENGLISH MECHANIC give information as to an idea which seems to be somewhat prevalent among colliers, that there is a "straining of everything in the mines" at midnight? As the idea has been given me from two independent sources, an English miner and a Scotch, there would seem to be a pretty widespread superstition on the subject. The account given me was that at midnight the miners assembled at the main shaft to be out of danger in case anything should come down, as if any coal were to fall it would fall at that hour. The explanation given by the miners appears to be that the earth is upside down at the hour of midnight.—GARRISON GUNNER.

[61654.]—**Sidney's "Arcadia."**—Is any cheap edition of this book in existence?—GARRISON GUNNER.

[61655.]—**Finishing Size.**—I have a number of gold flats to gild and finish in the best manner possible, but cannot get a good finishing size. Would someone kindly inform me how this size is made, so that I can make my own? I have tried to find out how to make it by experimenting, but have failed.—W. A. T.

[61656.]—**Amalgamating Copper Wire.**—Would one of your correspondents kindly inform me as to the best way of amalgamating the ends of copper wire?—IOTA.

[61657.]—**Hypopus Vulgaris.**—Can any reader kindly inform me what this animal is? Its calcined shell is used for making phosphorescent sulphide of calcium.—PI.

[61658.]—**Dyeing Canoe Sails.**—Can anyone tell me how to dye the cotton sails of my canoe a light golden brown? Details of materials and quantities will greatly oblige—KYAK.

[61659.]—**Spiral Springs.**—I should be glad if I could obtain, through the medium of your valuable paper, some information as to the mode of manufacture of spiral springs for safety valves, &c., and as to the machinery used in making them.—RESSORT.

[61660.]—**Picking Lever Locks.**—What is the method employed in doing this? The lock to be operated on is a well made six-lever one.—J. W. R.

[61661.]—**To S. Bottone.**—I have made a medical coil according to instructions given by you in the "E. M." (my numbers are at binder's) some short time since, and with a quart bichromate can get small shocks when I rub the negative wire against the binding screw; but experience nothing when the wire is under; neither will the hammer vibrate. The shaft is a steel spring, the head of brass. I don't wish to put on the secondary till I know I am safe, although there is no shock when the wire is under the binding-screw. The core is a temporary magnet. Should my connections from the binders on the base to those on the primary head be platinum wire? Bobbins, $4\frac{1}{2}$in. 3in., $\frac{1}{4}$lb. No. 24 dia., $\frac{1}{2}$lb. 36 silk-covered? Am I right?—SAFE.

[61662.]—**Pump for Compressing Air.**—I wish to make a pump for compressing air for experimental purposes. What would be the best style of piston and packing? With a pump of 3in. bore and 6in. stroke, running at 100 per min., would it get seriously heated in pumping, say, 30c.ft. of air to 30 atmospheres?—CYCLOPS.

[61663.]—**Photo. Enlargement.**—Can any reader conversant with photography inform me how I can construct an inexpensive apparatus, or devise any other simple means by which I can enlarge quarter or half-plate photos. direct from negatives on sensitised paper without the aid of the solar camera (the latter being too expensive for an amateur)? I want them enlarged, so that I can paint and fix them in frames about 15in. by 11in. If such an apparatus can be made, I will feel grateful for dimensions, and diagrams, if possible.—D. J. KEEGAN.

[61664.]—**Partial Silvering.**—I require to deposit an ornamental design on a number (500 to 600) of small copper articles (about size of half-a-crown), the design to be in silver (electro-deposited), the copper ground to show through. I can do the silvering, but I cannot find anything suitable for "stopping off." Something like the following might do: printing the article with a "stopping off" substance, using a rubber stamp which would leave the metal bare where the design is required to be deposited. If so, what kind of "stopping off" substance should I use to print with? I could not use a stencil, as the articles are slightly irregular, and it might smear the design.—BETA.

[61665.]—**Portable Engine.**—Can some reader give me some instructions as to putting firebox in portable engine, 8 horse-power, the best way to get old box out and put new one in?—in fact, all particulars will help me. I am afraid the bottom of boiler is thin. How should it be done? If it must have a piece put round bottom, should the bottom be cut off or the piece put on top? Would it be best inside or outside? How done at corners? What thickness should it be? Would $\frac{1}{4}$ be strong enough, or must it be $\frac{3}{8}$? How near rivets to make a strong and neat job? Can stays be broken off, or must they be drilled out? Can rivets be cut off at bottom, or drilled out?—ENGINEMAN.

[61666.]—**Non-conductor Insoluble in Ether.**—Would any of the readers of the "E. M." kindly assist? I want a substance for lining a metal box of small dimensions, temp. at or below freezing point, to be a good non-conductor, and not acted upon by ether. I thought of thin wood or wood pulp faced with vulcanite, so as to have a total thickness of $\frac{1}{8}$in. Can anyone suggest a better plan?—AMATEUR.

[61667.]—**Tempering Tools.**—I propose to temper tools by making them dead hard and letting down in hot oil. Wanted, a list of the various temperatures required.—DANDIE DINMONT.

[61668.]—**Walnut Veneer.**—How do cabinetmakers "fake" the light and bad places in above? What colours do they use, and how are they applied?—DANDIE DINMONT.

[61669.]—**Sharpening Carpenter's Tools.**—I have often thought that a circular Turkey stone running in a lathe would give better results than the ordinary flat one. Can anyone say if this this has ever been tried, and, if so, how the proper shaped stone is obtained?—DANDIE DINMONT.

[61670.]—**Theory.**—Would some of our Honours men tell me what knowledge of electricity, theoretical and practical, is necessary to pass in Honours stage of electric lighting, City and Guilds Exams.? Could a pure theorist pass first-class by reading up, or must he have some practical experience?—ELECTRICAL STUDENT NO. 2.

[61671.]—**To Mr. Conry, Mr. Bottone, &c.**—I have read a covered wire keeps cooler than an uninsulated one if carrying a heavy current. Is this the case, and, if so, why? In the bottom of the old Clarke gas-lighters there is a cavity for a drying agent. Having tried calcic chloride in vain, I would like to know what substance would suit best. Would one of our electrical friends kindly explain the best and readiest means of calibrating a volt and ampère meter. I have made current from about $\frac{1}{2}$ to 15 ampères, and E.M.F. from 1 to 20 volts?—ATOI.

[61672.]—**Electric Lighting.**—Will Mr. Bottone kindly help me in the following? I want to light twenty 20c.p. lamps, parallel arc, and have a $2\frac{1}{2}$H.P. Otto gas-engine. The distance is not great—say 30 yards. What would be best size of dynamo and cables, and what sized sheaves would be best for engine and dynamo? Would you recommend accumulator for this, as lights would be required, say, during winter, four hours a day, and, if so, what size ought they to be?—JANUARY.

[61673.]—**Dynamo.**—Perhaps some of your obliging correspondents would kindly reply to the following: I want to make a dynamo to light up all the house (I can buy a steam-engine cheap). It will require thirty 20c.p. lamps. I want to know what kind would be best to make and the length and diam. of the F.M., size of armature, size and quantity of wire for armature and F.M., with any additional information the obliging gentleman may think necessary. If F.M.'s are rectangular, the breadth and thickness, as well as length, will be required.—WEE SANDY.

[61674.]—**Butterine.**—Although I am for the present residing in an agricultural district where butter is plentiful, I cannot get butter I can eat. I believe I got more than one sample of butter and pig's fat, mixed when the butter was taken off the churn. I want to know how I can prove this to be so. Could the butter be separated from the pig's fat by one who is not up to chemical analysis, or must it be sent to an analyst?—A. B. C.

[61675.]—**Cardiac Affections.**—Will Dr. Allinson, or any other medical authority, explain the symptoms whereby a person may conclude that regurgitation is present in any valvular derangement of the heart? Can regurgitation exist apart from any dropsical condition of the extremities of the body? What are the chief symptoms which indicate the presence of a slight backward flow of blood, which may result in consequence of defective valves? Do cardiac diseases tend to produce aneurism of either veins or arteries? Any information will be received with gratitude.—G. F.

[61676.]—**Pitch Striker.**—Will some kind reader enlighten me on the pitch striker in "Greenwood's" Handbook, as I wish to make one, and do not properly understand its make and action?—YOUNG TURNER.

[61677.]—**Steel Castings.**—Would any of your readers kindly give me particulars of any substance used in the moulding of steel castings to facilitate dressing or fettling the castings?—G. W. T.

[61678.]—**Violin Bow.**—I have made a bow, but want to curve it a little more near the top. How can it be done best? I am told it is done by dry heat. Is that so?—BRUNO.

[61679.]—**Photographs.**—TO R. A. R. BENNETT.—Thanks for your information. I believe I have a real positive, as when held up to the light, light and shade appear in their proper places, as in a print you tell me to take a negative from it "by contact." Would you kindly explain how this is done?—DUSTY MILLION.

[61680.]—**Pendulum.**—Will some one of our readers tell me how many degrees a pendulum, whose length is 23in. and weight 5lb., should swing on each side of zero according to the scale fixed under the bob? I wish to know in order to regulate an electric pendulum which is hung on a knife-edge, and is quite independent of any escapement. A pendulum 36in. long in a regulator seems to swing about 11 deg. on each side of zero. Should a shorter one do the same?—CHRONOS.

[61681.]—**Electrical Measurement.**—What is the direct difference between a "coulomb" and an "ampère," and is the old electrical unit termed, a "veber" exactly equivalent to a "coulomb," or to an "ampère"?—BETTLER.

[61682.]—**Colombmetre.**—What is the exact purpose served by a colombmetre—its construction and usual price?—INVICTA.

[61683.]—**Organ Music.**—Would Mr. Audsley kindly indicate a few pieces of good chamber music with easy pedalling for a novice with classical leanings?—INVICTA.

[61684.]—**Harmonium.**—I shall feel obliged to G. Fryer if he will explain how to make a voix celeste stop without putting the reeds out of tune, as I wish to add that stop to my instrument.—H. E. S.

[61685.]—**Spring of Beam.**—A beam is firmly bedded in two walls for its support. Length of beam, 20ft. A weight of ten tons is placed in the centre of the beam. What springing force will it bring on the walls?—E. T. GEE.

[61686.]—**Tin-plate Creaser.**—Will anyone kindly inform me how to make a small machine for making a crease and smoothing the edge of the tin after the wire has been put in, which will gauge to certain thicknesses and width by means of a screw?—A READER.

[61687.]—**Water Pressure in Towns.**—Will some reader kindly inform me (in a few instances) where water from a high level reservoir works a set of pumps or other contrivance to force water to a higher district?—J. G.

[61688.]—**Condenser.**—Can any reader tell me what size and gauge copper a condenser should be to put outside a small launch? Engines, 3¾in. by 5in., high pressure. Also, how is it connected, and where does the pump draw from?—A. L.

[61689.]—**Dynamo.**—Could any reader inform me whether the coils of a dynamo are liable to fuse when they get hot, as I find they do when all the lights are on? The dynamo in question supplies a mill with about 130 16c.p. lamps. I should also be glad to know long a dynamo ought to last, being in use day and night.—ZANONI.

[61690.]—**To Mr. S. Bottone.**—I have a shocking coil. It is wound with ½lb. of 18 cotton-covered wire for primary and ¾lb. of 32 cotton-covered wire for secondary. It is very weak. Is there any way of improving it, say by rewinding and insulating with paraffin wax?—A. FOX.

[61691.]—**Engine.**—To "T. C., BRISTOL."—I have a cylinder, 5in. stroke, 3in. bore. What weight and size of flywheel should I want for above, and what H.P. would it be? The port-holes in cylinder are ⅜ round. Are they large enough?—YOUNG BEGINNER.

[61692.]—**Electric Lighting.**—Will any of "ours" kindly help me in the following? A and B are two dynamos; C and D two incandescent lamp circuits. It is required to have switches arranged in such a way that machine A can be switched on to circuit C or D, and also the same with B machine; but that no two machines can be on the same circuit at the same time. The ordinary arrangement would be A on C circuit, and B on D circuit; but in case of emergency, I wish to adopt the above. Kindly describe kinds of switches and arrangement to be used.—ELECTRON.

[61693.]—**Water.**—What quantity of water per week is required for two boilers, engine running 62 hours? Cornish boiler, 13ft. 6in. long, 5ft. diam.; inside shell, 13ft. 6in. by 2ft. 9in.; steam chest, 3ft. 3in. by 3ft. 3in. (inside measurements); firegrate, 3ft. 6in. long by 2ft. 8in. wide; height from firebars to inside shell, 1ft. 3in.; vertical boiler, 9ft. 9in. by 5ft. 6in. (inside measurement), two cross tubes, 7in. diam.; height from firebars to crown of inside shell, 5ft.; firegrate, 4ft. 6in., connected together by 3in. pipe, and work a 16 horse-power engine; fires banked at night; 1½in. pipe from said boilers to two steam boiling pans, and heating three hot rooms.—S. S.

[61694.]—**Lucigen Light.**—I should like to see the lucigen light described in "Ours." I believe it is now being used at the works of the new Tower Bridge. Will someone oblige?—H. F.

[61695.]—**Aromatic Burning Ribbon of "Bruges."**—Can anyone say how this is prepared, especially the method of obviating the pungent odour generally attendant on the destructive distillation of cotton or flax? Is it partially guncottonised before the aromatic gum and saltpetre is put on, and if so, by what strength of acid, and for how long?—PHOS.

[61696.]—**Oil Stains in Photographs.**—What is the best way to remove oil stains from photographs?—COOPER'S HILL.

[61697.]—**Violin.**—Will some one tell me how to fill a bow with hair, and also how it is that in some violins the belly near the bridge is much darker than the rest of the violin, and how it is produced?—A. W. F.

[61698.]—**Laundry Blue.**—Can some one say what are the different constituents of the various blues known under the above name? Is anything besides indigo and ultramarine used, and if so, what, how, and by what makers?—PHOS.

[61699.]—**Electro-Plating.**—Will some one please tell me if for electro-plating I connect the vats in series, shall I be likely to obtain better results by having anodes each side of cathode? Also, what copper wire is best to use from the dynamo to brass rods, as the ordinary corrodes so quickly? Any hints as to better mode of placing rods will be acceptable. Also how can I best connect up for small gilding and still have the other baths working, the gilding to be done without suspension rods in the old way?—ELECTRO.

[61700.]—**Nickel Crucibles.**—Are these (see p. 497) to be bought? From what is said, they would be useful. Will they stand fusion of silica to make water-glass? If so, they will save my platinum.—R. S. T.

Progress of Electrical Industries. — A notable instance of the development of electrical industries within recent years is seen in the works of Messrs. King, Mendham, and Co., of Bristol. Year by year the firm have found it necessary to enlarge their premises in Narrow Wine-street and Fairfax-street; but lately they have been compelled to seek additional quarters in another part of the city, Denmark-street, where they have an extensive display of electric and optical apparatus in great variety.

THE annual value of the mineral products of the United States is about 425,000,000 dols., and some 800,000,000 dols. are invested in the mining industry. Mining furnishes employment to 500,000 men. In Montana alone, the newest mining country, 50,000 people are dependent on silver and gold mining. Leadville has produced 114,000,000 dols., and is good for many times that amount. The production of California alone in the aggregate runs far beyond a billion of dollars. Nevada has yielded her hundreds of millions, and all the other States and territories have produced their quota of riches.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 9, and unacknowledged elsewhere:—

A. S. JONES.—S. Ford.—E. E. Hibling.—Cooper Cooper and Co.—J. B. Blew.—J. Harrison.—Sir O. H. P. Scourfield.—G. H. V.—W. H. Kope.—T. E. F.—Glatton.—S.—Bagot.—Volt.—J. M. G. and S.—Slandingo.—Acier.—T. F. S.—G. and S.W. Ry. Fitter.—H. B. Edwards.—J. Fletcher.—H. Watson.—W. R. W.—H. D. B.

ANXIOUS. (No, unless the substance is itself a magnet. Adamant is a name applied to the diamond and also to the loadstone—"You draw me, you hard-hearted adamant, but yet you draw not iron; for my heart is true as steel."—"Midsummer Night's Dream," ii. 2—hence the origin of the statement about adamant and the magnet.)—SLUGGARD. (See No. 725, p. 564, for a simple arrangement for an electric-clock alarum. There are many others in back volumes; but it is really very easy. Procure a clock in which the frame is of metal; fix an insulated contact piece at the hour at which the alarum is desired, and attach metallically a little wire brush to the short hand of the clock. The frame of the clock is then connected to one pole of the battery and the insulated contact piece to the other. When the brush sweeps over the contact piece, the bell, which is in the circuit in some convenient position, will ring as long as the contact lasts. By putting the clock fast or slow, the bell rings at any desired time.)—AMETURE, NO. 1. (Molasses, treacle, syrup, tar, pitch, or any other carbonaceous matter; but it will be necessary to burn them, and when the job is completed they will not be so satisfactory as sound plates. Other methods have been described in back numbers. It is better to break them up and use them in other batteries.)—NOVICE. (The numbers are out of print; but no doubt you could obtain them by inserting an advertisement in the "Wanted" column.)—AMPERE. (If by "electrician" you mean electrical engineer, the only way is by apprenticeship. As you have "studied electricity for a long time," probably you would not find much difficulty in obtaining employment.)—A. ADAMS. (See indices. You do not say whether the clock has a bell or not. 2. Bronzing copper urns has been frequently described. Several methods are given in No. 593, p. 527; but it is special work requiring much practice.)—J. C. C. (What is meant by a "cheap method"? If you cannot refer to back volumes, see Watt's "Electro-Metallurgy.")—HECTOR. (Soak the spot with benzoline, cover with blotting-paper and pass a warm flat iron over, or cover with Fuller's earth and place a warm iron on it.)—ANGULUS. (For a good method of treating incipient baldness, see p. 456, No. 1061, and many recipes in back numbers. You should endeavour to discover the cause.)—H. D. T. (No age mentioned, so it is impossible to say whether your eyesight will improve as you grow older. The probability is that the myopia will remain with you.)—GREENHOUSE. (Ordinary putty is as good as anything; but it is as well to apply paint at the time it is put on. The only radical remedy is to abolish putty or anything like it, and use one of the patented systems of glazing. They are widely used because putty is unsatisfactory here, and we presume it is at least equally so in Darjeeling.)—LIVRE. (Reynolds's "Elementary Chemistry" is published by Longmans in three parts, price 1s. 6d., 2s. 6d., and 3s. 6d. 2. Heather's "Plane Geometry," Crosby Lockwood and Co., 2s.; but see publishers' lists. 3. Depends on what you want. Warren's "Elements of Machine Construction and Drawing," published by E. and F. N. Spon at a guinea and a half, is a good work; but perhaps Unwin's "Elements of Machine Design," Longmans, 8s. 6d., or Maxton's "Manual of Engineering Drawing," Crosby Lockwood and Co., 3s. 6d., would suit.)—S. C. (Laboratory work is absolutely necessary; but see pp. 421, 443, 465, 486, last volume.)—WANTS TO KNOW. (Tallow is a commercial article, and can be bought in the usual way. Do you want to know how to melt fat down into tallow, or what?)—J. L. (Pitch, or cement, or plaster of Paris; but it would be advisable to have the job done properly, even if it does cost as much as a new gutter.)—COMBUSTION, Newcastle. (Such a query should go into the "Addresses" column. If still in existence, no doubt Melhuish and Son, Fetter-lane, keep them.)—A CONSTANT READER. (If executrix is to have interest during her life, it is not easy to see how the principal can be divided. It depends on the terms of the will.)—DRAUGHTSMAN. (You must endeavour to discover the cause. If a medical man cannot, after personal inspection, it is scarcely likely that our correspondents could guess it. Try a change of diet.)—OILS. (Mount your pictures with strong flour paste containing alum.)—DRYPLATE. (See indices. Most users buy them, as they cannot be made cheaply in small quantities.)—STATUE. (To remove rust from marble, see p. 197, No. 1076. To clean from stains, see p. 562, No. 1117, and the indices of back volumes.)—PANDO. (You must say whether you mean lacquer or what. Perhaps it is collodion, and perhaps again glycerine.)—Q. E. (F.S.A. mean Fellow of the Society of Antiquaries.)—R. M. (There is no method of absolutely melting horn and running it into moulds; but it can be softened by immersion in hot water, and then can be pressed into shapes by means of powerful moulding presses. The shaped pieces are joined together by carefully heating the edges over a clear fire, taking care not to handle or grease the surfaces to be joined.)—STEEL. (Perhaps it is rouge, coloured whiting, red ochre, or a dozen other things. You should have a sample analysed.)—GLOVASKI. (A full description, with illustrations of Noble's comb, is given in McLaren's "Spinning Woollen and Worsted" (Cassell). The principle consists in dabbing a lock of wool on two sets of pins placed close together, which are afterwards parted so that a portion of the wool adheres to each. The noil is left behind and is lifted out by knives set between the pins.)—UNEMPLOYED. (Do you mean reflector or refractor, or does the query relate to size? A good 3in. telescope mounted on a firm tripod stand, would do well for street exhibition purposes.)—DUMB. (Only the very finest emery should be used to clean brass. If it is worked brass, clean with a solution of oxalic acid, and polish with whiting and a brush or soft leather. Elbow grease is the principal factor in brass polishing.)—G. TELA. (You will probably find what you want at David Nutt's, in the Strand, or at Williams and Norgate's, in Henrietta-street. At all events, they would be able to tell you whether there are such works as you require. There are good dictionaries of technical terms in German; but it is doubtful whether any general dictionary includes all the words used in scientific books.)—FITTER. (See the "Notes on Plumbing," which appeared in Vols. XXXIV. to XL., and procure the manual issued by Mr. Eldridge, 54, Murray-street, Hoxton, N.)—LADY GARDENER. (That is really a rather large bed. Smaller ones are preferred. As to quantity, put in pieces of the brick about the size of a walnut at every 3in. or so. If the bed is at proper temperature, and the spawn good, the latter will find its way all over it. 2. It cannot be altogether avoided; but much may be done by thorough kneading and having the oven at the proper heat before putting in the bread.)—COLOUR. (There are several preparations of the kind; but we do not remember the addresses. As a rule, they are sent to architects and builders, and probably you would find the material to which you refer advertised in the *Building News*.)—FRUSTRATED. (Rub well with a damp cloth, and restore colour if necessary with an aniline dye. Then rub over with glair—that is white of eggs beaten to a froth, and allowed to fall into a clear liquid.)—J. C. C. (You should always mention the page on which the matter referred to appeared. No. 1010 is in print, and can be had from the publisher for five halfpenny stamps; but you should state what it is you wish to plate, and whether you have battery or dynamo.)—H. K. F. (Which new hot-air engine? We have given illustrations of nearly all, at one time or another. Do you mean the engine illustrated in No. 1099, p. 148, or those which appeared in Nos. 1078, 1084, 1088?)—F. J. B. (If you mean on the construction of the violin, procure Davidson's book from Pitman, Paternoster-row, E.C.; if on the art of playing, obtain Spohr's work from Augener and Co., Newgate-street, E.C.)—COOPER'S HILL. (Only by hunting up the various papers and magazines, or by direct application to the secretaries of the respective companies. 2. We believe a blue-book has been issued, or is about to be, on the subject. 3. No, except that it avoids the fumes.)—F. W. W. (The question has been answered many times. If the present gas-burners are sufficient, you will want the equivalent in incandescent lamps; but the circumstances might render it advisable to have lamps of greater power, and fewer of them. A two-man power gas-engine is, however, too small to do much in the way of electric lighting. See recent replies—one on p. 505, for instance.)—DENTIST. (Read previous answer. To obtain steadiness, as heavy a flywheel as possible is required, and the engine should always have more power than is actually required. A one-man gas-engine would only do for experimental purposes.)—ELECTRO. (The methods of polishing and burnishing silver and other goods have been frequently described; but if you cannot refer to back numbers you will find details in Sprague's "Electricity," or in Watt's "Electro-Deposition." Other question inserted.)—J. (Probably the magnets want remagnetising. How is the line erected?)—R. J. T. (You do not say, but presumably the gold solutions are for plating; but then you do not state how they are made up, nor how used, and answers could be little more than guesses. State the composition of the solution, how long it has been worked, whether the supply of gold has been kept up, and other particulars.)—PRINTER. (Hill and Co., 46, Essex-street, Strand, W.C., will quote prices for either wood or zinc blocks suitable for printing from. 2. The other question has been recently answered. You can purchase old type-metal, or prepare stereo metal by melting together four parts of lead and one part of antimony. See answer to "Stereo" last week, p. 510.)—W. B. H. (No book that is to be relied upon; but many hints, &c., in back volumes. It is advisable to purchase a pan, and it would be cheaper than the American organ of the same size, as the latter requires voiced reeds. The best plan is to hire instruments for a short time.)—COMET. (This query, without a signature, asks rather too much, as it would involve a long search in the library of the Royal Astronomical Society, or a similar institution, and the information, when found, would be of interest to few (if any) besides the querist.)—TCHIPS. (It is easily done without the preliminary motions of raising the hands five times slowly above the head, if the four operators will inhale deep breaths in time with one another, and hold the breath. The man lifted should also inhale and retain his breath; then it is said it can be done with the fingers alone; but even in your case the weight each man lifted was less than 56lb. In the first case—that is, without the preparation—the combined efforts were not made simultaneously.)—OLD FIREWORKS. (Simply a little fulminate of mercury put between two strips of glass-paper, which are separated in opposite directions when the "cracker" is pulled.)

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 18, 1887.

NOTES ON NEBULÆ.—V.

G. C. 600 = M 77 = *h* 262. A.R. = 2h. 35m. Dec. S. 0° 35′. A very bright nebula, diam. about 1′, brightening rather quickly to the middle, where there is an almost star-like nucleus with 150. With 320 less stellar; but the object being low, the definite was not good. The proximity of a star 10 mag., at 2′ *s.f.*, makes a striking object, the nebula being nearly of the same brightness. The star and nebula both give a continuous spectrum with a direct-vision prism. The nucleus seemed to sparkle at times (moonlight), Nov. 17, 1886.

G.C. 544 = H IV. 23 = 223*h*. A.R. = 2h. 20m. Dec. S. 1° 46′. Large and faint at edges, gradually brightening to a condensed patch in centre (perhaps a little *p.* the centre of nebulosity). Only star near is a very faint one, 13 mag., about 3′ *p.*, a little N. (D'Arrest says, "* 14 mag., prec. 12·4s., 70″ *ad boream*), extent of nebulosity about 2′ (moon rising and sky luminous). Power, 150. Nov. 17, 1886.

Apparently resolvable with 150, Nov. 18, 1886.

G.C. 434 = D'Arrest 31. A.R. 1h. 47m. Dec. N., 20° 1′ (near β Arietis). Exceedingly faint, a very small star 13 mag. preceding. This is a most difficult object without the air is *very* clear, as the illumination round the bright star β Arietis 7′ dist. quite masks it. Nov. 18, 1886; power, 150. Exceedingly difficult and faint, only seen as a suspicion, and yet one is almost certain it is there, just *s.f.* a 13 mag. star. Nov. 21, 1886; 150.

G.C. 2360 = H I. 170 = *h* 847. A.R. = 11h. 10m. Dec. N. 59° 33′. A rather bright nucleus (looking at times multiple), surrounded by haze rapidly fading away. About 2′ diameter outside; but object rather low down in hazy sky. Power, 80. With 200, nucleus appeared elongated in meridian; an exceedingly faint star following almost in the coma. Apparently resolvable.

G.C. 2362 = H I. 271 = *h* 848. A.R. 11h. 10m. Dec. N. 58° 45′. Very pale, rather large and diffused, not much condensed (but sky not clear). A small 12 mag. star prec. at 5′ ±. With 200, and clearer sky, much brighter towards centre, and nucleus granulous, looking like an irresolvable cluster. Nov. 21, 1886.

G.C. 2620 H IV. 62 = *h* 1017. A.R. = 11h. 48m. Dec. N. 55° 54′. A curious object, like a faint, double star in a bright haze fading gradually away. Diameter about 2′. Powers, 100 and 200. Nov. 29, 1886.

D'Arrest does not mention the nucleus as being double. He says: "Rotunda, clara, versus meditullium gradatim lucidior; Diametrus = 45″." 1866, Oct. 7. Also on Oct. 16, 1866: "Adspectu omnino cometari; clara, rotunda; diam. = 50″."

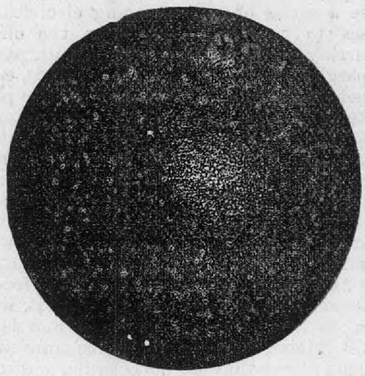
G. C. 2606 H V. 45 = *h* 1011 A.R. 11h. 46m. Dec. N. = 53° 6′. Very cometary, large and diffused, moderately bright, extended N. and S. Brighter to middle, which appeared to consist of several faint stars, almost resolvable — diameter about 3′; 11 mag. star following at 2′ ±; powers 100 and 200. Nov. 29, 1886.

D'Arrest says: "Circa centrum perlucida; grandiuscula propemodum rotunda. Prævia fixa 15 magn.; nebulositate illegate, inter stellulam et neb. centrum 38″ exquisitissime."

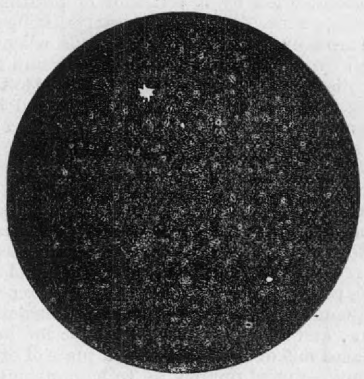
G. C. 1225. H IV. 34 = *h* 365. A.R. = 5h. 34m. Dec. N. 9° 0′. Planetary, small and rather bright, slightly oval, at times looking as if it had a double nucleus 12 mag., but light rather evenly distributed; powers 100 and 200. Nov. 29, 1886.*

G. C. 2413. H I. 194 = *h* 887. A.R. = 11h. 18m. Dec. N. 44° 22′. Large and diluted with low powers—about 2′ diam.; but faint nebulosity extended in a slightly lenticular form, *s.f.* and *n.p.* With higher powers (200), the brighter central part looks like a mass of very small stars unequal in size, giving to the whole a mottled aspect. A very faint double star, 14 mag., precedes at about 3′; and another 14—15 mag. star lies at about 2′ S., almost involved in the nebulosity. D'Arrest does not mention these stars. Dec. 24, 1886. (Sky not very clear.)

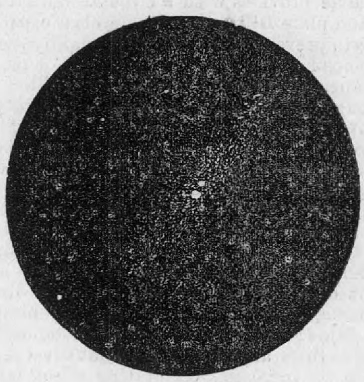
G. C. 2404. H I. 219 = *h* 881. (A.R.



G C 2413



G C 839
(T TAURI)



G C 2668

11h. 17m. Dec. N. 39° 32′.) Pale, rather faint, gradually brighter towards the middle, but no nucleus, apparently resolvable, but not so strikingly so as 2413; and with 200 not so mottled as with 100—about 1′ diam. A 13 mag. star follows at about 2′. Dec. 24, 1886.

G. C. 2227. H I 362 = *h* 773. (A.R. = 10h. 43m. Dec. N. 28° 43′.) This is rather a conspicuous nebula, and although placed by H in his second class, is brighter than 2404; a very faint 14 mag. star a little distance (2′ ±) S. The nebula brightens quickly, and a sharp, bright nucleus = 12 mag. star, almost stellar. Powers 100 and 200. Dec. 24, 1886. (The 14 mag. star is not mentioned by D'Arrest.)

G.C. 2723. H I. 195 = *h* 1088. (A.R. 11h. 59m. Dec. N. 45° 51′.) A curious object, with low powers very bright, but rather small—about 1′ diam.; but with 200 it apears to brighten suddenly to a bright oval nucleus about 8″ × 12″ elongated *s.f.* and *n.p.* The coma surrounding is also drawn out in faint wings in same direction to extent of about 2′. Dec. 24, 1886.

G. C. 2836. H I. 89 = *h* 1171 (A.R. 12h. 11m. Dec. N. 28° 58′. Bright, not very large, about 1′ diam., brightening suddenly to a nucleus which appears elongated and double at times at an angle of 20° ±. The nebulosity appears more on the south side of the nucleus. No star near. Powers 100 and 200. Dec. 24, 1886.

G. C. 2855. H I. 75 = *h* 1186 (A.R. 12h. 13m. Dec. N. 30° 4′). Large, about 2′ diam. Pretty bright and not very condensed, gradually brighter towards the centre, but no nucleus. Power 100. Dec. 24, 1886.

G. C. 2851. H I. 75 = *h* 1185. (A.R. 12h. 12m. Dec. N. 30° 24′). Very pale, large and cometary, very diffused. Elongated on the parallel, about 1′ × 2′. No nucleus, only gradually a little brigher towards the middle. A 13 mag. star about 2′ S., and an excessively faint star in the coma preceding the centre. It is described in the G. Cat. as much brighter to a nucleus, and D'Arrest's observation on May 12, 1864, says: "In centro æquat. fixam 11 mag."

This is worthy of note. The sky was not very clear when the above observation of my own was made; but I could not have missed the 11th mag. star if in centre.* Power 100. At times I seemed to glimpse a very faint nebula just *s.f.* this and nearly between it and 90 H I. Dec. 24, 1886.

G. C. 839 = Auw. N. 20 (A.R. = 4h. 13m. + 9° 12′ Dec.) Hind's variable (?) neb. near T Tauri. Dec. 29, 1886, searched for the nebula. The variable star was about 12 mag. Could not distinctly trace any nebula near it, but saw O. Struve's and D'Arrest's faint nebula prec. it by about 12 seconds. Very faint and difficult, about 40″ diam., but only seen by glimpses with power 200. (The night not very clear, and much trouble with dew on o.g. Air mild, but ground covered with snow.)

January 26, 1887. Again searched for Hind's nebula. I could see no nebula round or near the variable T, which appeared about 12-13 mag., brighter than the faint star, about 60″ north of the 10 mag. star, a short distance *s.p.* I certainly glimpsed D'Arrest's nebula seen on Dec. 29, 1886, as above stated. This with 200. With 320 there seemed to be a number of very small stars glimpsed between the variable and the bright 10 mag. star. However, I carefully examined T, and it was certainly free from any nebulosity.

C. G. 880 = *h* 322. A.R. = 4h. 30m. Dec. S. 3° 35′. Very faint and difficult. A very faint star just north, only seen by glimpses. D'Arrest says: "Debilissima quidem, sed manifesta et indubia." ν Eridani precedes the nebula by 48 sec. The nebula is easier seen with 700 than 100. Jan. 26, 1887.

Very faint and seen by glimpses. Jan. 28, 1887.

G. C. 200. 2668 = H I. 253 = *h* 1050 (A.R. 11h. 54m. Dec. N. 62° 40′).—Pretty bright, elongated in the parallel, gradually brighter to the middle; but the ends lengthened out into a faint ray or wisp on either side, but more so on the following end. The nucleus appears to be a faint double star (sometimes there appear to be more than two points; but apparently arranged in the parallel = 12 mag.) There appears to be an excessively faint star in the nebulosity just N. of the nucleus, and a 13 mag. star a short distance *s.p.* Also one at some distance S. with suspicion of several other faint points in the neighbourhood. Extent of nebulosity

* Secchi's drawing shows a *dark* centre.

* Or nucleus equal thereto, which Dunér seems to infer.

about 2½' long by 30"—40" broad. Examined with powers 100, 200, and 320. Night clear, but definition bad, and much trouble with dew on object glass, Jan. 28, 1887.

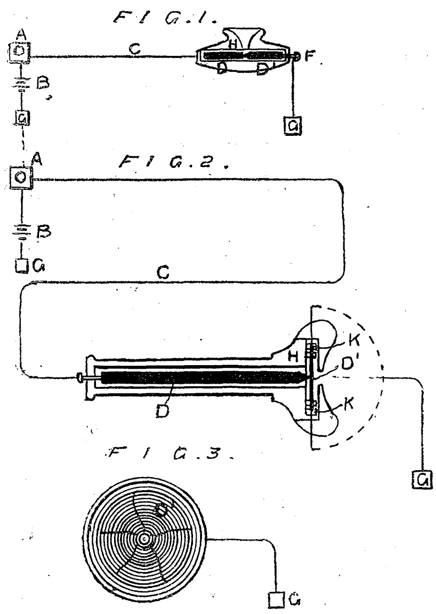
There is a great discrepancy between the description of this object by the two Herschels. H says, "Very bright, very large, elongated," and *h* "pretty bright, 25"; round." D'Arrest's description agrees fairly with my own. It must have been seen by *h* on a bad and hazy night, so that he has missed the faint outlying nebulosity. In the notes to the G. C., Sir John seems to think that the difference in the descriptions are extraordinary, and so I thought till I saw the object, the character of which will quite be altered on a clear or hazy night.

Herbert Ingall.

THE KROTOPHONE.

WE have already at p. 22 ante given a brief account of the Krotophone, an apparatus for reproducing articulate sounds, and now give details with illustrations of the apparatus as patented by the inventor, Mr. E. S. Spaulding, of New York, in this country. The novelty of the invention lies in the method of reproducing the human voice through the medium of crepitations, or minute crackling sounds or detonations, and it particularly consists in causing the original disturbances in the transmitter to be transmitted over the line so as to affect the receiver and cause it to give forth a series of crepitations or intermediate detonating sounds which will have the same articulate value as the original sounds, whereby the human voice will be transmitted electrically from one point to another without the use of magnets, diaphragms, helices, secondary currents or induction coils, or any vibrating or sonorous material whatever in the circuit, thus dispensing with the complicated parts, and the various objections to which transmitters and receivers are liable and subject.

Fig. 1 is a plan of the apparatus employed to



carry out this method of transmitting sound. Fig. 2 is a similar view showing a modification of the form of a receiver, and Fig. 3 represents the circumferential connection of one of the carbon contact points. A is an ordinary transmitter, B the battery, C the line, and G G the grounds or earth plates. H illustrates the simplest form of the receiver or Krotophone in which D D¹ are the carbon points which form part of the circuit or line C, one of the points, D, being rigidly secured in the receiver H, and the other point, D¹, being secured therein adjustably with reference to the other point by means of the screws F. The receiver H containing the carbon pencil points D D¹, and adjusting screw F constitute the complete receiver.

The transmitter A may be in one of the various forms of "microphones," or, in fact, any instrument may be used in which the sound or voice produces a series of crepitations in the circuit, which being transmitted over the line are reproduced in their identical quality between the carbon points in the receiver, which reproduction will have the same relation to the original sound as the original sound or voice had to the crepitations in the first instance.

For the sake of illustration, assume that the circuit consists of a battery, line, and the receiver shown in Fig. 1 to be used as a transmitter and as a receiver proper. Assuming that the current passes through the carbon pencils in parallel lines, any disturbance of the point of contact of these pencils in the transmitter will produce a series of crepitations, which cause a series of corresponding electrical impulses to be transmitted over the circuit. Referring to the receiver, this circuit, passing in parallel lines through the pencil D, causes its points of contact with the opposite pencil D¹ to vary by reason of the elongation and contraction of said pencil D, due, for want of a better term, to the polarisation of the molecules or atoms of the pencil. Now assuming that through the pencil the current passes in a series of many parallel lines, then the movement of the atoms in each of these lines would be uniformly similar and in parallel lines, and thus the disturbances created in the receiver correspond to the impulses affecting it, which impulses in turn correspond with and depend on the primal disturbances in the transmitter. It being shown that the polarisation or disturbance of the atoms in the pencil D in the receiver is produced, it has been noticed that this result is accompanied by a series of crepitations or crackling sounds, which are clearly distinguishable from even the faintest sounds when produced by vibrations or other cause, and from this distinction the patentee infers that the crepitations are strictly "neutral," and he so denominates them. Therefore, as such crepitations are individually neutral, when they are arranged in constantly varying groups, corresponding exactly to the primal disturbances which cause them, if articulate sounds be the primal cause of the disturbances in the transmitter, articulate sounds will be the effect in the receiver. Mr. Spaulding has found that when two pencils of carbon are used as a receiver, the sounds will be audible and distinct, but faint; and to overcome this objection he has replaced one of the pencils by a plate of carbon of such size and quality as to be non-sonorous and non-vibratory, as shown in Fig. 2. This plate he provides with a circumferential ring, K, and plate D¹ has a suitable elastic packing ring to prevent fractures when rigidly secured in place in holder H. In this form of receiver the current passing as before in parallel lines through the pencil D and thence to the plate D¹ over the point of contact of the pencil, the current then radially diverges in every direction towards the metallic ring and thence to the ground as before. This construction gives an amplified sound, and this result is attributed to the radial or diverging path the current takes. In the first form of receiver described, the current passes in parallel lines and the movement of the atoms on each of these lines is uniform, and, consequently, the crepitations are faint; but in the second instance these several lines are not parallel, but diverge, and hence an increased crepitating effect is produced.

The patentee does not claim the transmitter, as the whole invention consists in the method of reproducing the voice through the medium of the receiving device, and from this it is clear that any form of carbon transmitter may be used in connection with the receiver.

So far as Mr. Spaulding is aware, prior inventors have employed some means substantially different from his; for example, in the well-known experiments of Prof. Hughes, the microphone requires a free pencil, and the effect seems to depend on the vibratory effort of the voice or other disturbing cause on the pencil, causing it to move bodily and vary the amount or number of contact points, while those of Bulmer show and claim a diaphragm, and Cook employs a vibrating metallic diaphragm, all of which Mr. Spaulding distinctly disclaims.

A NEW DRAUGHT EXCLUDER.

A NEW draught excluder for doors and windows has just been patented by Mr. T. J. Porter, of Fleetwood, which is certainly novel in its character, and has the decided advantage of being a permanent as well as a perfect preventer of draughts. If we may judge from the excellent testimonials of several well-known architects before us, and the local success which this draught preventer has so far met with, it is the best thing of its kind which has yet been introduced, and bids fair to find a very general adoption, not only as a remedy for existing leaky doors, but in making perfect and draught-proof doors and windows in new houses as they are erected, for which purpose it is peculiarly adapted, giving a neat and cosy finish round the doors, and being most suitable to be glued to door casings before they are painted. This excluder is styled the "Matrix" from the fact that it forms, when fixed, a solid and permanent cloth-lined bed round door casings, on which the doors rest when closed, and the exact counterpart of that portion of the door against which it comes in contact, allowing the door to close and latch solidly, tightly, and firmly without any pressure on spring, and forming a perfect draught and dust proof joint. The excluder consists of a composition in a long narrow strip of warm-coloured cloth, which, when shaped, forms a round bead about ⅜in. diameter, with a flat lip about ⅜in. wide extending from it along its whole length. The excluder is made in 7ft. lengths, each being rolled into a coil. In fixing, a coil is dipped slightly into hot water, which immediately softens the composition, and the lip is then glued or tacked on to the door casing, the bead part being allowed to touch the door when closed. Where the excluder has been firmly attached to the casing, the bead is pressed with the finger firmly against the door and into the corner formed by the door and casing. Being pressed thus along its whole length from top to bottom of the door, a long, narrow, and perfect matrix, counterpart, or shape, about ¼in. wide., of the door is formed, fitting all unevennesses and making a permanent and perfect bed for the door, and a tight joint, effectually preventing the passage of draught or dust. After fixing, the excluder should be left untouched for a few hours, to permit of its setting, and in a day or so it will be quite hard, and form a solid part of the now perfectly-fitting door casing. The excluder is fitted to windows in the same way as to doors, and should it be damaged at any time by a blow the injury can be repaired in a few minutes without unfixing, by softening the part with hot water, and re-moulding it by pressing against the door, as in the first instance.

CELLULOID.

THE recommendation of a committee of the Franklin Institute that an Elliot Cresson gold medal should be awarded to the Celluloid Manufacturing Company will draw renewed attention to a material which, in the words of the committee, is of great possible value, and has been successfully utilised in many important industries. Celluloid has been known and utilised under a variety of names for many years; but as celluloid *per se* it dates from the patent issued to Hyatt Brothers in 1870. The material in its earliest form was first prepared in England by Alexander Parkes about 1855, and from him received the name Parkesine, a subsequent modification being known as xylonite, a material which has been made and sold for years by a company located in Homerton. Parkes prepared nitro-cellulose, or pyroxiline, by treating a pure cellulose with nitric and sulphuric acids, and then dissolving in some such liquid as naphtha (of both kinds), nitro-benzol, or glacial acetic acid. The pyroxiline was then precipitated as a curdy mass, which was moulded and dried. Later he adopted the use of an alcoholic solution of camphor as the solvent, and since then we believe camphor has always been used in the preparation; but the Hyatt Brothers, after considerable experimenting, discovered that melted camphor was a perfect solvent for pyroxiline, and enabled masses to be produced which were thoroughly homogeneous and plastic—all of which will be found set forth in detail in our

earlier volumes. In 1874 the American patent was re-issued, and the manufacture of celluloid in the improved form has been carried on by the company above-named at Newark, New Jersey. At the late "Novelties" Exhibition of the Franklin Institute, the fine display made by the Celluloid Company induced the judges to award them a silver medal, and to call the attention of the Institute to the "introduction of a new raw material of great possible value," which has resulted as mentioned above. In the modern process of manufacturing celluloid a pure form of cellulose is the raw material, and this is preferably a tissue paper specially prepared in large rolls. After "nitration," a thorough washing, and partial drying, it is mixed with a certain proportion of camphor, and the mixture is ground in suitable machines, moistened with alcohol to make it "pasty," and to allow it to be worked at a comparatively low temperature, and is then submitted to a heavy hydraulic pressure for some time. If a colouring pigment is desired, it is usually introduced before pressing the mixture into blocks. The blocks so obtained are broken up, and known as "stock," which is fed between heated rolls and turned out as finished celluloid in sheets, which may be made transparent, translucent, dead white, or coloured with a variety of pigments either in self-tints or stratified and veined in imitation of natural products. Amongst the earliest applications of celluloid was its use as a substitute for ivory in all the manifold purposes to which this beautiful material is employed in the manufacturing industries; and notable amongst them are the keyboards of musical instruments, such as pianos, organs, and harmoniums, handles of pocket-knives and cutlery, combs, brush-backs, and mirror-frames. For the manufacture of billiard-balls it is said to be preferred to ivory, as the spheres can be made of absolutely uniform density throughout, while they can be coloured or made dead white. Celluloid has the advantage over ivory that it does not crack or "craze," is said not to become yellow with age (though it is scarcely old enough to determine that point), and is superior to amber and other more or less valuable materials, because it can withstand a sharp blow or a fall. Celluloid, too, from its ability to withstand the "weather" and frequent washing, is coming into use for many other purposes, and is surely supplanting ebonite, or vulcanite, whenever it is required to bring metal into contact with it, as sulphur is entirely absent from its composition. The latest application—a promising one, too—is the use of celluloid for casting stereotype plates for printing. These plates have already met with a favourable reception in the United States, as they are light and elastic, take ink freely, and yield a clear impression, while they do not "batter" readily like metal, and can be sent through the post or by train with the minimum of packing. For colour-printing celluloid surfaces give excellent results, for the material is not affected by the pigments, as copper electrotypes are, for instance, by vermilions, nor by the lye, benzoline, or water used to cleanse them, while the time occupied in casting and mounting them does not exceed that now required for producing a plate in stereo metal. For some time the applications of celluloid, although very various, have been confined to uses in which positive advantage could be shown over the material displaced: it is not unlikely that its comparative cheapness and the facility with which it can be worked will conduce to a still more widely-extended use of this very valuable product, many of the applications of which are set forth in Vol. XXIX., p. 154.

AMATEUR ENLARGING ON A SMALL SCALE.*

By J. TRAILL TAYLOR.

THE problem of a simple and easy mode of enlarging for amateurs, as regards the lighting department of the operation, is still open to receive more attention.

I am the fortunate possessor of several oil lamps, whose fine Greek names do not sufficiently counterbalance the trouble in trimming the wicks (which in some instances are many), the great heat, and the unpleasant smell. Could an enlarging lantern be lighted with common gas, then, indeed, would all troubles cease; but carburetted hydrogen gas, as supplied from the company's mains, is frequently deficient in illuminating qualities in a lamentable degree.

It is, however, well known to all of us that house gas may have its luminousness greatly intensified by mixing with it the vapour of some one or other of the numerous hydrocarbons. This subject has been brought before the world at various intervals during thirty years or more, and a greater or less degree of success has attended individual instances of the application. It is this system of illumination which I have thought might fittingly be impressed into the service of the photographer who, without having the mess with charred wicks and oil every time he wishes a light, might desire his appliances reduced to a gas-burner, and the whole preparation reduced to connecting a rubber pipe with the nearest gas bracket.

Of the various systems employed for more thoroughly carburetting gas, that which I bring before your notice is one of the Albo-carbon *genus*. I purchased it at one of our London shops for 8s. 6d., and having had it in use for some time can speak of it very favourably. Its principle consists in a piece of metal being placed above the gas flame, and which, thus becoming heated, conducts the heat to a chamber behind, which contains a hydrocarbon that vapourises at a temperature of 150 or more.

The arrangement is such that either the gas in its primitive state, or after it has been enriched to saturation may be emitted at the jet, and, without having had recourse to photometry to determine the advantage, it appears to me that the intensity of the light is increased fourfold.

But in order still further to obtain the highest advantages offered by the system, I have had this modified burner constructed in which two flames are employed, one being about an inch behind the other, with an air space between. This is essential to success in obtaining the best effect.

[The speaker then exhibited and explained the construction of the gas-burner to which referenee had been made. By means of a socket which had a thread similar to any ordinary gas-burner, this one could be lifted in or out of the enlarging lantern immediately, and by previously warming the reservoir, so as to initiate the vaporisation of the "albo-carbon" inside the light, assumed its energy in half a minute after being ignited. He spoke of the disadvantage of dimensions in the flames; magnitude, he said, was not compatible with the highest definition. Hence, having first secured the required brilliance, he interposed a screen or diaphragm between the lantern condensers and the flame, and as close as possible to the latter. The aperture in the diaphragm was circular, and it varied from ½in. to 1in. in diameter, the smaller one giving greater sharpness to the enlargement than the other. The position of the diaphragm was such as to hide all the light save a very bright portion selected from the most luminous part of the flame. He found it also advantageous to insert immediately in front of the diaphragm a small plano-convex lens, which prevented some loss of light by concentrating it upon the lantern condensers, at the same time that it permitted the light to be brought a little closer to them.

* A paper read at the Photographic Conference. From the *British Journal of Photography*.

HOW TO INSPECT A WATCH.

IN adjusting a cylinder watch we should first attend to the case and the parts intimately connected therewith, for the case-snap, and the fastening at the pendant may be defective. If the snap moves too hard, as is generally the case, this defect is to be corrected, when the movement has been taken out, with a small mallet, the blows of which are directed upon the bottom bezel near the joints. When the bottom is being opened, it will often be seen that the winding-post and hand-square, as well as the cups, project. They should be level with the dust-cap, because a pressure from the bottom of the case on these parts might cause the watch to stop, or, at least, make the rate irregular. Since these defects cannot all be corrected at once, it is advisable to note them upon a slip of paper, or impress them upon the memory, that they may be corrected in regular order as each part is taken in hand. Next open the dust-cap to see whether the barrel and balance have free shake in the case, and whether the closing of the dust-cap is interfered with by a bridge or screw, a condition which is easily ascertained by putting a little rouge on the suspected parts, and then closing the cover. When opening the crystal bezel we must observe the position of the hands to each other. It is necessary sometimes to raise or lower the hour-hand; the centre-staff must not touch the crystal. When defects of this kind cannot be corrected at once, they are either to be borne in mind or noted upon paper, as already advised, so they will not be forgotten. When the dial has been taken off, observe whether anything stands higher than the plate. The screws, barrel-arbor, and stop-work of low-grade watches are invariably higher than they should be, and the touching on the dial of the movable parts, such as the minute-pinion and stop-work, often causes the watch to stop. The pressure of the screw-heads, screw-ends, and barrel-arbor against the dial is apt to cause it to break.

The movement is now to be taken out of the case, and the case-snap set in order if it is found defective. Before we take down the movement a general inspection should be made. Various questions present themselves to the adjuster. How do the barrel and balance stand to the centre-wheel? Has the balance-spring free shake? Does the fourth pinion as well as its arbor approach very close to the balance? These questions can all be answered by this inspection, which will save much time if it is thoroughly done. We have now progressed sufficiently far to take down the movement and commence the actual work. The order in which the parts are examined and treated varies much among workmen. The majority begin with the train, then put in the escapement, and end with the barrel and its parts. This method is good enough; but it would be incorrect to commence with the escapement, because both the centre and 'scape wheels frequently stand out of truth, and exert a harmful influence on the position of the cylinder and the balance. I am accustomed to work according to the following method, which I think the best, although I am sometimes compelled to adopt the former. The labour required to bush and upright the centre-wheel and barrel being about the same, I take these one after the other; next I proceed to the small wheel-work, leaving the escapement until the last.

After all the parts, up to the centre-wheel, have been taken down, see whether the latter stands truly upright to the plate. In most cheap watches it does not, and is a great defect, because if not thoroughly corrected, it may cause trouble, even when the watch is about to be delivered as "ready." The hands will barely move with sufficient freedom, especially if the watch has a second-hand. The hole in the plate is frequently taken as the standard, and the whole in the bridge centred by it. This is not correct, because it invites a new error. It is certainly advisable, before commencing the bushing, to satisfy yourself of the condition of the barrel depthing, which can, at this time, be corrected with ease, and be placed deeper or shallower, as may be necessary, although the dial-hole must never be left entirely out of view. We now know what hole is to be centred in favour of the barrel depthing. The wheel is then taken down, and the quality of the pinion examined—that is, care is taken to see whether, when placed upon a tapering-tuning arbor, it will run true, whether the pinion leaves have the correct shape, whether they are too thick, and in what condition the pivots and shoulders are. These pivots, which are subject to a strong friction, must be treated with care. Pivots without polish are ruined in a short time, and spoil both the jewel holes and the oil. A composition file and rouge, or a depthing tool specially prepared for this purpose, will give them the desired polish. Having ended our labour of inspecting and taking down, we can now apply correctives to the parts requiring them.

G. Voget (in *Jewellers' Weekly*).

GUMS AND PASTES FOR LABELS.

IT is usually found that the addition of acetic or nitric acid to gums, glues, or pastes will make an efficient adhesive for almost any purpose; but the following notes by Mr. L. Eliel, read before the American Pharmaceutical Association, may be useful. Mr. Eliel says:—The formulas here presented are not original with the writer, but have been in use by him for many years with entire satisfaction. 1. Gum tragacanth, 1 ounce; gum arabic, 4 ounces. Dissolve in water, 1 pint; strain and add thymol, 14 grains, suspended in glycerine 4 ounces; finally add water to make 2 pints. This makes a thin paste suitable for labelling bottles, or wooden or tin boxes, or any other purpose which paste is ordinarily called for. It makes a good excipient for pill masses, and does nicely for emulsions. The very small percentage of thymol present is not of any consequence. This paste will keep sweet indefinitely, the thymol preventing fermentation. It will separate on standing, but a single shake will mix it sufficiently for use.

2. Rye flour, 4 ounces; powdered acacia, ½ ounce. Rub to a smooth paste with 8 ounces of cold water, strain through a cheese cloth, and pour into one pint of cold water. Continue the heat until thickened to suit. When nearly cold add glycerine, 1 ounce; oil of cloves, 20 drops. This is suitable for tin or wooden boxes or bottles, and keeps sweet for a long time.

3. Rye flour, 4 ounces; water, 1 pint; nitric acid, 1 drachm; carbolic acid, 10 minims; oil of cloves, 10 minims; glycerine, 1 ounce. Mix the flour with the water, strain through a cheese cloth, and

add nitric acid. Apply heat until thickened to suit, and add other ingredients when cooling. This is suitable for bottles, tin or wooden boxes, and will not spoil.

4. Dextrine, 8 parts; acetic acid, 2 parts; alcohol, 2 parts; water, 10 parts. Mix dextrine, water, and acetic acid to a smooth paste, then add the alcohol. This makes a thin paste, and is well suited for labelling bottles and wooden boxes, but is not suitable for tin boxes.

NOTES ON THE PROCESS OF POLISHING AND FIGURING 18in. GLASS SPECULA BY HAND, AND EXPERIMENTS WITH FLAT SURFACES.*

BY H. F. MADSEN.

(*Concluded from page* 516.)

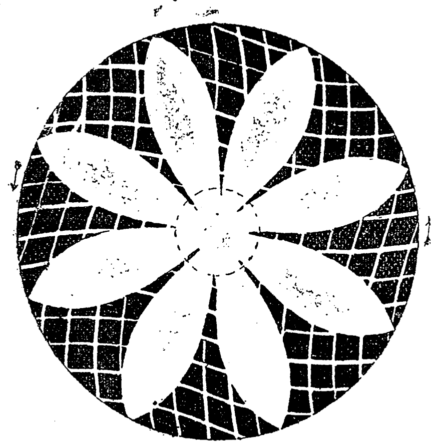
FIGURES 4, 5, and 6 represent the corresponding figuring forms of the polisher; by increasing or diminishing the acting part of these surfaces the time required can be altered. Of course the same object may be obtained by reducing the squares, as long as the given proportion is maintained.

Pitch being a yielding (non-elastic) substance, might be expected not to act similarly to a rigid surface; but still I have found Nos. 1 and 2 to give the desired result. No. 3 does not seem to answer with the weight of the glass over the polisher. (See p. 515).

The form with which the present glass was figured was No. 2.

Both polisher and glass having been regularly raised in temperature, were left together (the glass having been now and then slightly moved round its

Fig: 4.



axis) until cool, after which the usual stroke for keeping the spherical form was proceeded with for about ten minutes, when the correction was found sufficient.

In another case, No. 1 form was used upon a similar mirror, but with only 10ft. 4in. focus requiring abrasion at the edge exceeding $\frac{1}{20000}$in.

Knowing that theoretically a curve of revolution could not coincide with the polisher, except when the axis of both were in one line, this position was maintained and the glass simply revolved. By this motion rings were expected to appear, but such was not the case, and in less than ten minutes an over-corrected but true surface was the result.

The greatest inconvenience in this method is, that should the mirror become over-corrected, or a hyperboloid, the polisher must be remodelled before the spherical form can be restored. A perfectly even temperature must exist, and the polishing powder be evenly distributed, with uniform contact at every point between the two surfaces before the correction or figuring can be satisfactorily proceeded with.

Supposing, then, that in this way a regular curve receding from the sphere through the ellipsoid towards the hyperboloid has been obtained, it will next be necessary to judge the exact time when the paraboloid has been developed, and to do this nothing is so satisfactory as the artificial star, or minute pinhole test at the centre of curvature, first invented by M. Foucault. For use in this test the fourth and fifth columns of the above table have been calculated, but it was shown that in mirrors in which the length of focus exceeded twenty times their diameter, no correction from the spherical form was required, and that the amount such correction would increase in the ratio $\frac{1}{8r^3}$ (y constant), from which it would seem that this form of specula would be the easiest to make perfect.

Such is, however, not the case except within certain limits.

The rate of decrease in the amount of correction required is very rapid with the increase of radius of curvature; but the injurious effect from almost infinitesimal irregularities increases in a still higher degree, and it seems to me that even supposing that a theoretically perfect speculum could be obtained with from 20ft. to 40ft. focus, the slightest touch or variation in temperature would be sufficient to destroy its good definition

Fig: 5

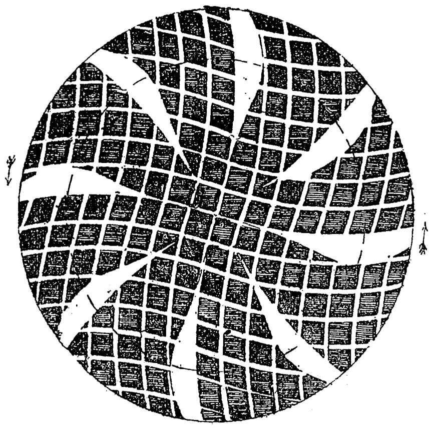


Fig: 6.

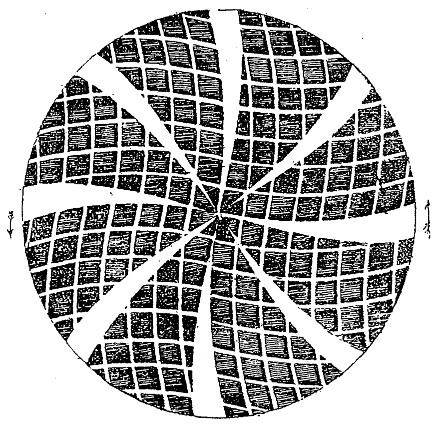
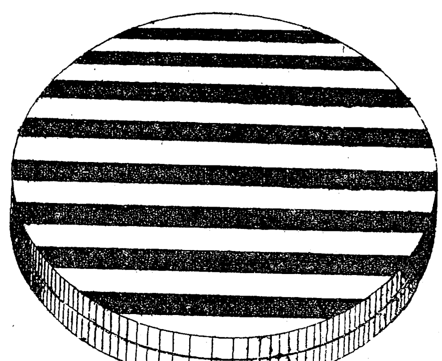


Fig 7



An equal film of air or perfectly flat surfaces.

under a high magnifying power, irrespective of the disturbing effect of the atmosphere.

By decreasing the focal length the rays cross at a less acute angle, and small variations in the reflecting surface have not so detrimental an effect. The correction required increases; but that does not seem to be of much consequence, so long as the proportion is not less than six to one in glasses from 10in. to 20in. diameter, as it only requires longer work in the same direction.

Such are a few of my observations during my working of these specula, and considering their weight and the care necessary to avoid the slightest inequality in temperature by handling, &c., I almost think they are the largest size that can be produced by hand; but under the same process with suitable machinery I have no doubt that much larger surfaces can be satisfactorily produced under the condition that their focal length be not allowed to exceed 20ft., or at most 30ft., which in the Newtonian construction (if required), may be lengthened by the introduction of a concave achromatic or Barlow lens.

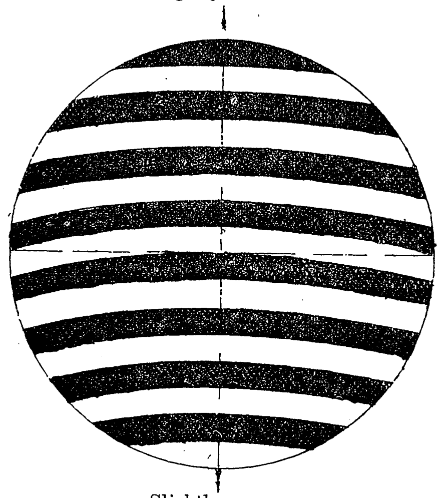
In regard to silvering the mirror, very little need be said: the process is now so well known (Brashear's method), that by ordinary attention to cleansing the mirror, equality in temperature and pureness of chemicals used, success is inevitable. (See ENGLISH MECHANIC, 11th June, 1880, p. 327.) A nearly opaque film of silver can be obtained, which, by a few minutes' polishing, becomes an almost perfect reflecting surface; but unless this can be proved to be extremely thin and perfectly even, serious injury may be occasioned to the efficacy of the reflector.

Some two or three years ago my attention was drawn to this subject by an unusually thick coating of silver applied to one of my mirrors. The definition seemed to be impaired, and the rays from bright stars to become more troublesome after silvering than before. This, it appears, was caused by the greater amount of light reflected from silver than glass; but, to prove that no change in figure had taken place, I determined to measure its thickness. The late Dr. Draper, in his work on the telescope, says: "The thickness of the silver film after polishing is about $\frac{1}{200000}$in., and variations in that amount cannot therefore cause any optical defect in the telescope.*

His results were obtained by measuring the quantity of silver deposited over a large surplus, but my intention was to compare its thickness with

FIG. 8.

Slightly convex.



Slightly concave.

the length of a wave of light. To do this I required two perfectly flat surfaces. After long and patient work, I succeeded in producing three such surfaces 5in. diameter, which by the colour test, so admirably described by Mr. Brashear in a paper read before the Engineers' Society of Western Pennsylvania, produced at an angle of incidence of 65° one uniform colour gradually changing by other inclinations, and showed by monochromatic light straight, dark, and coloured bands (Fig. 7.)

Several precautions must, however, be taken in using this test. An even temperature is absolutely necessary. The angle of observation should not be greater than 70° with the normal, but better much less, and the glasses must be as perfectly clean as possible.

These precautions refer more particularly to compound solar light. When monochromatic light is used, the test may not be so delicate, but is certainly of much more practical use, and as will be demonstrated corrrect to less than $\frac{1}{200000}$in.

When one end of the glasses is pressed, or when impurities prevent them from being exactly the same distance apart, the deviation from theoretical flatness can be judged and rigidly calculated by measuring the curve, or bends, in the bands in comparison with the distance between them, which should be as large as possible, say, from ½in. to ¾in. (Fig. 8).

For, let A (Fig. 9) represent two glasses 5in. diameter placed together and illuminated by a homogeneous yellow light (wave length = λ =

* A paper read before the Royal Society of N.S.W., July 7, 1886.

* This has lately been doubted by one of the leading opticians in a letter to the ENGLISH MECHANIC; and in the last number of that paper it has been giveen by one writer as 1-200th of an inch, perhaps (?) a misprint, 4/6/86.

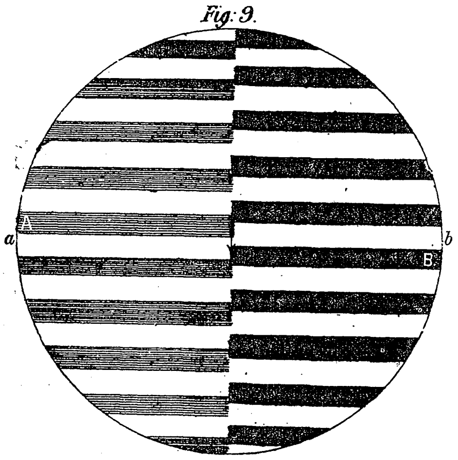
$\frac{1}{44000}$) at an angle of incidence ϕ of 30°, then from optics it is known that the dark bands appear whenever the thickness of the film of air δ is $= \frac{n}{2} \lambda$ sec. ϕ and the bright ones at $\delta = \frac{2n-1}{4} \lambda$ sec. ϕ, and that consequently the deviation in thickness between two dark bands is expressed by $x = \frac{\lambda}{2}$ sec. ϕ, so, if thus a curve in the middle band were by measurement found to be $\frac{x}{2}$ the deviation from flatness in one or both of the glasses would be $\frac{\lambda}{4}$ sec. ϕ = 0·0000065; and, as even a much smaller displacement might be observed and measured, defects of less than $\frac{1}{300000}$in. can be seen. Having thus obtained my measuring scales, my silver film was estimated in a similar manner to the above.

An ordinary film of silver once repeated was deposited upon one of the glasses, and a part of it afterwards removed by strong nitric acid. When the bands were next examined at an angle of 30° they were found to be broken or displaced at the edge of the silver, a distance about $\frac{2}{5} x$ (x = to distance between two succeeding bands).

The thickness of the silver δ would be thus expressed by $\frac{\lambda}{5}$ sec. 30 = 0·00000525, a quantity nearly agreeing with that given by Dr. Draper. Several similar measurements of single silvering or films gave results less than $\frac{1}{300000}$in.

The experiment was repeated with similar results, but on account of the excess of light reflected from the silver, part of which can only interfere with that reflected from the lower surface of the glass, the bands were difficult to be observed.

Fig. 9.



a, silver; b, glass.

The above expression might have to be added to any number of half wave-lengths $\frac{\lambda}{2}$ sec. ϕ, but that such was not the case was proved by using compound solar light.

By repeated silvering, or by using a stronger solution, the film might be considerably augmented; yet it may be concluded that by ordinary care in the polishing no optical change will be produced in the reflecting surface.

To ascertain the exact effect produced by heat and pressure upon these glasses, I placed them as before upon a wooden chuck, 2in. diameter, and observed a uniform colour at 65°.

I then placed my finger, touching without pressure, upon the centre of the top glass, and watched the effect. Almost instantaneously the colour changed to regular concentric rings continually diminishing in size but increasing in number by additional heat.

By lowering the point of sight these rings (Fig. 10) travelled towards the centre, proving the glass to have become concave, and that by a measurable quantity. At first glance, this augmentation in the film of air immediately below the point to which heat was applied might be thought to have been caused by its excessive expansion in comparison with glass. This is, however, not the case; the glasses were unconstrained, and if one part of the air between them expanded, it would only be the cause of lifting the glass equally throughout.

When the heat was removed to any other part above the top glass the same effect was produced, the lower surface becoming hollow at that point; but when the heat was placed in closer contact with the other surface, as at one end of a diameter, or at the edge, B (Fig. 10), the very opposite was the result; both glasses expanding approached nearer and nearer to each other until no light was reflected.

From this it appears that, when heat is applied at the central part of one side of a round piece of glass, the other side contracts and becomes hollow in a regular curve from edge to centre, and that such an effect will continue for some length of time, it having been observed to do so in this experiment during 10m. or more.*

It may also be noticed that when the source of

Fig 10

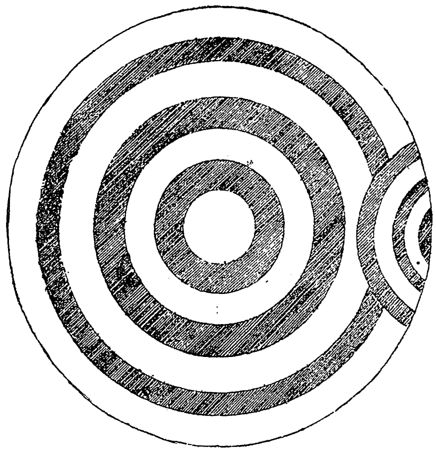

Concave (by heat).

Fig 11

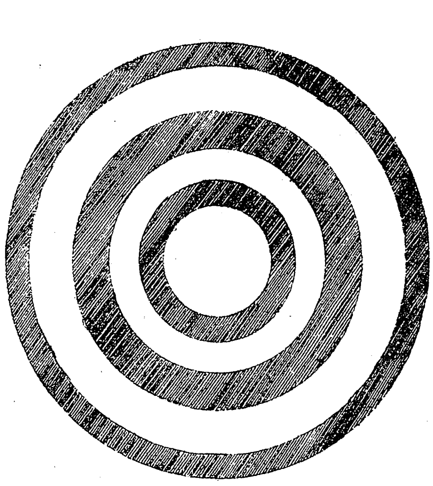
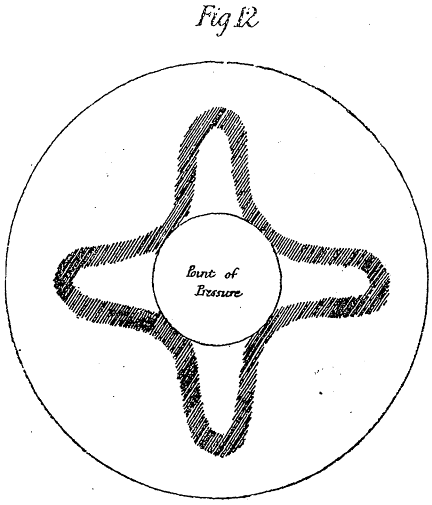

Convex (by cold).

Fig 12



Pressure.

heat was removed it only occupied 2m. for the glass to return to its normal state, and that the thickness of the glass was $\frac{3}{8}$in.

* This result is what ought to take place. Heat applied at one side of the glass causes the molecules near the point of contact to expand; but it cannot pass through so bad a conductor, and consequently those in the lower side are pressed together, and the glass becomes hollow.

The glasses were next removed from the wooden support to an iron one of the same shape, and although this had been kept in the same room, yet the chill from the iron was enough in less than 1m. to produce convexity in the middle surfaces to the extent of $\frac{1}{30000}$in., but also in a regular curve (Fig. 11). A pressure of 8lb. was next applied to the same central part of the glasses, when the colour began to change, but in a different manner to that produced by heat.

Two wide bands of colour (Fig. 12),* appeared, reaching nearly to the edge of the glasses, and crossed in the middle, showing that they had become strained in two directions, and their figure completely destroyed.

This shows that although pressure has to be avoided, yet the regularity in temperature is the most important factor in the production of the true glass surfaces, and that in finished specula (particularly with long foci) a very small inequality in the temperature of their sides will produce serious defects in their defining power. It also shows that a material of small heat-conducting power would be the most desirable for the mirror to rest upon.

In conclusion, noting the regular contraction of the lower surface towards its centre, it has occurred to me that it might be possible to employ heat as an agent in the figuring of mirrors, but I have not yet tried the effect.

Since this paper was transmitted to the Society I have received the last monthly number of the ENGLISH MECHANIC, in which I wish to draw attention to two articles. One, let. 25,603 (p. 148, Vol. XLIII.), by Mr. Brashear, in which the writer expresses the same opinion as I have, in regard to the practical superiority of employing a monochromatic source of light in the testing of flat surfaces; and another, let. 25,499 (p. 80, Vol. XLIII.) by Mr. Wassell (author of a long series of valuable papers on Glass Specula), in which my conclusion as to the thickness of the silver film seems to be doubted, and is sought to be disproved.

He says: "The fact that a thick film will receive a scratch that becomes visible by reflecting light from its sides, proves that the silver film is thick enough to perceptibly allow a deviation from the figure of the surface below."

I do not maintain that variations even in the thickness of the film, as deducted by me, cannot, by polishing, be carried so far as to cause perceptible alteration in the figure of the speculum; in fact, that such can take place will at once be apparent by examination of the table for corrections as given in this paper; but, as to the visibility of the scratches proving anything in regard to the thickness of substance in which they appear, seems doubtful. Supposing the least particle which can be perceived by natural vision to be more than $\frac{1}{2000}$in., it follows that whether the thickness of the film be $\frac{1}{2000}$in. or $\frac{1}{200000}$in. the depth of scratches could not be seen; nor do these appear to our view as stated, by the light reflected from their sides, but simply by the width of the silver removed by them, and the consequent exposure of the less reflecting surface below.

Flames 350ft. high.—Not long ago, telegraphs the St. Petersburg correspondent of the *Times*, the town of Baku was threatened with partial destruction by the sudden outburst of a natural naphtha fountain, which swamped a number of buildings, and for some days was quite unmanageable. Now a volcano of earth and hot mud has broken out about ten miles from the town on the Lok Batan, close to the Ponta Railway Station, and on the night of the 15th of January the inhabitants of Baku were alarmed by a shock like that of an explosion, which made all their window panes tremble violently, whilst towards the south-west the sky was illuminated by an intense light, as of some terrible conflagration. A similar phenomenon occurred on the following night. It was soon discovered that an eruption from Lok Batan had taken place, and the following information was furnished by the railway officials of Ponta Station:—"Quite suddenly, at eleven o'clock at night, the noise of an explosion was heard, and the summit of Lok Batan shot up an enormous column of fire some 350ft. high. The whole country was instantly lit up brighter than day, and the heat could be felt at nearly a mile from the crater. There was scarcely any wind, so that the column continued to ascend quite vertically, carrying with it, as could be seen, large dark substances, which appeared to fall again into the volcano. This lasted with short intervals of subsidence all through the night and the following twenty-four hours, but luckily the matters ejected did not reach the railway station. The volume of muddy liquid thrown out is estimated at half a million cubic *sojenes*—the Russian *sojene* equalling 7ft.—and has spread itself over more than a square mile to a depth of from 7ft. to 14ft."

* Figs. 10, 11, 12 best shown under compound solar light.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE annual general meeting was held on Friday, the 11th inst., Mr. J. W. L. Glaisher, president, in the chair.

General Walker asked the leave of the meeting to withdraw the name of Miss Pogson, who had been nominated for election to the Fellowship of the Society. On behalf of the other two Fellows who had joined with him in nominating Miss Pogson, he stated that they desired to postpone her nomination until the question of the eligibility of ladies for election to the Society should have been decided.

Leave was given to withdraw the nomination.

Mr. Bryant read the auditor's report, which stated that the Society's balance at the end of the year was £459 9s.

Capt. Noble said: I wish to ask a question of the treasurer. In the estimates passed in the House of Commons, either in October or November last, I noticed that there appeared an item of £24,000 for the learned societies. It was passed without any remark in the House of Commons. I have already had an inquiry made at the Geological and another learned society, and find that they obtained no part of the money, and I should like to ask Mr. Common whether this society received any part of it?

Mr. Common said: I am not the Chancellor of the Exchequer, and cannot answer for his accounts. Perhaps the sum which Capt. Noble refers to is that which was expended for the maintenance of the public buildings occupied by the learned societies. No part of the £24,000 fell into our hands as money; but probably some of it reached us, as it is a part of the duties undertaken by the Government to look after the outside of our building and maintain the structure.

Mr. Ranyard: I think that I can answer Mr. Common's suggestion as to the sum mentioned going for repairs. Our external repairs are done by the Department of Works, and the £24,000 did not go to the Department of Works or to the Commissioners of Woods and Forests. It was voted direct for the learned societies; but I do not understand how such a large sum is made up. The Royal Society gets some; but we get none I am thankful to say, and I hope, for the peace and quietness of the society, that we may never get any. (Laughter.)

The secretaries then read parts of the council's annual report on the progress of astronomy. Eleven minor planets were discovered during the year 1866, and six comets, including the periodic comet of Winnecke; of these six, three were discovered by Mr. Brooks, of Phelps, New York. The various paragraphs of the report having been shortly referred to by the secretaries, the president read his address on presenting the gold medal of the society to Mr. G. W. Hill, of Washington, for his researches on the lunar theory. The president stated that Mr. Hill had very ingeniously applied some of the methods of modern mathematics to the lunar problem. Amongst other things he had made use of an infinite determinant. By a curious coincidence, Prof. Adams had also made use of an infinite determinant in discussing another lunar problem. Prof. Adams's investigation had not been published, and consequently Mr. Hill's investigation contained the first application to a physical or astronomical subject of such an instrument of research. On examining the infinite determinant made use of by Prof. Adams, it turned out to be identically the same determinant as that discussed by Mr. Hill; so that no doubt this infinite determinant had some connection with the physical problem which was not yet altogether clear. Having given the gold medal to Dr. Huggins to forward to Mr. Hill, with the best wishes of the Society for his further success, the President called on Mr. Ranyard to move an amendment of the by-laws, of which he had given notice.

Mr. Ranyard said: The resolution of which I have given notice is, "That the following words be added to By-law 75, 'nor unless the nominee selected be a foreign astronomer not resident in Great Britain.'" By-law 75 reads at present: "No medal shall be awarded in any other way than in the manner and at the time above described, nor unless three-fourths at least of the members of the council shall agree thereto." My motion would make it read — "nor unless three-fourths at least of the members of the council shall agree thereto, nor unless the nominee selected be a foreign astronomer not resident in Great Britain"; that is to say, that in future medals shall not be given to astronomers resident in Great Britain. I should like to ask your very patient consideration of the matters I am going to lay before you, because this is a self-denying ordinance. I know that I am going to ask you to go against the stream of inclination. I feel I have a difficult matter to urge; but the question is a very important one. I am going to ask you, as a fountain of honour, to behave like all other fountains of honour, and not on any occasion to bestow the medal on yourselves or on anybody connected with you. The House of Lords does not make lords. At the Bar all distinctions are conferred by an outside authority. From our schooldays upward it has been the same thing with our prizes. I believe Captain Noble will confirm what I say that county magistrates, when they grant licenses, if they are in any way connected with the grant, whether as landlord or even in the most indirect way, think it is necessary to stop away; and so it is on the judicial bench. If a Judge is concerned in a case, he immediately withdraws. It has long been recognised as only consistent with his dignity to do so; and for the dignity of this society I urge that we should do the same thing. We should put ourselves entirely above suspicion, like Cæsar's wife. We shall make a better choice, too, if we do so; for a prophet is never esteemed in his own land. There are all sorts of proverbs one might quote to show that a man in his own family is either over-estimated or under-estimated. We never form as just a judgment about those who are immediately associated with us as we do of those who are at a distance. Last year I said we could only judge fairly of those who had lived long before us. I do not go so far to-day; but I say with regard to those who are immediately connected with us, there may be jealousies or there may be friendships which may upset our judgment, one as much as the other. There is only a small body of workers at any particular science, and there is a tendency to form cliques that upset the scientific spirit; and if the scientific spirit is upset, the work will be upset. I believe that people do better work when they do it with the highest and best motive, and without any personal interest in view. Last time the only argument that was urged in favour of medals was urged by Mr. De la Rue, who can put a case as well as any one, and very cleverly it was urged; but all that he could say was that it was a pleasure to us to give medals—that it was such a privilege that we could not give it up. Now, I do not think that is an argument at all.

Mr. Common: I rise to order. Mr. Ranyard, in quoting Mr. De la Rue, is not giving his words. Mr. De la Rue said that the Society, in giving medals, was honouring itself as much as honouring the recipient of the medal.

Mr. Ranyard: I do not want to misrepresent Mr. De la Rue. I think he said that in addition to what I have stated.

The President: The words he used were, I think, that it was a graceful act of recognition.

Mr. Ranyard: At all events, we cannot say that because it is a pleasant privilege to give medals, therefore we should go on giving them. The only sort of argument that I can recognise is that it is good for our science, or that the society is better for it, and that the individual workers do better if they think there is a chance of gaining the medal. But it seems that that cannot be urged. That was universally agreed to by the medallists present last year. Anything which promotes jealousy amongst specialists must do harm, and there is great urgency in the race for the hall-mark the medal is supposed to give. Some workers feel it very acutely indeed. I do not wish to take any English instances; but I will give a few French instances at the beginning of this century. Arago was a pleasant biographer, who never said anything unpleasant, if he could help it. He tells us of men struggling earnestly in France and being upset for the whole of their lives and soured by the struggle for such rewards. He speaks of Fourier, who gained the great mathematical prize of the Academy for his great work on the "Conduction of Heat" in 1812. There was some criticism in the address that was given on the occasion of presenting the prize, and Arago says:—"Fourier never admitted the validity of this decision. Even at the close of his life he gave unmistakable evidence that he thought it unjust, by causing his memoir to be printed in our volumes without changing a single word. Still, the doubts reverted incessantly to his recollection. From the very beginning they had poisoned the pleasure of his triumph. These first impressions, added to a high susceptibility, explain how Fourier ended by regarding with a certain degree of displeasure the efforts of those geometers who endeavoured to improve his theory. This, gentlemen, was a very strange aberration of mind of so high an order." Some persons imagine that people who study science are necessarily above all human feelings; but it is not so. (Laughter.) I am glad to hear that laugh, because that is a great point in the agument; the advancing of science is done by men who are frequently, in other directions, comparatively weak men, and we ought to do everything to prevent their weakness coming up; and it will make it easier for all workers if these distinctions are abolished; they will then be juster to one another, and will lead healthier and better lives. Arago, in speaking of Malus, the discoverer of polarisation, after stating that he was not a member of the Academy, and that he had been in the army and had fought in Egypt and elsewhere, says:—"Among the candidates there was conspicuous an engineer of roads and bridges, who had also borne a part in the Egyptian expedition, and *whose connections with the Academicians were numerous and of old date.* Everyone, therefore, foresaw that the place would be vigorously contested. On the day of election, August 13, 1810, one of Malus's friends undertook to bring him the news of the result the moment it was known. But, by an unfortunate combination of circumstances, the scrutiny was not opened till a later hour than usual. Malus obtained thirty-one votes, his opponent twenty-two. The friend alluded to did not lose a moment in going to announce the result. But the usual hour at which the news ought to have reached him having long passed, the great physicist believed himself to have been defeated, and abandoned himself, in spite of all the consolations which his wife afforded him, to the deepest despondency. Thus the intrepid soldier of the army of the Sambre and Meuse; he who had seen the near approach of death at, &c., &c., allowed himself to yield and sink under the supposed want of success in an election of the Academy." It is a thing that upsets men, this striving after the hall-mark of their fellows, and this proposal of mine would take that difficulty out of the way. Perhaps we are not so fond of decorations as the French, and, if so, it is all the easier to give them up. There is just one other quotation from Arago that I should like to read, to show how considerations with regard to membership of the Institute upset Arago's judgment. He had written a life of Fresnel. It was at a time of great political excitement in France — and Fresnel had his political allies—a minister did not patronise him because he was on the other side politically, and Arago was begged to take some lines out of the éloge of Fresnel. Some of his friends urged him thus: "If you execute your project, they said to me, the Institute will be abolished; now, have you, then, the youngest member of the Academy, any right to provoke such a catastrophe? And to support this remark they pointed out to me several savants whose sole livelihood lay in their appointment as members of the Institute. These observations, strongly represented, shook my determination." Arago did modify considerably his judgment because of these strong feelings. It would be very much better to let people rely on their work than on a hall mark. A man really does get a great deal of honour from his work if he does it honestly and well; and it is as well to keep people looking to their work and to their own consciences rather than to popular applause for the reward of their work. I don't think that can be doubted. Last year it was pointed out that scientific work was not done for the medals. I do not think it is; there is something else which pushes men forward; and therefore these medals do not make men work. I say it hinders work, and I should like to hear what can be said for the system not hindering work. The men who get the medals fairly do not get them till they have earned their laurels, and do not want the patronage, and if they do want the medals it is a pretty good indication that the medal has been wrongly given.

Mr. Franks: I have great pleasure in seconding the resolution which has been proposed, not merely as a matter of form, but because the proposal has my hearty sympathy. I think by limiting the award of medals to foreigners we shall raise the *morale* of the Society; and with regard to ourselves, if we can be magnanimous enough to set the example, we may very well leave our scientific men to the tender mercies of foreigners.

Prof. J. C. Adams: I would crave a few remarks on the present proposition. It seems to me that, logically, if Mr. Ranyard makes this proposal seriously, he ought to carry it far beyond the point which he stops at. He ought not to say we ought to confine our medals to foreigners; but that we ought not to give any medals at all. Why should we demoralise foreigners (laughter) by proposing them for medals any more than we demoralise our own people. Therefore, I should propose, instead of Mr. Ranyard's proposal, to enlarge the scope of it. Besides that, we ought clearly to be logical. Even if we admit foreigners, we ought not to admit any of our foreign Associates. There are a number of them, and generally we have picked out the most eminent men we can find to make them Associates; but we ought, at the same time, to say, "Remember, by electing you an Associate, we render you incapable for ever of getting any medal from us." That does not appear on the face of it very rational. As to the idea of demoralising our own people by giving medals, when they have done their work, not for a medal, but for the pleasure of doing it and for the benefit of science, then to pick out such men as are worthy and present them with the medal, cannot demoralise them. I do not think Mr. Hill, who did his work ten years ago, will find himself very much demoralised

When he wrote his valuable paper, of which we have had such an interesting account, he did not think about getting a medal for it, and if he had, he probably would not have got the medal. We should not have picked out a man whose object in writing a paper was to get a medal. We pick out a man because we think he has done his work worthily, and we have no doubt he had a good motive in doing his work. If we do not give medals we shall suffer in one way, as we shall not have the pleasure and advantage of listening to such an admirable address as we have had to-day from our president.

Captain Noble: I am disposed to move an amendment to Mr. Ranyard's motion. I think that as good work has certainly been done in England as has ever been done abroad, both in mathematical and observational astronomy, and I do not see why if foreigners are to have medals, Englishmen—if they earn them—should not have them too. But I agree with one thing which fell from Mr. Ranyard, that, like Cæsar's wife, we should be above suspicion, and I think we might do this. There is a rule in the Geological Society that no member of council can receive a medal so long as he holds office, and that rule has been found to work very well. I think we might go as far as that, and say we would not give a medal to one of our own body so long as he was holding office. But beyond that I would not go. If the meeting is disposed to accept that as an amendment, I would propose it.

Mr. Sadler: I will second the amendment.

Mr. Nightingale: I should like to say a few words on this question. There is no doubt that in a Society like this, where the council is made up of the very best men, a large number of medals must of necessity fall to the members of the council. Thus we have the curious position of the council giving medals to itself, so to speak. I think there is no other instance in the world in which such a curious state of things exists. It is like the Wranglers of Cambridge meeting and settling between them as to who is to have the prize. It seems totally anomalous to me. I have always had the idea that whether they are dignities, decorations, or promotions, or any kind of reward, there should be some outside person, some superior individual or individuals, to settle the claims of the various applicants. There is no case in which the recipient, or the prospective recipient, of an award sits on the committee which votes that award. If that is so, it necessitates serious consideration by anybody who is in favour of the present system, and they must show very cogent reasons why the rules of this society should support such an extraordinary anomaly. Mr. Ranyard has put it very clearly that there may be friendship amongst members, and if the council awarded the medals, there will always be some personal feeling among the most scientific people that ever lived. Why risk the dignity of our society? Why run the slightest risk that anything should be imputed against the society for the mere sake of what I might almost call tinsel decorations of really sterling merit? What is this medal? Its value is purely the work it represents. That work surely can stand alone. If the work is good it needs not a medal to support it. If the work is indifferent the medal gives it a fictitious value. It is, as Mr. Ranyard says, a sort of hall-mark. But is it advantageous as a hall-mark? Is there any evenness in the regular standard by which the award of medals is made? It is arbitrary to a degree. It has therefore a very indifferent value as a hall-mark. What, then, is the merit of the medal? It has been admitted on all hands that it does not encourage work. Everyone seems to say so, and surely there is no member who wants the medal as a trade mark. What, then, can be the use of it? If it is liable to introduce jealousies and party feeling amongst the members; if it is liable to set members who would otherwise be friendly at loggerheads, why carry on this procedure? There is a sort of feeling about it to me that a medal is as for schoolboys—a sort of prize. It is fit to excite the ambition of a schoolboy; but that is not the object of it in this Society, and I have never yet discovered that any other reason was given for awarding prizes. Under these circumstances, though I think the amendment has a great deal to be said for it, I shall support the original motion.

Mr. Ranyard: Prof. Adams asks first, if I mean the motion seriously. Certainly I do; very seriously. It is an unpleasant motion to press, and I should not have undertaken it unless I considered the matter a very important one for the improvement of the society, and for the advance ment of astronomy. Prof. Adams says we ought to extend the motion to exclude Associates; I do not follow that at all, because Associates have no vote. I simply said, "Cut out all those from receiving the medal who have a right of voting for it"; therefore, Mr. Hill would not have been cut out, and therefore we should not have lost the interesting address of the president to-day. I say this, though I should be inclined generally to speak against *è loges*, especially speeches in praise of those with whom we are immediately connected—for there is a very small circle of workers at any particular science, and they are apt to say things too highly in praise of one another, or to detract from their neighbours.

Capt. Noble's amendment was then put, and lost on a show of hands, though there was a considerable minority for it. A smaller minority held up their hands for Mr. Ranyard's motion.

The list of names proposed by the late council for officers and council for the coming year was carried without any alteration.

WESTERN MICROSCOPICAL CLUB.

ON Monday week the club met at the house of F. Crisp, Esq., LL.B., the well-known secretary of the Royal Microscopical Society. After due attention to the tea-table, adjournment was made to the conservatory. Here, by an ingenious arrangement of mirrors and rock-work, plants and animals appear perched on inaccessible heights, or seemed placed along endless avenues of ferns and lights. Proceeding thence to the museum, the vast collection of microscopes and microscopical apparatus was thrown open to the examination of the members. Mr. Crisp said it might be interesting to the members and visitors, before they proceeded to examine in detail the collection of instruments, if he were to give a general description of the collection, and of the system of classification adopted in the arrangement. Broadly stated, the collection consisted of—(I.) *Antique* microscopes and (II.) *Modern* Microscopes. The Antique Microscopes comprised the whole series known (so far as it had been possible to obtain them), from the earliest to the date of the general application of achromatism—about 1824. These, again, were divided into—(1) *Simple* Microscopes, (2) *Compound* Microscopes, and (3) *Solar or Projection* Microscopes. Of the Simple Microscopes, those designed by Leeuwenhoek must, of course, be regarded as of very special interest, for though he belonged by birth to Holland, and was hardly known to have ever quitted his native town—Delft—yet the whole of his microscopical researches had been communicated to the world through the medium of the Royal Society. The Simple Microscopes of Musschenbroek, Wilson, Joblot, Lyonet, Cuff, Lieberkühn, George Adams, sen., Benjamin Martin, and others, had each special points of interest. He might note particularly a pretty model in silver made by George Lindsay in 1742, which was the subject of the first patent specification relating to microscopes registered in England. Stephen Gray's Water Microscope was an ingenious effort to utilise lenses consisting of drops of water. A large dissecting instrument, devised by Lieberkühn, with its ghastly array of adjustable hooks for stretching out the preparation, showed that the inventor intended the microscope for service. Of Antique Compound Microscopes, that of Hooke's design (1665) stood first in the front rank of interest, by reason of its general design, and also as embodying the first application of a field-lens to the eyepiece. Then there were Italian microscopes by Giuseppe Campani, Eustachio Divini, and others, of which some might possibly be of earlier date than Hooke's. A highly ornate microscope, which had formerly belonged to one of the Popes, would doubtless attract attention. Other highly ornate instruments, made by the Duc de Chaulnes, G. Adams, sen., Culpeper, Demainbray, and sundry of unknown origin, the designs of which, however, clearly pointed to Italian workmanship, should also receive attention. The substantial improvement in the early arrangement of the focussing adjustment, initiated by John Marshall, would be observed in an excellent example of his construction; and a second model, evidently modified from Marshall's, showed one of the earliest known applications of a mirror to the microscope. Lieberkühn's "Compass" microscope was curious, both on account of its apparent fragility and as containing a considerable number of special appliances for dissecting and for viewing live objects. Of Antique Solar Microscopes, Cuff's early application of a heliostat mirror, actuated by catgut and a rod, to Lieberkühn's instrument (which previously had no mirror, and, consequently, had to be directed to the sun by means of a "scioptric ball") would be noted, and the various subsequent improvements in the mechanism for controlling the mirror, devised by B. Martin and G. Adams, and copied more or less by certain Dutch and Italian makers. The swinging tail-piece applied by W. and S. Jones to their Lucernal Microscope towards the close of the last century was interesting in showing that the principle of radial illumination was then known and put in practice, thus preceding Grubb's Sector Microscope by some 50 years, and Zentmayer's swinging tail-piece by 70-80 years, in both of which the special feature was the provision for radial illumination. Turning to *Modern* Microscopes, they had been classified firstly into the two great divisions of (1) *Simple* and (2) *Compound*. The Simple Microscopes presented so many varieties, that it had not yet been possible to subdivide them in a manner wholly satisfactory. The Compound Microscopes had been dealt with more successfully, though he could not regard the classification he had made of them as that finally to be adopted. The provisional arrangement was their division into seven classes: (*a*) *General form*, which included all microscopes that might be regarded as type-models of general design, where the makers had sought to embody a number of points the combination of which gave some claim to originality; (*b*) *Binoculars*, &c., which included all the known forms of microscopes devised for binocular vision, and to enable two, three, or four observers to view the same object simultaneously; (*c*) *Illumination*, comprising all microscopes in which the chief aim had been the application of special means to control the illumination, of which Grubb's Sector Microscope, Zentmayer's "Centennial," and Wenham's "Radial" might be regarded as types; (*d*) *Special Mechanism*, including the two sub-divisions of peculiarities in the fine-adjustment, and peculiarities in the object-stage; of the former he might mention D'Arsonval's water fine-adjustment, and various applications of catgut, and many special devices showing great mechanical ingenuity; of the latter, the double-lever mechanism devised by the late C. Varley, and a jointed-arm mechanism by Pillischer might serve as types; (*e*) *Portable*, in which the principal aim had been to render the microscopes conveniently portable, with more or less regard to the completeness of the equipment; (*f*) *Demonstration*, or Class Microscopes, where the intention was to provide a convenient instrument to be handed round to a class of students, or for carrying a number of slides for demonstration purposes, in which might be mentioned the ingenious locking arrangements of objective, eyepiece, &c., devised specially for French students by M. A. Nachet; (*g*) *Special object*, where the microscopes were designed for particular investigations, which class would probably incline to outgrow all reasonable limits, for there were already a dozen or more varieties of petrological microscopes and micrometer microscopes (of which Nobert's was especially interesting). Then there were stomach microscopes, ear microscopes, eye microscopes, frænum microscopes for observing the circulation of the blood, aquatic or tank microscopes, botanical microscopes for observing the growth of plants, vacuum or air-pump microscopes for viewing objects in a rarefied atmosphere or vacuum, and, on the other hand, a microscope for viewing objects under the pressure of 500 atmospheres or more; microscopes for counting the threads in different fabrics, for examining the toothed wheels of watches, &c., for observing chemical reactions, the fusion of metals, &c., for determining the number of vibrations of a particular note emitted by a tuning fork, a violin string, &c. (Helmholtz's Vibration Microscope), and many others, the tendency to specialisation in modern microscopy, as in other sciences, having plainly set in for the production of instruments with particular adaptations for the special purpose in view.

Referring to the large number of appliances designed as accessories for the microscope, the classification of them had not yet been completed. The illuminating apparatus included devices acting as simple reflectors (plane mirrors and prisms) and condensing reflectors (concave mirrors); simple refractors, and condensing refractors (prisms, lenticular prisms, lenses, "buttons," &c.); and, again, achromatic and non-achromatic condensers; diaphragms, and light-modifiers, &c. Then there were numerous forms of drawing prisms, micrometer eyepieces, micrometer stages, electrical stages, warm stages, mechanical fingers, frog-plates, compressoria, multiple nose-pieces, changing nose-piece adapters, and many other appliances. The visitors were then invited to examine in detail the various microscopes and apparatus, Mr. J. Mayall, jun., giving detailed explanations regarding the history and chief points of interest. These and many more unmentioned compounds of brass and glass were freely thrown open for the members and visitors to handle and examine at their leisure.

A thoroughly interesting evening was spent by the club in this unique collection of microscopical wonders. The next meeting will take place on March 7th at the house of B. T. Lowne, Esq., F.R.C.S., subject, "Mouths of Insects."

Any information as to the club may be obtained of the hon. sec., Mr. A. W. Stokes, Vestry Hall, Paddington Green, W.

THE telephone rate between Paris and Brussels is fixed at 3fr. for five minutes' conversation; and subject to a deposit of 60fr., and to the adaptation of the apparatus at his own expense, any Parisian already having a telephone can communicate direct with Brussels.

THE tomato pack of 1886 in the United States was 2,363,760 cases of two dozen cans each. This was not up to the figure of 1883, when 3,000,000 cases were produced; but it was much in advance of 1885. The annual consumption of the United States calls for about 2,500,000 cans.

SCIENTIFIC NEWS.

FROM Dun Echt Circular No. 135 we learn that Dr. Oppenheim, of Berlin, has computed the elements and ephemeris of comet Brooks (B, 1887) from observations made at Strassburg, Kiel, and Paris. T = 1887, March 18·8369 Berlin M.T.; $\pi - \Omega$ 160° 8′ 18″; Ω 280° 37′ 6″; i 103° 51′ 21″; log. q 0·20722. The ephemeris for Berlin midnight reads:—Feb. 18, R.A. 2h. 31m. 34s., N. Dec. 68° 21′; Feb. 26, R.A. 3h. 15m. 58s., N. Dec. 58° 58′; brightness decreasing. Dr. R. Spitaler, of the Vienna Observatory, makes the time of perihelion passage March 23·01985 B.M.T.

Barnard's comet (C, 1887) has been observed at Paris, and Prof. Weiss, director of the Vienna Observatory, computes its perihelion passage at Nov. 23·6302 Berlin M.T. The ephemeris for Berlin midnight on Feb. 20 is R.A. 20h. 29m. 54s., N. Dec. 42° 12·3′. The comet is now in Cygnus, and will be always above the horizon as long as it continues visible, though low down. It is becoming rapidly fainter.

From the Liverpool Astronomical Society's Circular No. 15 we learn that Mr. T. W. Backhouse finds that 28 Andromedæ is probably variable within small limits. The observations are too few to allow of any period being determined. The star is, however, of short period —perhaps of the Algol type.

According to a computation by Mr. J. E. Gore, of Ballysodare, the orbit of the binary 14 Orionis is such as to give a period of about 190 years.

We have received the first number of the Publications of the Liverpool Astronomical Society's Observatory, containing a memoir on "Photographic Photometry," in which is a catalogue of 500 stars, the photographs taken with the Grubb equatoreal stellar camera of 4½in. aperture, and another on "Spectroscopic Observations with the 17·25in. equatoreal." The Rev. T. E. Espin is the observer to the society.

Prof. Peters, of Clinton, N.Y., has named planetoid 264, discovered by him on Dec. 17 last, Libussa.

The report of the Administration of the Meteorological Department of the Government of India for 1885-6 gives an account of the establishment of a new first-class meteorological observatory at Allahabad. The total number of observatories provided with instrumental equipments in various degrees of completeness amounted at the end of the year to 131, two being in the Bay Islands, and six extra-Indian. A special object of attention has been the influence of forests on climate, and the observations made with this view greatly tend to strengthen the theory that the rainfall is greater over forest tracts than beyond them. Measures have been taken for extending the Bengal storm-warning system, a subject to which public attention was aroused by the destruction of life and property at the settlement of Hookeytolla at False Point, in Orissa, by a cyclone which passed over that place on the 22nd of September, 1885.

The death is announced of Dr. Philip Fischer, the well-known mathematician and professor at the Darmstadt Polytechnic.

The famous Indian botanist, Babu Harimohun Mukerji, of Bengal, is dead. He was at one time head-master of a small agricultural school attached to the botanical gardens of Sibpur, but left it to pursue his wanderings in search of Indian plants in the northern and eastern districts. He was the author of several botanical works.

The bankers of the Royal Society have received a cheque for £7,800 from Sir W. Armstrong. It is his contribution to the Scientific Relief Fund.

According to the *Athenæum* the *Philosophical Transactions* of the Royal Society is about to undergo a change of form. Vol. CLXXVIII. (1887) will probably be issued in two parts, one mathematical and physical, the other biological; and this division will be continued in subsequent years, so as to form two independent series. A still more radical change in contemplation is the separate publication of a certain number of copies of each paper as soon as ready for press.

With reference to his remarks in the discussion on Mr. Taylor's paper on "Photographic Lenses" (p. 517), Mr. J. Mayall, jun., has addressed a letter to the *Journal* of the Society of Arts, in which he says:—"In my remarks on Mr. Taylor's paper on 'Photographic Lenses,' which he read at the Society on the 26th January, after criticising what I considered his extraordinary misapplication of the term 'aplanatism' in using it as equivalent to 'angular aperture,' I said I did not attribute the origination of that idea to Mr. Taylor, because it had been more or less used (in that sense) in popular treatises on photographic lenses, and even in Monckhoven's work on 'Photographic Optics.' In justice to the late Dr. Van Monckhoven, I must ask you to allow me to withdraw that statement so far as he was concerned, for on referring to his work again —which had not been in my hands since 1867, the date of the English edition—I find he used the term 'aplanatism,' in its relation to photographic lenses, as Coddington and Herschel had employed it, namely, as signifying freedom from spherical aberration. It appears to me, then, that the withdrawal of Monckhoven's authority in support of Mr. Taylor's erroneous definition of aplanatism, leaves the responsibility for the adoption of the error far heavier on Mr. Taylor. On reference to my correspondence with the late M. Prazmowski, of Paris, I find the photographic portrait lens he made for me—in which he got rid of the usual separation of the flint and crown in the back combination by using flint glass in the whole construction—was made in 1868-9, and not merely 'about ten years ago;' my showing the lens to the late Mr. J. H. Dallmeyer would hence have been about 1869, and not merely 'ten years ago.'" In connection with this paper (pp. 495, 517) it may be noted that "chromatism" appears for achromatism, and "clouded fringes" for coloured fringes.

The Geographical Society of Australasia has been authorised to prefix the word "Royal" to its title.

By the terms of a Bill introduced into the Governor-General's Legislative Council, an Inventions Office will be established in India under the superintendence of the Revenue Secretary to the Government, and holders of patents obtained in Great Britain may apply for "leave to file a specification" in India within twelve months from the date of sealing of the patent here. The Bill also extends the copyright in a design to five years.

It may be of interest to some of our readers to learn that the net cost of publication up to the present of the report of the scientific results of the voyage of the *Challenger* amounts to £53,000.

According to an American contemporary, "Oxford and Cambridge professors do more original work than our [American] professors, simply because they are given the time for it." We are afraid our American contemporary does American professors an injustice.

The destruction of the remarkable terraces of pink and white silicious sinter on the shores of Lake Rotomahana, in New Zealand, during the eruption of Tarawera last June, has given rise to speculation as to the rate at which the old terraces were formed. Mr. Kerry-Nicholls states that names and dates written on the terraces, over which the silica-loaded waters poured, were covered in the course of twenty-five years with only a very delicate layer of sinter, the deposition being so slow that it would have taken hundreds of years to obliterate the writing. Mr. Lant Carpenter, however, says that the wing of a bird, shot by Dr. Hector as it was flying over the terraces, fell in a favourable spot, and became so completely incrusted in the course of a fortnight that its form was beyond recognition.

Evidence as to age always requires careful examination. The New York *Lumber Trade Journal* says that many surveyors and lawyers know that the concentric rings shown by trees are not to be taken as evidence of the lapse of time, and it gives the following as the result of an examination of pieces of wood from trees the age of which was known. Pig Hickory 11 years old showed 16 rings; Green Ash, 8 years, 11 rings; Ky. Coffee Tree, 10 years, 14 rings; Burr Oak, 10 years, 24 rings; Chestnut, 4 years, 7 rings; Peach, 8 years, 9 rings; Chestnut Oak, 24 years, 18 rings.

At the recent meeting of the Liverpool Astronomical Society, the Emperor of Brazil was elected a member, and the claim of the Pernambuco branch, which now numbers more than eighty members, to elect a local executive, was unanimously allowed.

A patent has been obtained in this country for the use of hydrofluoric acid, either in a gaseous or in a liquid form, to eliminate vegetable matters from animal fibres or mixed fabrics.

One of the tunnels which the City of London and Southwark Subway Company is driving under the Thames near London Bridge is approaching completion, if it has not by this time reached the Surrey side. The distance from the Middlesex shaft at Old Swan Wharf is 667ft., and as the shield for driving was not fixed until Oct. 28 last, it follows that modern appliances enable the engineer to drive a tunnel under the Thames in sixteen weeks. The second tunnel has been commenced, and the company are so satisfied with the work that they have sought powers from Parliament to extend the line beyond the Elephant and Castle to the Swan at Stockwell.

Lord Stanley of Preston, replying to Lord de la Warr, in the House of Lords on Monday evening, said that the subject of continuous railway brakes still engaged the attention of the Board of Trade; but he could not promise that any further steps would be taken to enforce the requirements of the circular. Much progress has, it appears, been made by the companies in the direction of securing efficient brakes, but there is great difference of opinion as to the best brake for any particular line.

Apropos this question of the brakes, a new brake, the joint invention of Mr. J. Cowling Welch and Mr. Parker-Smith was tried last week on the Hadleigh branch line near Ipswich. It is an interchangeable automatic brake, and each vehicle would be required to be fitted with two train pipes, so that the brakes could be worked on either the Westinghouse or the automatic vacuum pattern.

The new 110-ton gun has successfully withstood its preliminary trials; but it will be some time before a full report of its performance will be issued. The following are the correct dimensions:—Length over all, 524in.; length of bore, 487·5in. (30 calibres); bore, 16¼in. The breech engages in the breech-piece, leaving the A tube with its full strength for tangential strain. The A tube is in a single piece, and was supplied from Whitworth's works. There are four layers of metal hoops over the breech. The maximum firing charge is 900lb. of cocoa powder, the projectile weighs 1,800lb., the estimated muzzle velocity is 2,216ft. per second, and the estimated total energy is 61,200 foot-tons.

The White Star liner *Celtic* has been fitted with appliances for using forced draught, and on a recent run from Belfast to the Mersey the results obtained were considered highly satisfactory.

According to Dr. Eisenmann, of Berlin, a solution prepared by mixing tungstate of soda 6 parts, phosphate of soda 1 part, and water 60 parts, slightly acidulated with sulphuric acid, is regenerated by mere exposure to the atmosphere when used in a zinc cell.

The master of a Swedish steamer says that he observed the reflection on the sky of the light from the Isle of May at a distance of 46 miles from the lighthouse.

It is proposed, in accordance with Royal and Ministerial decrees, to open on the 1st of May next, at Milan, an international competition of corn driers, and especially of driers of Indian corn. Foreigners as well as Italians may compete. Two prizes are established, each of the value of 2,000 lire, with a diploma of honour for the best driers of Indian corn and rice respectively. Applications for admission must be forwarded to the Executive Commission, at the Ministry of Agriculture, Rome, by March 31st.

It is proposed to hold in London, next autumn, an international congress of shorthand writers and of those interested in the stenographic art.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE DIAMETER OF STAR DISCS.

[26833.]—THE following is M. André's formula, for which "Orderic Vital" asks in letter 26759, page 476:—"Cet agrandissement du disque central, à mesure que l'ouverture diminue, est une conséquence directe de la théorie. En effet, nous avons posé

$$n = \frac{2\pi}{\lambda}\,\frac{d}{f}\,r;$$

or, si δ est la valeur en secondes du diamètre du cercle sur lequel se trouve le point M, O l'ouverture $2\,r$ de la lunette, et A la quantité $\frac{2}{\pi}\,\frac{\lambda}{\sin. 1''}$ on a

$$\delta = n\,A\,\frac{1}{O};$$

de telle sorte que *le diamètre du disque central*, ou celui d'un anneau quelconque, *est inversement proportionnel à l'ouverture de l'objectif.* La valeur du diamètre de ce *disque central* est, pour chaque objectif, une constante caractéristique qui joue un grand rôle dans les observations qu'on peut faire avec lui. Si l'on suppose l'objectif *parfait*, son ouverture égale à 10 centimètres, et si l'on prend pour λ la valeur qui correspond au jaune, partie la plus intense du spectre, d'où

$$A = 0{\cdot}727,$$

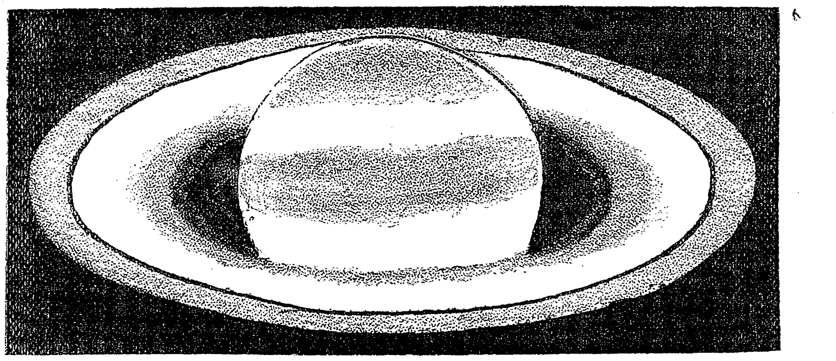
on a comme *valeur maximum* de ce disque central.

$$2{\cdot}80''.$$

On comprend, en effet, et nous le démontrerons plus loin, que ce disque lumineux nous apparaît plus ou moins grand suivant l'intensité de la source observée, ou bien le plus ou moins d'éclat du fond sur lequel on le mesure, &c." The following quotation from the Report of Durham Observatory in the *Monthly Notices* of the R.A.S., Vol. XXXII. p. 152, will be of interest in this connection:—"Some success attended an attempt to measure the diameter of the first optical ring of light round the image of the star Polaris by its transit over the meridional wires of the transit circle; but the observation, though easily and satisfactorily made, and though agreeing with a similar determination made two years ago, does not agree with the diameter which theory assigns for the object-glass employed." I cannot say whether the theory referred to is Airy's original one, or as corrected by Mr. Stone (c.f. *Monthly Notices*, XXVII. p. 303; ENGLISH MECHANIC, Feb. 5th, 1886, Vol. XLII. p. 468), as no details of the Durham observations have been published. **H. Sadler.**

SATURN—PHOTOS OF STARS AND ANONYMOUS WRITERS.

[26834.]—AS the most favourable time for observing Saturn is rapidly passing away, I send a sketch of the planet as it appeared in my 8½in. Calver reflector on Dec. 26th, powers 250 to 300, definition moderately good. The top of the ball was seen well over Cassini's division, and very nearly touched the outer edge of ring A. No part of the ball could be seen on north side of the ring. The south polar cap was dark grey, not so dark as sometimes seen, but quite as extensive; north was a broad band of yellowish light, and then a broad band of darker belts followed by the equatoreal belt, which appeared as usual. There was hardly any shadow of the ball on the rings, what there was was on preceding side. The outer edge of outer ring was not clear and distinct, like the ball, but undersized, its colour greyish, same hue as the lighter belts. Cassini's division was clear and distinctly broader at the ansæ. Ring B, nearest the division, was very bright, fading gradually into the crape ring, which was a dark blue, but sometimes it has appeared to me reddish brown: it was seen as a thin dusky line over the ball. What was especially noticeable was that ring B nearest the division was far brighter than the Equatorial belt, and was the brightest part of the whole system; the shading in the east and west ansæ nearest the

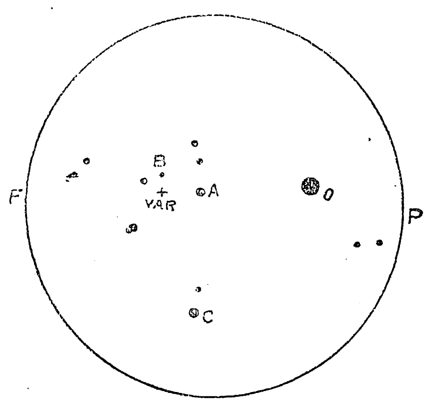


crape ring was very conspicuous. The following ansa seemed more shaded than preceding one, but on other occasions I could detect no difference. I hope amateurs will continue yearly to send sketches of the planets to "Ours," as such always interest and encourage us to observe and to report our observations, even when taken with small apertures.

I have seen no sketches of Saturn this season, and none of Jupiter last year. A correspondent asked, some weeks ago, if photographs of the heavenly bodies as recently taken could be anywhere obtained. I think Mr. Herbert Sadler replied: "None except Rutherfurd's moon photos." I am pleased to inform you that excellent reproductions of the photos of the Brothers Henry have appeared in *Knowledge.* The May number has a faithful copy of part of Cygnus; June has the Pleiades, July the nebula round Maia, October Saturn, November Jupiter. They are extremely like the original prints (which I have seen, the stars being shown white on a black background). I am sure they will delight many amateurs. The concluding paragraph of the letter of a third R.A.S. (No. 26788) I suppose is very crushing; but would it not be fairer and more English-like if the writer signed his name, so that the public could judge of Mr. Roberts's and the writer's comparative merits as benefactors of astronomy. Anyone who has read the *Proceedings* of the Royal Astronomical Society will see Mr. Roberts's work has been justly appreciated by well-known astronomers, who have thanked him personally in public. Mr. Roberts no doubt is well capable of answering for himself, or treating with silent contempt attacks made by anonymous writers. **H. Watson.**

THE NEW VARIABLE STAR NEAR THETA TAURI AND NEAR OMICRON CASSIOPEIÆ.

[26835.]—THIS star, whose variability was announced in Circulars Nos. 10, 12, and 13 of the L.A.S., is in all probability not a long, but a short period variable. It is so easily found, being in the same low-powered field with θ Tauri, that some of ours may care to watch it. It seems probable that if it is well observed a period will be found for it before it passes out of sight to the west. I there-



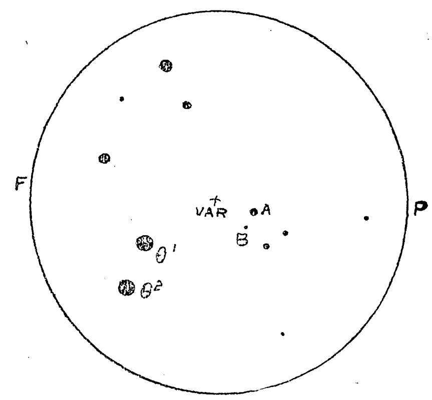
The brighter stars in field with the new variable near o (Omicron) Cassiopeiæ.
1887, Feb. 6, 17¼ equatorial, power 70.

fore venture to send you a rough drawing of the field, which will enable your readers to identify it easily. The comparison star A was estimated Feb. 2 as 10·0, while B was entered as 11·5; probably these estimates were affected by the moonlight, and are 0·5 too low; but adopting them for the time being, my observations of the variable are:—

1887.	Jan. 29	11·0mag.	Feb. 8	9·7mag.
	Feb. 2	10·5 „	Feb. 9	10·3 „
	Feb. 5	9·5 „	Feb. 10	10·3 „
	Feb. 6	9·5 „		

Mr. Gage, on re-examining his observation of Jan. 16th, does not feel positive that he observed this star; but there can be no doubt that he observed it on Jan. 22nd, at which time it was evidently decreasing in light; there seems good reason then for suspecting that it is a short-period variable. It would be hazardous to name a period at present, but probably it is about 20 days, and we shall have another maximum in that case during the last days of the present month. On Feb. 9th the star was observed by Mr. Baxendell, junior, and Mr. Gage, their estimations agreeing well together.

The other new variable star near Omicron Cassiopeiæ will be easily found from the brighter star with the help of the second drawing. The



The brighter stars in field with the new variable near θ Tauri.
1887, Feb. 2, 17¼ equatorial, power 70.

star A I suspect to be variable; C is about 8·5; while B is 10·2. Observing last night, Feb. 10th. The variable was estimated 10·6, while A was 8·6. **T. E. Espin.**

L.A.S. Observatory, Wolsingham, Darlington, Feb. 11th.

COMET B, 1887 (BROOKS)—JUPITER.

[26836.]—THE comet was seen here about 9h. 40m. and 10h. 40m. on the 12th inst., as well as on the night of the 13th, very nearly on a line between Epsilon Cassiopeiæ and the Pole Star, and apparently slightly nearer ε Cass. It was, however, a very faint object in a 4in. Dollond.

I must thank "F.R.A.S." for kindly referring me (Dec. 3 last) in connection with the self-luminosity of Jupiter, to Captain Noble's interesting observations in the *Monthly Notices.* The existence of a dull red glow would, I presume, in no appreciable way affect the apparent brilliancy of Jupiter, unless indirectly by its action on the surface, or by promoting atmospheric conditions around the planet more favourable for reflecting solar light.

Hendon, Feb. 14. **P. F. Duke.**

[26837.]—I SAW the above comet last night. It was pretty bright with the 10in., power 100. Diameter of coma, about 3′—4′, with a slight granular condensation. There appeared to be a very small star-like nucleus = about 11 mag.; but as it was in a rich field of stars, the apparent nucleus may have been a small star; but clouds coming over prevented me from ascertaining this. It is most favourably situated for observation at present. **Herbert Ingall.**

DOUBLE STARS η CASSIOPEIÆ (Σ 60) τ CYGNI.

[26838.]—IN answer to Mr. H. Sadler's interesting note on η Cassiopeiæ (letter 26566, page 322), I have recently measured the star on several nights with my reflector, as given below, and can fully

corroborate the fact of the curious similarity existing between the pairs η Cassiopeiæ and 70 Ophiuchi. Both are difficult to measure in distance, possibly owing to the inequality of the components, and in each case the smaller star is a very peculiar colour, which renders it difficult to see with any considerable illumination of the field. The angle would seem to be larger and the distance somewhat smaller than that given in the *Star Guide;* but it is evident that all the elements hitherto obtained are more or less unsatisfactory; possibly, however, the orbit (like that of 70 Ophiuchi) may be disturbed. In making the measures, bright field illumination with red light has invariably been used (this giving the best result), and the highest power employed which the night would bear; but since the end of November the air has almost always been unsteady, and good measures have consequently been difficult to obtain.

η CASSIOPEIÆ = Σ 60. MAGS. 4 – 8·3.

Epoch.	Pos. A.	Dist.	Wt.	Power.	Remarks.
1886·783	177°·5	4″·97	4	280	Definition fair
1886·909	178·1	4·69	4	200	
1886·944	177·1	4·69	4	280	
1886·980	179·0	4·45	2	200	Images unsteady
1886·991	179·2	4·85	4	350	Very good
1887·011	178·5	4·37	1	160	Images diffused and blazing
1887·063	180·03	4·65	3	280	Unsteady
1887·082	178·1	4·99	4	280	
1886·970	178·323	4·768			

With regard to τ Cygni (A.G.C. 13), since publishing the results of measures of this star (made in 1885) in the *Journal* of the Liverpool Astronomical Society, I have received a note of some measures made by Prof. C. A. Young at Princeton, New Jersey, with the 23in. refractor of that observatory, which differ so widely from my own as to lead to the inevitable conclusion that the object measured by me in 1885 must have been a spurious image. According to the Princeton measures, the angle in 1885 was about 70°; but there were several curious discrepancies in the various measures, for I find that the star was measured by Prof. A. Hall at Washington with the 26in. refractor on Sept. 25th, 1885, when he found P = 100·7° D – 0·62″—a result which, although differing considerably from my own, disagrees still more violently with the Princeton measure of about the same epoch. There is, however, but little doubt that the pair has since closed up out of reach of any but the largest aperture, and therefore the orbit computed by Mr. J. E. Gore (published in the *Ast. Nach.*), in which my measure was used, will require revision, as well as the data attached to the star in the *Star Guide* supplied by me to Mr. Sadler. The period in this case is evidently below 50 years, and it may turn out to be one of the shortest known; but the task of obtaining an orbit is one from which the most persevering computer might well shrink, taking into consideration the varying results obtained by two skilled observers, both using large refractors. **Kenneth J. Tarrant.**

Letchford House, Pinner, Feb. 9.

THE LUNAR RAY SYSTEMS—LIST OF STREAK SYSTEMS — ALPHA FORNACIS.

[26839.]—WITH reference to Mr. Gemmill's remarks as to these on p. 499, there seems to be less objection to dividing the individual rays, rather than the ray systems themselves, into the three classes of "Tychonic," "Copernican," and "Messier." Nevertheless, I think it will be found that there is no marked line of demarcation between the different classes, and it will often be found extremely difficult to decide into which division many of them should be placed, particularly, perhaps, in the two classes of "Copernican" and "Messier." The adoption of this method of classification will, though, indicate well the intimate connection existing between the "rays" properly so called and the ordinary light streaks. There are great numbers of these latter which present precisely the same appearance as the Messier rays in all respects, excepting, perhaps, length and brightness. The striking appearance of the "comet tail," as it has been termed, is, of course, due in great part to its surroundings; but the chief characteristics of the rays composing it, apart from their compound nature, appear to be:—(1) Straightness; (2) narrowness; (3) equable intensity; (4) uniformity of breadth; and these characteristics will also be found in very many of the ordinary light streaks. The two streaks forming the streak ζ in Plato, for instance, form, with the central crater, almost an exact miniature of the Messier system.

I had not overlooked Mr. Dennet's map of the Proclus system, which is a very useful one so far as it goes; but it does not give much information, if I recollect rightly, as to the characteristics of the individual rays, as regards differences in width, brightness, appearance, &c., or their connection, apparent or otherwise, with the numerous light spots and patches and other objects.

In the text to his "Charte der Gebirge des Mondes," Schmidt gives a list of 100 streak-systems, light-surrounded craters, and light spots. The following streak-systems extracted from this list will form an addition to those mentioned by Mr. Gemmill. Many of them are but insignificant, judging from the brief notes added by Schmidt. As Mr. Gemmill appears to be working in this direction, I hope he will observe some of these systems and make further additions to the list. A series of carefully-made observations upon some of the smaller ray systems with a map of the principal rays, after the style of that of the Proclus system made by Mr. Dennet, with notes on the class and characteristics of the separate streaks of the system would prove a real service, and that of some magnitude, not only to selenography, but also to selenology.

List of Streak-Systems.—Autolycus, Eudoxus A; Manilius; Menelaus; Taquet, east of Littrow (long. 92°W., lat. 21·5° N.); Tralles A; Cleomedes A; north wall of Mare Crisium (long. 57° W., lat. 22° N.; Taruntius; Dionysius, south of Apollonius (long. 62·5°W., lat. 2·2° N.); Timocharis; Geminus; north of Volta (Schmidt) = Chevallier in Neison; Gambart A; near Galilei (long. 58° E., lat. 8° N); Cavalerius (W. wall); Zuchius; Mersenius (W. wall); south of Sirsalis (long. 59° E., lat. 14° S.); Euclides; Alphonsus (S.S.E. wall); Lalande; Stevinus a; Furnerius A; Langrenus; Mädler; Timaeus A (long. 2° E., lat. 60° N.); Timaeus ——; Agrippa; Hipparchus d; Godin; Maurolycus.

In letter 26808, p. 520, Mr. Sadler refers to the suspected variability of the star α Fornacis, or 12 Eridani. In Mr. Gore's "Catalogue of Suspected Variable Stars" the authority given for the suspected variation is W. Herschel; and, in the *Phil. Trans.* for 1796, Herschel gives the observation "19, 12." If we assume, with Prof. Pickering, that the comma is equivalent to a difference of 0·2 mag., and take for 19 the mag. of the "Harvard Photometry," the magnitude of α, according to this observation, would be 4·4. The following, then, are the determinations by different observers of the magnitudes of these two stars:—

	H	U.N.	Heis.	U.A.	H.P.	Wms.
19 Erid.	(4·21)	4	4	4·5	4·21	4·0
12 „	(4·4)	3—4	3—4	3·6	3·77	4·1

It will thus be seen that there are rather strong reasons for suspecting variation in the light of 12 Erid. My observations were made on the 14th Oct., 1885, the comparison stars (δ and π Eridani) being the same for both stars. From Mr. Gore's Catalogue Lalande made it 3m., and Lacaille 3½. Are there any other determinations of the brightness of this star? **A. Stanley Williams.**

OCCULTATIONS IN MARCH AND APRIL, 1887.—THE TOTAL SOLAR ECLIPSE OF AUGUST 19.

[26840.]—BELOW I give a list of occultations visible in the British Isles in March and April of the present year, together with the elements for predicting them for any place where visible. The method for making the computation may be found in the ENGLISH MECHANIC, No. 1,075, for Oct. 30, 1875, and in subsequent numbers. I am pleased to say that this method has found favour in all parts of the world, beyond my most sanguine expectations. In a private letter received recently from Assistant-Astronomer Cooke, of the Adelaide Observatory, South Australia, he says: "You can easily understand that with our small staff, and the large amount of meteorological work we have always in hand, any regular series of occultation computations by any of the old methods would be quite beyond our powers. By your method, however, a whole month's visible occultations can be calculated in a very short space of time."

I shall send you at an early day the elements for predicting the total solar eclipse of 1887, Aug. 19. **Chas. L. Woodside.**

Boston, Mass., Feb. 1.

ELEMENTS FOR COMPUTING OCCULTATIONS VISIBLE IN THE BRITISH ISLES IN MARCH AND APRIL, 1887.

Star's Name.	Mag.	Declination.		Wash. M.T. of geoc. ☌.			Washington hour angle.		Y	x'	y'	Limits.	
												N.	S.
				March.									
		°	′	d.	h.	m.	h.	m.					
Aldebaran	1	+16	16·8	2	0	38·4	–5	10·3	+0·2973	·5559	+·0960	+53	– 8
f Gemini	6	+17	55·7	5	7	5·2	–1	34·0	+0·6650	·5948	–·0498	+88	+18
45 Leonis.........	6	+10	20·1	8	2	42·4	–8	34·5	+0·4052	·5957	–·1706	+60	– 9
ρ Leonis	4	+ 9	53·1	8	4	48·0	–6	33·8	+0·4829	·5956	–·1731	+66	– 5
γ Virginis	2½	– 0	49·9	10	9	53·0	–3	29·0	+0·6486	·5864	–·2039	+82	+ 1
μ Ceti	4½	+ 9	38·0	27	0	57·8	–1	21·6	+0·7271	·5313	+·1564	+90	+ 9
θ^1 Tauri	4	+15	42·4	29	3	30·4	–0	24·0	+0·7263	·5526	+·1009	+90	+15
θ^2 Tauri	4	+15	36·9	29	3	33·1	–0	21·4	+0·8308	·5526	+·1009	+90	+22
B. A. C. 1391 ...	5	+15	56·6	29	4	25·8	+0	29·6	+0·5630	·5526	+·0995	+75	+ 7
115 Tauri	6	+17	51·7	30	6	18·6	+1	30·1	+0·5666	·5636	+·0592	+76	+11
				April.									
3 Cancri	6	+17	36·9	2	0	16·6	–6	54·8	+0·6188	·5853	–·0667	+81	+13
46 Virginis	6	– 2	45·7	7	5	0·9	–6	50·5	+0·9067	·5862	–·2049	+87	+16
48 Virginis	6½	– 3	3·4	7	6	23·8	–5	30·6	+0·9135	·5862	–·2046	+87	+16
94 Virginis	6½	– 8	21·2	8	8	21·7	–4	30·7	+0·9590	·5865	–·1902	+82	+20
29 Ophiuchi ...	6½	–18	43·0	11	9	4·9	–6	30·4	+1·0140	·5839	–·0817	+71	+27
54 Cancri.........	6½	+15	46·0	30	3	54·2	–2	16·6	+0·9210	·5790	–·1054	+90	+28
o^1 Cancri	5½	+15	45·3	30	6	32·5	+0	16·0	+0·6495	·5789	–·1101	+85	+10

THE LUMINIFEROUS ETHER.

[26841.]—I SHOULD like just to say, with reference to a statement in letter 26791, that I was quite aware of Clerk-Maxwell's theory as to the phenomena of electricity and light being caused by movements of the same medium, and that I fully believe it to be correct. But this does not prove the medium to be "luminiferous ether" any more than the fact that two men are seen reeling about in similar fashion proves that they are both under the influence of beer, and not whisky. Many high authorities seem to consider that light, no less or more than electricity, is a movement of molecules of ordinary matter independent (to a certain extent) of their condition as constituting masses of what we call solids, liquids, and gases.

To take a rough illustration, a violin may be swung in the hand or carried about a room (mechanical motion): it may be played upon so that its molecules vibrate with that finer mechanical motion which causes phenomena of sound. It may be heated before a fire so that its molecules move in the manner required to produce the effects of heat. Its strings may be conveying electrical energy as motion of some kind; and all this variety of motions may be going on simultaneously in the ordinary molecules of the violin. Why may we not go one step farther, and suppose that these same molecules are capable of taking up and passing on that kind of motion which produces the phenomena of light? Why should an additional, non-material medium be required for this particular movement, which is not required for the rest?

Heat and light are in many respects closely related; radiant energy manifests itself as heat or light simply according to the surface it falls upon. Why should a supra-material medium be required for the one and not for the other? **A. X.**

[26842.]—IT appears that the various writers who have referred to my remarks upon this subject fail to apprehend my position in the matter. As I said before, it was not the luminous relations of the ether that I treated of at all, but the endeavours now being made to turn electricity into the ether.

Of course, as Mr. Grey says (p. 500), we know a great deal about the effects brought about by the agency of the ether; our knowledge of the undulatory theory of light is very considerable, and as trustworthy as any knowledge can be of matters which cannot be directly seen and measured. When I said that we know there is something which transmits light, and which we call the ether, and that is the end of our knowledge, I was obviously speaking of our knowledge of the actual nature of the ether itself—its *essence*, not of our knowledge of the effects produced by its agency. No one has yet touched the gist of my objections to the practice of making assertions as to the actual nature of a substance of which we really know nothing, and have no possible means of examination

No one has really ventured to defend the propriety of assuming the properties and nature of the ether, devoid of weight and friction, from those of matters possessed of weight and friction even in the state of gas of the utmost tenuity.

Mr. Grey, and also "E. L. G.," if I quite catch his meaning, object to my suggestion that it is just possible that the ether may be ordinary matter in the state which Crookes calls the fourth condition of matter, as found in ultra-vacua. But I merely expressed a hinted thought, springing from other thoughts not mentioned. It seems to me that we do not at all know what that fourth condition is; it is not at all inevitable that it is really "gaseous." When we pass beyond the bounds of knowledge and enter the realms of hypothesis, we are freed from many of the limitations of strict law. I can conceive readily that there is a limit of pressure at which "dissociation" takes place, just as there is a limit of temperature, and that matter may assume a condition wholly different from that in which we know it. Furthermore, I think that hypothesis is more reasonable and better formed than that which represents the ether as having the properties of a jelly or solid while not possessing the first fundamental attributes of matter at all. For it must be remembered that just as I said that we know nothing of the essential nature of the ether, so neither have we any knowledge whatever of the essential nature of matter or of energy or of force; in fact, the very fundamental property of matter, that by which we measure it—its mass or weight—is not a property of *matter* itself at all; it is a measure of *force*, which, for all we know, may be a something superadded to matter. It is an unproved, but reasonable and largely held, idea that matter as we know it, as the elements, is a manufactured article; that there is an unknown something underlying them, and into which they may be again resolved; that underlying, original element may very well be the ether, while the properties of ordinary matter may be derived from energy charged upon it.

In fact, it cannot be too thoroughly realised by every earnest thinker that, wide as may be our knowledge of actions in nature, we have absolutely no knowledge whatever about the real agents; of ultimate causes, the essence of things, we are utterly ignorant, nor is there the smallest probability that we ever shall know anything about them. It is well to recognise the limits of our field of operation.

I fully agree with Mr. Evans (p. 451) that we must assume ideal pictures of things beyond the scope of actual knowledge; in fact, our atoms and molecules of chemistry are really ideal pictures which embody certain known facts and derived theories; therefore I have no objection to the statement that the action of the ether in transmitting light can be represented by that of a jelly transmitting vibrations. But while that comparison (involving the giving it for a special purpose properties which we know it does not possess) may be convenient as aiding us to form an ideal picture of light traversing space, it is fatal to true knowledge to transfer the same idea to other conditions where we cannot with any truth bestow on it these artificial properties. As an instance, Sir W. Thomson, having originated this jelly notion, went on to indicate that a flash of lightning can be pictured as a crack in the jelly. Now, this is monstrous; we have no single particle of evidence that there is anything resembling electrical action in space; we have no knowledge of any electrical action excepting as related to ordinary matter; flashes of lightning occur only in the air, not in space; even the Aurora (which, however, is not an electric action, except in that all magnetism is electric action) occurs in the atmosphere. What right, then, has anyone to assert that electricity has anything to do with the ether when we are sure that no electricity is manifested where nothing but the ether is present?

That is the whole meaning of what I have said, that while we may form ideal pictures to aid us in understanding certain facts, we must not give actual existence to those pictures, or apply them to other facts of a different order. **Sigma.**

NOTES ON THE CHURCH ORGAN.—TO "C. R. O.," DEVON.

[26843.]—I HAVE read your remarks relating to the harmonic upper partial tones with considerable interest. I may commence my reply by remarking that, in the simple calculation of the vibrations of the harmonics, we have nothing to do with the "wolf." You must bear in mind that the numbers of the vibrations producing the upper partial tones are simply multiples of the number of vibrations of the prime. Thus, the first upper partial tone has twice the number of the vibrations of the prime: the second upper partial three times the number of the vibrations of the prime: the third upper partial four times the number of vibrations of the prime, and so on with unvarying regularity. If Helmholtz and Kœnig are correct, and the experiments of Seebeck, Cagniard-Latour, and other physicists go for anything, we must accept the above as conclusive. For your reference I give you the numbers of vibrations of all the notes which extend upwards from the C of 256 vibrations to the g^3 of 3072 vibrations per second, according to the just or untempered scale. It must be remembered that we have the just scale alone to deal with in considering the question of harmonic upper partials.

C	= 256	—Prime tone.
C sharp	= 266·66	
D flat	= 276·48	
D	= 288	
D sharp	= 300	
E flat	= 307·20	
E	= 320	
E sharp	= 333·33	
F flat	= 327·68	
F	= 341·33	
F sharp	= 355·55	
G flat	= 368·64	
G	= 384	
G sharp	= 400	
A flat	= 409·60	
A	= 426·66	
A sharp	= 444·44	
B flat	= 460·80	
B	= 480	
B sharp	= 500	
c^1 flat	= 491·52	
c^1	= 512	—first upper partial tone.
c^1 sharp	= 533·33	
d^1 flat	= 552·96	
d^1	= 576	
d^1 sharp	= 600	
e^1 flat	= 614·40	
e^1	= 640	
e^1 sharp	= 666·66	
f^1 flat	= 655·36	
f^1	= 682·66	
f^1 sharp	= 711·11	
g^1 flat	= 737·28	
g^1	= 768	—2nd upper partial tone.
g^1 sharp	= 800	
a^1 flat	= 819·20	
a^1	= 853·33	
a^1 sharp	= 888·88	
b^1 flat	= 921·60	
b^1	= 960	
b^1 sharp	= 1000	
c^2 flat	= 983·04	
c^2	= 1024	—3rd upper partial tone.
c^2 sharp	= 1066·66	
d^2 flat	= 1105·92	
d^2	= 1152	
d^2 sharp	= 1200	
e^2 flat	= 1228·80	
e^2	= 1280	—4th upper partial tone.
e^2 sharp	= 1333·33	
f^2 flat	= 1310·72	
f^2	= 1365·33	
f^2 sharp	= 1422·22	
g^2 flat	= 1474·56	
g^2	= 1536	—5th upper partial tone.
g^2 sharp	= 1600	
a^2 flat	= 1638·40	
a^2	= 1706·66	
a^2 sharp	= 1777·77	—6th upper partial tone.
b^2 flat	= 1843·20	(= 1792 vibrations).
b^2	= 1920	
b^2 sharp	= 2000	
c^3 flat	= 1966·80	
c^3	= 2048	—7th upper partial tone.
c^3 sharp	= 2233·33	
d^3 flat	= 2211·84	
d^3	= 2304	—8th upper partial tone.
d^3 sharp	= 2400	
e^3 flat	= 2457·60	
e^3	= 2560	—9th upper partial tone.
e^3 sharp	= 2666·66	
f^3 flat	= 2621·44	
f^3	= 2730·66	—10th upper partial tone.
f^3 sharp	= 2844·44	(= 2816 vibrations).
g^3 flat	= 2949·12	
g^3	= 3072	—11th upper partial tone.

With the above scale before you, perhaps you may more correctly or more easily judge your own way of thinking, as set forth in your letter (26797). I shall be in your town for a few days shortly, and it will afford me much pleasure to have some conversation with you. Will you let me hear from you direct. **G. A. Audsley.**

Devon Nook, Chiswick, W.

[26844.]—I NOTICE that Mr. Audsley in his last article but one on "The Church Organ" intimates his intention of directing attention to Mr. T. Casson's system of organ construction. Having made myself well acquainted with it, and believing, as I do, that it is destined to work a revolution in the great art of organ building, I am sure Mr. Audsley will forgive me for suggesting to him that his account should be as exhaustive as possible, and thus aid in bringing to the front a system as excellent as it is simple.

E. W. Taylor, Mus.D., F.C.O.

HORIZONTAL WINDMILLS.

[26845.]—I THINK it is only right to mention, upon reading what "Q. E. D." says in letter 26823, p. 522, that I haven't had practical experience in the construction of any class of large windmills. Now, as to the merits of any form of horizontal windmill, it may interest some of "ours" to know that this is an ancient invention. I believe that I was experimenting, say, some fifty years ago with an arrangement for feathering the sails by means of a fixed eccentric similar to that in use upon feathering paddle wheels. As to the diagram of F. Russell, upon p. 522, if three of those sails were removed, I am convinced that it wouldn't revolve, and certainly it couldn't if it had any work to do, whereas even one of these sails upon a vertical would work well. To "Q. E. D.," same page: I really cannot see any reason to suppose that any vertical windmill would require a stronger framing or tower to carry same than would be necessary for a horizontal of same power. I am of opinion that the latter would offer more surface of resistance to the wind than the former—most of us know how, when a sail-boat is "put about" in a strong breeze, how she "lays over" until "way" is got upon her, and then assumes a more upright condition.

I cannot see any reason for assuming that the more or less jerky banging sails, as these proposed with ropes and stops, wouldn't, in a gale, require a much stronger edifice, if erected at a reasonable elevation. **A.**, Liverpool.

WIND POWER.

[26846.]—AS there appears to have been some slight difference in opinion among some of your correspondents relative to the pressure of wind, I send you a table which may be of some service to our friends contemplating the use of wind power.

This table is calculated from the data of Col. Sir H. James, and appears in his "Meteorological Observations," published by order of the Secretary of State for War, 1860.

Velocity and Pressure of Wind.—The pressure varies as the square of the velocity, or $P \propto V^2$. The square of the velocity in miles per hour multiplied by ·005 gives the pressure in pounds per square foot, or $V^2 \times \cdot005 = P$; also the square-root of 200 times the pressure equals the velocity, or $\sqrt{200 \times P} = V$. The subjoined table is calculated from this data.

TABLE OF VELOCITY AND POWER OF WIND.

Pressure in lb. per sq. ft.	Velocity in miles per hour.	Pressure in lb. per sq. ft.	Velocity in miles per hour.	Pressure in lb. per sq. ft.	Velocity in miles per hour.	Pressure in lb. per sq. ft.	Velocity in miles per hour.
oz.		lb.		lb.		lb.	
0·08	1·000	2·50	22·360	8·75	41·833	15·00	54·772
0·25	1·767	2·75	23·452	9·00	42·426	15·25	55·226
0·50	2·500	3·00	24·494	9·25	43·011	15·50	55·677
0·75	3·061	3·25	25·495	9·50	43·588	15·75	56·124
1·00	3·535	3·50	26·457	9·75	44·158	16·00	56·568
2·00	5·000	3·75	27·386	10·00	44·721	16·25	57·008
3·00	6·123	4·00	28·284	10·25	45·276	16·50	57·445
4·00	7·071	4·25	29·154	10·50	45·825	16·75	57·879
5·00	7·905	4·50	30·000	10·75	46·368	17·00	58·309
6·00	8·660	4·75	30·822	11·00	46·904	17·25	58·736
7·00	9·354	5·00	31·622	11·25	47·434	17·50	59·160
8·00	10·000	5·25	32·403	11·50	47·958	17·75	59·581
9·00	10·606	5·50	33·166	11·75	48·476	18·00	60·000
10·00	11·180	5·75	33·911	12·00	48·989	18·25	60·415
11·00	11·726	6·00	34·641	12·25	49·497	18·50	60·827
12·00	12·247	6·25	35·355	12·50	50·000	18·75	61·237
13·00	12·747	6·50	36·055	12·75	50·497	19·00	61·644
14·00	13·228	6·75	36·742	13·00	50 990	19·25	62·048
15·00	13·693	7·00	37·416	13·25	51·487	19·50	62·449
lb.							
1·00	14·142	7·25	38·078	13·50	51·961	19·75	62·849
1·25	15·811	7·50	38·729	13·75	52·440	20·00	63·245
1·50	17·320	7·75	39·370	14·00	52·915	20·25	63·639
1·75	18·708	8·00	40·000	14·25	53·385	20·50	64·031
2·00	20·000	8·25	40·620	14·50	53·851	20·75	64·420
2·25	21·213	8·50	41·231	14·75	54·313		

Lance Corporal
(2nd L. N. Lancashire Regiment).
Pembroke Dock.

[26847.]—I FIND that at Liverpool Observatory, Bidston Hill, which is about 200ft. above mean sea level, the mean hourly speed of the wind was in—

1879	15·6 miles per hour
1880	15·5 " "
1881	16·8 " "
1882	18·0 " "
1883	17·4 " "

At Oxford (113ft. elevation, I believe), Mr. Baxendell informs me that he has ascertained the

hourly mean for six years was $10\frac{1}{2}$ miles, and at Greenwich, where the anemometer is "50ft. above ground," the mean for 13 years is 11·9 miles. These results are much more favourable in regard to speed than at Southport. It is certain that much depends on elevation and situation. Bidston Hill is, of course, exceptionally situated, and it is not surprising that a high wind-speed is shown there. I hope the discussion will tend to some practical result.

Southport. **Benjamin Boothroyd.**

[26848.]—F. RUSSELL'S plan (letter 26821) would knock itself to pieces; I understand it to be four flaps to open and shut, according as the wind blows. Fancy the jarring of the flaps opening and shutting. F. Russell has left much to imagination, and does not appear to have thought of springs to mitigate the jarring. **R. S. T.**

HORIZONTAL WINDMILLS.

[26849.]—I CONTINUE to read with much interest the ingenious contributions of your inventive correspondents on the practicability of horizontal wind motors, but I have seen nothing yet that impresses one with the conviction of success. Mr. Hoskens (p. 522, Feb. 11) seems nearest the mark; but when he gets out of his model period into that of utility he will meet with many difficulties which do not appear to present themselves to his mind as yet, and which will probably render his machine unacceptable. I see he has adopted my suggestion of extending his outer spar as much below as above the arm to which it is fastened; but I qualified my opinion of it, and fear he will find it bristle with inconveniences in practice. Then his 11in. planks of 10ft. long will abstract a good deal of his sail-power, driving against the wind, when, to use a nautical idiom "you can hardly hold the edge of a knife to it."

A Mr. J. T. Hewes appears to have applied for a patent (No. 2154) on this plan in 1864; but it does not appear that he ever completed his specification.

The device so modestly introduced by Mr. F. Russell, of Walsall, is liable to much the same objections. The slamming of those doors of his, as each changes its position from going before the wind to coming upon it, requires so strong a framework that it is a mere variety of Mr. Valance's system, and would be very lumbersome, and any cordage to check the flam out of the sail (or door) would be liable to chafe itself through very soon. Jibing in a boat or ship running before the wind takes place at long intervals, and is carefully attended to by those on board, who haul in the sheet, and ease it off again. But in a horizontal wind-motor on either of these plans, let us say (in a working machine) at only eight revolutions a minute, every sail must jibe eight times in that brief space, or 480 times in an hour, automatically, or without extraneous aid. I do not say that this is a fatal objection; but no remedy has yet, I believe, been discovered for it.

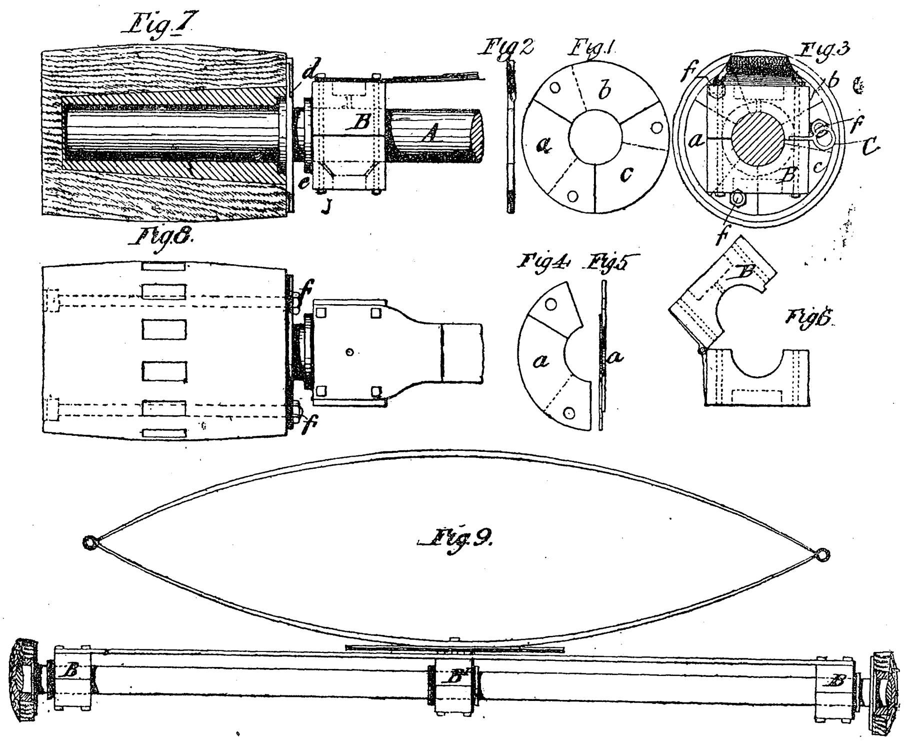
The suggestion of "Q. E. D." on the same page, to follow the lead of the ingenious Saml. Miller with more modern improvements, may be the right clue. But "Q. E. D." makes a mistake when he says that such a horizontal wind-motor "would need no more support than the absolute power given out by the machine at its best." He seems to have overlooked the resistance offered by the arms and flattened sails on the reverse side, for which at least 25 per cent. should be added. The support to a wind-motor capable of 2H.P. should be computed to bear a strain of at least 3H.P. I join with your other readers in offering thanks to Mr. Boothroyd (26760) for his lucid explanations and his table of wind velocity at Southport.

London, 12th Feby. **Raymond Browne.**

IMPROVEMENTS IN CARRIAGE WHEELS.

[26850.]—MR. EDWARD M. EARLE, of Kingston, Jamaica, has recently protected some improvements relating to carriage wheels and axles. He provides a very easy method for attaching wheels to mail-coach axles applied to carriages, buggies, and other vehicles by making the flanges in, say, three pieces, *a b c*, Figs. 1, 2, 3, 4, and 5, which partly overlap, and are flush with each other, with holes to receive the nave-bolts *f f f* when they are put over the axle A between the two shoulders *d* and *e*, and secured to the wheel by the nave-bolts *f f f*, holding the wheel on the axle as firmly as the ordinary solid flange, with the advantages, however, that when worn out, they may be replaced at a trifling cost without interfering in any way with the shoulders *d* and *e* on the axle. They may be taken off and replaced by any one who can use a spanner, and no smith is required.

Combined with these flanges or not, Mr. Earle makes the axles A of ordinary carriages, buggies, or other vehicles straight and round, with one or two shoulders near each end, as shown in Figs. 7, 8, and 9. The wheels revolve on the axles A, and the axles in bearings B; thus a very free or double



rotary motion is produced when the vehicle is in motion. The extra shoulders on the new axle are placed at particular points to keep the box-bearings B in place. Or, instead of using the means before described for securing the wheels in their places, the ordinary screw-caps may be used. The centre-box bearing B^1 on the front axle, as shown in Fig. 9, will have the perch attached by a coupling somewhat similar to that shown with reference to C, Fig. 3, which is for connecting the shafts or swingle-tree gear. The hind axle may be secured to the perch by stays.

77, Chancery-lane. **Jensen and Son.**

CLOCK AND SUNDIAL.

[26851.]—THE problem that Fred. Carre ascribes to me (p. 521, 26818) was not, I think, to make an identical dial give clock time throughout the year, but for a kind of double dial, with two gnomons and scales, each to serve that purpose nearly half the year. If I at first thought of their serving jointly through the whole year, I afterwards gave up as impracticable about the last half of December and a week in June. With those two exceptions—viz., about the week that the sun is in northernmost declination and the fortnight that he is southernmost, my form of dial (universal for all latitudes by standing on a pedestal rightly inclined), would, by mere inspection, give very nearly the second of mean time (certainly the tenth of a minute) whenever shone on by a sun 10° above the horizon. A sun lower than that is too refracted to give this degree of accuracy on any dial, at least outside the Tropics. Near the Equator we might so modify the scale of minutes as to obviate refraction, but not in moderate latitudes. I will shortly send the form of dial.

E. L. G.

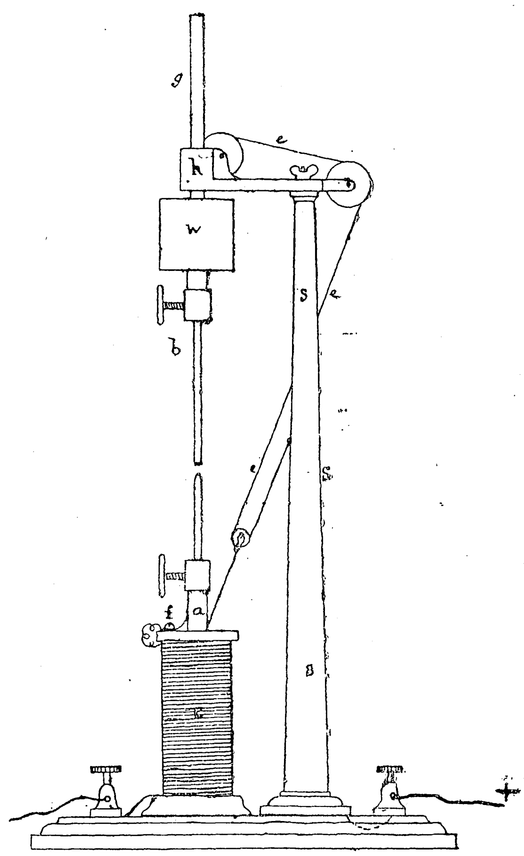
ROAD REFORM.

[26852.]—I THINK "F. R. A. S." must be looking at the work of reforming our roads with a microscopic eye. If taking traffic over unnecessary hills and dales is cheapest, why did our railway companies cut their roads level? Not because steam engines could not ascend gradients, but because it was cheaper to remove the hill-tops once for all, rather than carry a thousand times the weight of the hill-tops in traffic over the entire hills.

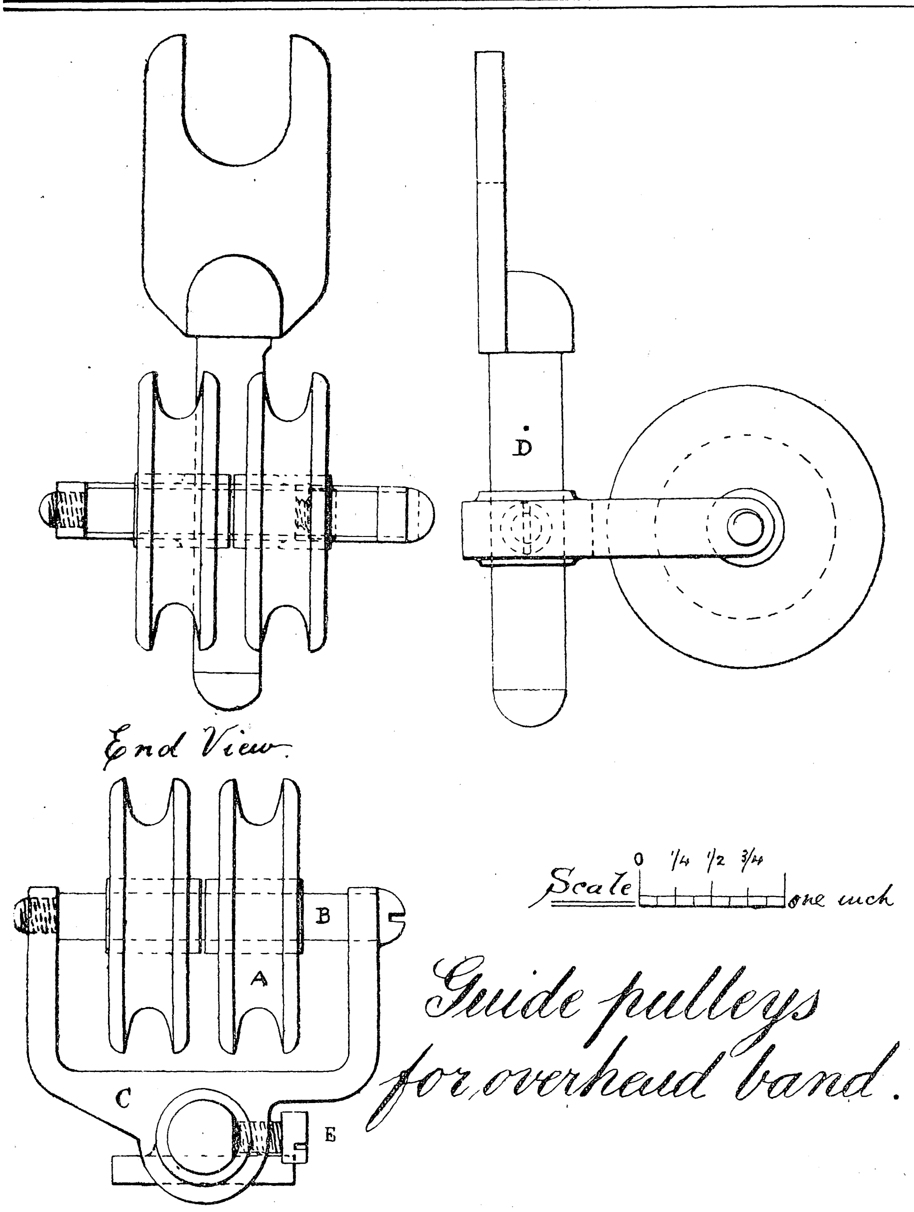
In reforming our roads, probably one half, at least, of our road hills might be avoided without materially hurting private property or increasing distance. The roads to be first reformed should be those upon which there is most traffic. The foot-pound unit cannot be discarded in calculating physical labour, for if "F. R. A. S." were to take one of the hill-tops to remove into a valley below, he would first go and measure the amount of earth to be removed before he would tender for the job; hence, he asks me questions respecting the roads of Devon and Cornwall which no man can approximately answer. A road-hill may be thick or thin, a valley wide or narrow, and the quantity to be taken from a hill will probably depend upon the valley to be filled up. A road-hill from which 20,000 cubic yards of earth had to be tippled into a valley below would probably cost an outlay of £600 with ordinary workmen; but if I had an imperial prerogative in the matter, I should have more than a hope to see it done for half that money. **Norfolk.**

A SIMPLE ARC LAMP.

[26853.]—THINKING it might interest some of your numerous readers, I venture to inclose a sketch of a simply-constructed arc lamp which I



have designed and believe to be original. Referring to sketch—*a* is a brass tube with a holder for the negative carbon. At the lower end of this tube a short bar of soft iron is fixed, and the whole is capable of vertical motion in the helix *c*. A light spring (*f*) makes connection with *a*, and is again connected to one end of coil, the other going to the negative terminal. *g* is a square guide-bar sliding in guide (*h*) and carrying the holder and upper carbon, *b*. It has a groove down one side in which the supporting cord (*e*) may run. *w* is a



weight counterbalancing that of *a*, to which it is connected (not electrically) by means of the cord and pulley arrangement. It is sufficiently heavy to bring the two carbons together when no current is flowing. To effect this, taking into consideration the mechanical advantage of the pulley arrangement, the weight of *w*, together with that of holder, should be rather more than half that of *a*, and should be made adjustable, so that the length of arc may be regulated to suit the current employed. The action of the pulleys and cord is apparent. Through whatever distance *a* ascends, *b* descends through double that distance, and thus as *b* is the positive carbon and burns at twice the rate of *a*, the centre of light will remain practically stationary. The whole action of the lamp is simple. A current entering at + terminal flows up the support (S), down through the carbons, round the coil, and back to the source. The carbons are immediately separated by the pulling force exerted by the helix. Should the separation exceed a certain amount, the weight (*w*) brings them together again.

Sydney, N.S.W. **H. D. B.**

LATHE MATTERS—GUIDE PULLEYS FOR OVER-HEAD BAND.

[26854.]—FREQUENTLY, while working with the overhead motion as supplied by the maker of my lathe, I have been troubled by the band overrunning the pulley of the drilling spindle or other tool in use at the time.

When this occurs during a finishing cut, it leaves an objectionable mark on what would otherwise have been a finished surface. A very slight amount of guidance is all that is necessary to prevent accidents of this kind, and, in the hope that it may be of use to others in the same position as I used to be, I send the accompanying sketch of the guide pulleys which I now use with perfect success.

When in use, the forked tongue is fixed under the nut of the central bolt of the Willis pattern tool-holder.

The pulleys on their movable framework (C) are then moved along the arm (D), until the band runs nicely on to the pulley of the drilling spindle, and is then clamped into position by the set-screw (E) at the side of the frame.

The pulleys I prefer made in hard wood, thickly bushed with brass, as these bushes can be easily renewed when the pulleys become noisy through wear. They run upon a steel spindle (B), one end of which is screwed into the gun-metal sliding-frame (C).

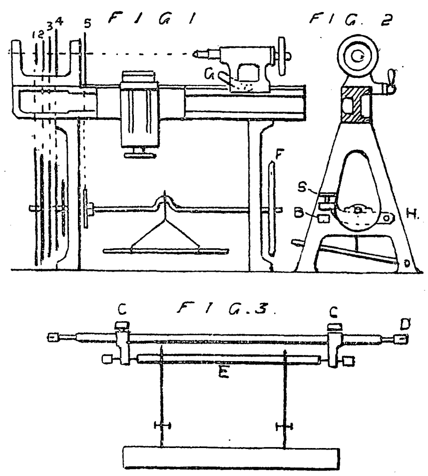
The arm (D) and the tongue are of gunmetal in one piece, and though shown forked for fitting round the bolt of a Willis tool-holder, it could be easily fixed by a couple of set-screws in any convenient position.

Castings of the gunmetal parts off my patterns may be obtained at Messrs. Mills's foundry, whose address I have already given in the address column. **W. R. W.**

[26855.]—To Mr. Carre, who asks me to return a drawing he sent me, I am very sorry to have to confess that I fear it is lost.

I am glad "Vulcan" is working at the "E. M." lathe. The primary idea with which we started on the "front-slide" railway was that the saddle should pass out of the way without requiring the poppet to be disturbed, nor work held between the centres unfixed; possibly, we may be sacrificing too much to obtain this, but, for my part, I do not feel able to give it up and go back to the old system of lifting the poppet about. In a properly-arranged lathe the washer under the poppet will turn a quarter round, and lift out between the shears as easily and quickly as in "Vulcan's" plan, but we don't want to have to lift it at all.

As to the lower part of the lathe, I send a little sketch to show what seems to me a good way of arranging matters. I think it would be a great convenience to have the flywheel *overhung*, because then the belt for speeds 1, 2, 3, 4, and for the overhead need not have hooks and eyes, but might be spliced or endless, and have no nasty periodical jerk when going over a small pulley; the belt on speed 5, which represents the groove in the large faceplate, works with a small separate pulley *inside* the frame; it will be a shorter belt, and will require a hook and eye. The bed is really *better* supported on the moved-in frames; also the crank shaft is shortened, and therefore not so liable to spring. Instead of centres the crank-shaft runs in a cast-iron bearing, separate from the frame but hinged to it at H, Fig. 2; a screw, S, in the other end of the bearing-arm rests on a lug B, and takes the weight of wheel, axle, treading, &c. This screw and the one at the other end is easily adjusted by



hand, and serves to tighten or loosen the band. The rocking end of treadle has also a height adjustment, which will compensate for that of the shaft, see Fig. 3, where D is a strong stay-bar (very different from the little ⅜in. rod usually put in) CC, are short cranks fixed upon it, and carrying the points on which the treadle bar E turns. This part is similar to Mr. Plant's arrangement; at *k k* the bottom of the forked pitman ends take hold, on Mr. Evans's plan, so as to support both ends of the treadle foot-board.

How do our friends dislike this arrangement?

I have four ostrich eggs to mount, and am rather disturbed to find the small end is about as large as the other; also they are not truly circular, but slightly flattened, elliptical in cross-section slightly, and elliptical (not oval) in longitudinal section, too, yet not truly so. Surely the bird's lathe was out of order. Will someone advise me? I will give my experience if anyone cares for it.

F. A. M.

GUT LATHE BANDS SUPERSEDED.

[26856.]—I HAVE resided for some years in the dampest of our English counties, and have been worried by the continual stretch and softening of "gut bands" in my foot lathe; I am now happy to say I have discovered a most satisfactory substitute in the "Metallic Sash Cord," warranted by the patentee to last 150 years!

I anticipated objectionable results in heat and friction; but was agreeably surprised to find that the cord remains as cool as possible under the highest rate of speed, and that there is no abrasion in either that or the wheel. I prefer brass or copper hooks and eyes, as they easily admit of soldering to the cord; but in my case, having a lot of the above steel joints on my hands, I have been content to fasten them in the following way:—I have drilled a very small hole through the screw part of each by softening them, and have attached them to the cord with "bicycle cement," then putting a sharp steel pin through the holes. This additional trouble is quite unnecessary when the work is soldered in the manner described. The metallic cord should be thoroughly stretched and straightened before mounted with hooks and eyes.

Eos.

THE STRUCTURE OF EUPODISCUS ARGUS.

[26857.]—MR. E. M. NELSON, in the April number of the *Journal* of the Royal Microscopical Society, describes the above diatom as "consisting of two membranes; the outer with oval areolations with granulated interspaces, and the inner with white dots with very minute perforations grouped around them."

With regard to the outer membrane I have nothing to say, as it entirely agrees with my own observation; but with all due deference to so great an authority, I cannot accept his interpretation of the inner membrane.

I admit the white dots; but in my opinion they are perforations of the same character as the outer

only smaller, and what he considers minute perforations to be granulations also, but larger than those on the interspaces of the outer membrane. I am confirmed in this opinion by the fact that there are similar dots scattered about in the interspaces of the outer membrane, which behave when viewed either in or out of focus in precisely the same manner, showing no colour, while the minute granulations change from red when in, to white when out of focus, the same as Angulatum.

T. F. S.

RAILWAY SIGNALS.

[26858.]—MR. STRETTON says that "signalmen sometimes omit to put back the signal lever," consequently the signal is left in the "off" position, and the train unprotected—which certainly is correct, having led to many serious and fatal accidents. Now, the object of my patent apparatus is for the train to automatically release the signal to "danger," without interfering with the duties of the signalman; and should the lever be left "off," the signal would be at "danger," the lever (by means of a catch) might admit of being put back in locking position, thus preventing the signal being locked by electricity on the wrong side.

Jno. Harrison.

185, Well-street, Hackney, E.

ELECTRIC LOCKING FOR RAILWAY SIGNALS.

[26859.]—I HAVE read with very great care and interest Mr. Spagnoletti's description of his system of electric locking (page 521, letter 26184), but the important point which I raised in my former letter, page 436, 26710, still remains absolutely unanswered, and cannot be explained away.

Mr. Spagnoletti says, page 521, line 28, "On 'A.' putting the lever back it is mechanically locked." This is perfectly true; but suppose for a moment that signalman "A." omits to put the lever back. What is the result? Simply, the electric locking system will be rendered useless, and fail in its object.

No system can be considered safe which depends solely upon one man replacing his lever. I am very glad to learn that Mr. Spagnoletti (p. 521) has "somewhat altered his views, and prefers two strings to his bow." That opinion entirely coincides with my own, and for that purpose I would give the signalman at each end of each block-section the control over the starting signal at the entrance to such section. For short sections the mechanical slot-signal is very efficient, and for long distances I know of no appliance more simple or more efficient and safe than the "electric-slot."

Mr. Spagnoletti considers that the important objections to the lever having to be put back are "quibbles"; but he must remember that it is upon such so-called quibbles that railway signalmen are, and have been, sent to prison for six months' hard labour; therefore, I cannot consistently with my duty report in favour of any system which does not provide an absolute mechanical block-system which cannot fail in its object, or break down by the mistake of one man.

Clement E. Stretton,
Consulting Engineer, Amalgamated Society of Railway Servants.

St. Pancras Hotel, London, N., Feb. 11.

[26860.]—I WAS very pleased to see Mr. Spagnoletti's account of his system. Would it be asking too much to give a sketch of the lock with the electrical apparatus for releasing it? One or two points are, however, not quite clear to me. I do not see how it is possible for one instrument at a junction to work any number of lines approaching it. Also, at what time is the disc "Train arrived" taken off in the indicator?

Reymond.

FAST TRAINS.

[26861.]—I CAN assure "M. R." that I carefully timed the train referred to in my letter (26774), between Luton and St. Alban's, and it was done in as near as possible 8 minutes.

O. H. P. Scourfield.

VERY DAMP.

[26862.]—IN the early part of 1872 "E. L. G." had a discussion with "Sigma" concerning a miraculous comet, which the former contended had caused the Noachian Deluge; and *apropos* to letter 26832 I wish to say that I have no desire to renew that controversy. If it pleases my friend to imagine that on one occasion six hundred feet of rain fell in a single day, it is not for me to argue about the matter—in fact, *argument* is impossible. I may mention, however, that at present the wettest place in the world has a rainfall of only six hundred inches in a *year*. A fall of one inch in twenty-four hours is not common, and a fall of six hundred feet in that time is nonsense. I can easily understand how a man who manages to believe this rejects the evolution theory, and personally I am glad he does reject it.

Wm. John Grey, F.C.S.

Newcastle-on-Tyne.

THE ACHROMATISM OF LENSES.

[26863.]—IN reply to "W. G. P." (letter 26795), the formula I gave is certainly not a new one. I cannot say to whom it is due; but my first meeting with it was in Barlow's paper on "The Object Glass," where he uses it to find the dispersive ratio of a crown and flint glass pair. Anyhow, it can easily be deduced from ordinary optical equations; but I consider it quite unnecessary to take up space with a demonstration. I have an impression that Sir John Herschel also used this formula. As regards the modification for a particular value of *s*, which has relation to the Galilean form of opera or field-glass, I believe Dr. Brewster used it in discussing the prospective improvement, or increase, in magnifying power, without destroying achromatism, by the use of eyeglasses of high dispersive power.

I am not so readily convinced that the formula given by your esteemed correspondent is "much more correct" than the preceding one. It seems to me to be purely an eyepiece formula—that is to say, the emergent rays of different colours are to be rendered parallel; whereas in the original formula, which is, in its unmodified form, strictly an objective one, the different coloured rays are to be brought as nearly as possible to one focal point. I freely admit that in its modified form it may not be altogether correct, owing to the altered conditions, as the rays are then transmitted direct through the concave lens to the eye, and are not brought to a focus; but if the original formula is used, and the rays permitted to come to a focus, I see no reason for doubting the correctness of the equation.

I should be glad if "W. G. P." and "F.R.A.S." would notice the following matter. Recenty, in looking carefully through Prof. Harkness's "Theory of Achromatic Object-glasses," in which he uses Cauchy's formula, it occurred to me to compute the constants for several of the new optical glasses. But I could come to no satisfactory conclusion, as to which lines could be considered to give the most nearly correct constants. If the formula were strictly correct, any three lines should give identical results; but I do not find this to be so. If, then, we have, say, a table of measured indices for the lines A to H inclusive, which three should be used to compute the constants, and what is the most correct method of computing them? Dr. Hastings speaks of using the "method of least squares" for a similar purpose; but no example is given.

Prof. Langley, in his "Observations on Invisible Heat Spectra," speaks of the use of Wüllner's new formula (founded on Helmholtz's theory). Can any of your correspondents say what this new formula is, and in what respect it differs from Cauchy's? Reference is made in the Professor's pamphlet to Wiedemann's *Annalen*, Band XXXIII. p. 307.

Orderic Vital.

WASTE IN LECLANCHE BATTERIES.

[26864.]—PERHAPS it may interest some of the readers of "Ours" to know a simple and inexpensive method of preventing the creeping salts in Leclanché batteries. I have used the following for some time with perfect success. After charging the battery with the exciting solution, pour carefully a layer of oil (I use raw linseed oil), about $\frac{1}{2}$in. thick, on the top of the solution, where by its lighter gravity it remains and effectually prevents creeping salts.

J. A. Halhead.

BURNT AIR.

[26865.]—THE inconsistency of human nature is truly marvellous. Here we have "A. P. S." rebuking me with scathing irony for writing what he avers I do not know, whilst he himself concludes his diatribe with a merely weak-kneed hypothesis. As to what is, or what is not, an absurdity, I don't think the world at present is prepared to accept "A. P. S.'s" *ipse dixit*. At all events, when a man deliberately calls a thing an absurdity, the onus of proving it so rests with him.

In corroboration of the aqueous vapour theory as set forth in my letter (26792), I beg to refer "A. P. S.," or any other sceptic, to the "Encyclopædia Metropolitana," 1840 edition, article "Stove," and if this is a manifest absurdity, I will ask "A. P. S." to explain the following, which occurred within my own experience. Two boilers recently under my charge, of the cylindrical multitubular marine type, connected through their smoke-boxes and dry uptakes to one funnel, in such a manner that a small segment of each boiler shell was inclosed within the uptake, and subject, of course, to the heat of uptake. These portions of boiler shell were in the steam space. A process of rapid deterioration by oxidation took place within the boilers on these heat exposed surfaces only, purely local, and not in any sense allied to boiler corrosion, as generally understood to be due to magnetic action. Both boilers are fitted with Hannay's patent "Electrogen," which acted admirably, for there is no sign of deterioration in any other part.

How will "A. P. S." explain this but on the hypothesis that the immediate layers of steam, in contact with these heated portions of the shells, are decomposed, and the free oxygen thereon combining with the iron? The ends of the longitudinal stays in this vicinity are similarly affected, $2\frac{1}{2}$in. stays being quickly reduced to $2\frac{1}{8}$in.; but bear in mind only in the locality particularised. And let me say that the heat here never approaches to a red heat; flame there is none—merely the hot products of combustion, so that the analogy to a hot stove or stove pipe is nearly perfect.

I cannot think the red hot gun-barrel is a *sine quâ non* to the decomposition of aqueous vapour.

J. Q. D.

GELATINE HYGROMETER.

[26866.]—ON reading your article on p. 426, I made a gelatine hygrometer as per sketch, Figs. 1 and 1a, but with six instead of three free coils. This I fancy too sensitive, and reduced the number of coils to three. They are made by varnishing one side of a paper strip $\frac{7}{8}$in. wide with a varnish I had by me, consisting, I believe, of shellac and a little gum benzoin. The varnish being about the consistency of French polish, it took three coats to produce a shiny surface.

While still damp, I coiled the paper round a $\frac{5}{8}$in. ruler, and left it till the outside felt dry. I then slipped the ruler out, and allowed the inside to dry,

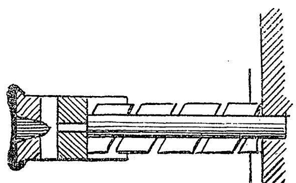


FIG 1a.

FIG. 2.

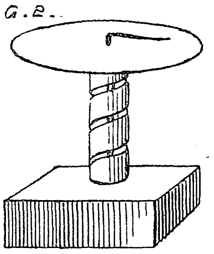
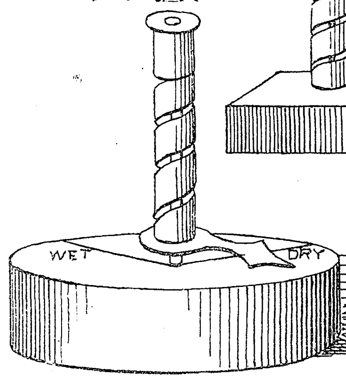


FIG. 1



and then replaced the coils on the ruler, coiling them tightly, and fixed the ends with indiarubber bands.

Not knowing the proper proportions, I soaked some gelatine (Nelson's opaque) in a half-saturated solution of salicylic acid (which was hot) until I had a glue of the thickness of treacle. With this I gave the paper two coats, and left to dry. Before quite dry I again loosened the ruler, and separated those coils which had stuck together. I then replaced the ruler and indiarubber rings and left till next day. The coating of gelatine when dry was about twice as thick as the coloured gelatine on crackers; I used cartridge paper. A wooden rod was then fastened with shellac to the top of a cardboard box, and a cork made to fit the top of it.

This cork I drove into an empty Eley cartridge case, to which also one end of the coils was cemented; the other end hung freely, and carried a paper index. In Fig. 2 the wire index is stationary, and the dial revolves with the paper.

Glatton.

DEPOSITION OF ALUMINIUM.

[26867.]—IT would be of interest if Mr. White (p. 521) would give details of Mr. Thompson's pro-

cess of depositing aluminium, for very little seems to be known about it, and Gore, quoting from the *Chemical News*, XXIV. 194, says the temperature was "about 500° Fahr." Perhaps Mr. White would tell us how the "strip" referred to was coated with aluminium. A. J. T.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[61048.]—**Electric Conductors.**—The printer, in adding a dot after "in." in my question (2), page 502, has answered it. For want of this dot under Mr. Lancaster's table, page 457, I failed to understand that he meant the current per square *inch* of conductors is 1,400 to 1,700, which this little dot has enabled me to do. In looking further into Mr. Lancaster's table, I now consider that 19/16 means only one wire, each way, of 19 and 16 gauge for forward and return current respectively. —ACIER.

[61083.]—**Axles Breaking (U.Q.)**—TO MR. RABACHE.—When once a flaw in steel has started, and the jar or work is continued, nothing can stop its growing. It is easy to speak of making things "unbreakable"; but I ask, Can it be done? I reply, No.—PRACTICAL RY. MAN.

[61084.]—**Fireclay.**—I observe with pleasure that I have not received the castigation which perhaps I deserved. What do your readers say to a lining for a furnace made of—ganister (nearly pure silica), alumina, lime (milk of), as a binder, and magnesia? For the moment, leave cost out of the question.—R. S. T.

[61138.]—**Yacht Steering.**—Mr. Beeching will find my address advertised. I think "H. S." may modify his opinion when he is informed that the yacht in question would be shallow, and intended chiefly for river sailing, in which quick turning is essential.—G. H. V.

[61338.]—**Coiling Wire.**—Suppose this querist uses a built-up mandrel for winding the wire round, and, having hammered or rubbed the latter into proper position, drives out the centre or tightening-piece of his mandrel, will not that suit him? Probably he disarranges his coils in forcing the wire off the mandrel. The remedy is to take the mandrel out of the coils by withdrawing a centre-piece.—NUN. DOR.

[61340.]—**Gramme Dynamo.**—Should not this querist adopt some one of the series of measurements given many times in back volumes? It seems to me that particulars of all sorts of small dynamos have been supplied over and over again. C. K. L.

[61350.]—**Air-Gun.**—To answer this query it would be necessary to examine the gun; but let the querist refer to p. 43, this volume, and p. 36, last volume, and he will probably be able to understand the construction of his gun.—C. K. L.

[61452.]—**Electrical Apparatus.**—Secondary batteries can be charged by means of a primary battery for lighting to advantage. There being but few cells used, and the solution can be worked out almost to complete exhaustion, which is impossible when lighting direct from primary batteries on account of the fall of E.M.F. The secondary batteries are charged in parallel from a set of three to four primary cells (in series). The secondary batteries are connected to a switch for turning them into series and on to the lamp circuit, or in parallel on to battery circuit. The following formulæ and example may be useful:—
Let

P = average candle-power required,
h = number of hours lighting per day,
$24 - h$ = available charging hours.
C = minimum charging current which for $(24 - h)$ hours would give Ph, the candle-power hours required.
V = E.M.F. of each secondary cell.

Supposing charging from primary cells takes place the whole of the time when lamps are not on—that is, for $(24 - h)$ hours, then

$$C = \frac{P \times h \times 4}{V\,(24 - h)} \text{ allowing 4 watts per candle.}$$

Example.—Let

P = 15 (three lamps of 5c.p. each),
h = 4
V = 2

$$C = \frac{15 \times 4 \times 4}{2\,(24 - 4)} = 6.$$

Thus six ampères for 20 hours charging accumulators in quantity would give 60c.p. hours. In my formulæ I take 4 watts per candle, which I find sufficient for loss in secondary batteries, assuming the lamps have an efficiency of 3 watts per candle. —W. HABGOOD.

[61466.]—**Gold Gilding.**—The answer to this in issue of January 28 may, in the hands of your correspondent, be successful, but is hardly a usual one. The common way is this: To begin with, most metals will do if clean without painting, but are generally better for several coats. The last should dry flat. Wood or any absorbent material must be painted, or something done to prevent the gold size drying in too rapidly. It will generally be best to give the parts to be gilt, whether painted or not, a thin coat of shellac varnish; it makes the surface smooth, and prevents the drying in. Next, the parts to be gilt are coated with gold size (mentioned again below), and when it is just tacky to the back of the finger the gold is laid on, either directly out of the book or preferably with a tip or thin, wide, long-haired brush, out of a pad generally made of soft leather, with a back of parchment to keep the gold in. The gold is taken up by the knife and manipulated till in a suitable position on the pad, and then gently blown down flat. Seeing this done would be advisable, or you will spoil plenty of gold. It is then cut with the knife, which must have a smooth, sharp edge, into suitable pieces; for some things they do not want cutting at all, but it is very difficult to lay a whole leaf at once. It is then taken up by the tip, which is generally rubbed on the hair or beard, but unless this is charged with some *statical electricity* in the shape of hair-oil, it will not assist the tip to lift the gold. When the gold is in place, it is pressed lightly on with a bit of wool or a soft-haired brush, and left for a time, and afterwards brushed off with a somewhat harder one. Gold size.—There are two kinds used commonly, one known as quick size, which dries under an hour, and is, therefore, only suited for small or short jobs, though it may be slowed by mixing chrome yellow in tube with it or a little oil size. Oil size is sold in pots, is something of the consistency of white lead, and requires thinning with quick size, and sometimes drying oil, before use. It requires some experience to do this, so an amateur had better use quick size, though the other makes the best work. There are other kinds made, but cannot always be had, and not in small quantities.—J. M'G.

[61474.]—**Silver Cell.**—Whatever does your correspondent, "C. D. R.," mean by "previous to connecting up (chloride or silver cell) just short circuit for ten minutes"? I have made and used a number of these cells, and have always found that a cell short-circuited for even ten minutes was half spoilt. Short-circuiting battery cells means simply wasting their contents.—J. PEYTON DAVIES.

[61504.]—**Double Electric Bells.**—Thanks to Mr. Lewis for his reply. Should he or any of our readers wish to know more about the short-circuit bell he is good enough to send a sketch of, they can do so by referring to pages 572, 596, and 646 of Vol. XXI. "E. M." At the time this bell was introduced (1875) for some reason it met with considerable opposition; in fact, from my own point of view, faults were found that did not in reality exist. I had one of the bells made exactly as Moseley's, and testing it with same cells as the ordinary one, its sound was quite equal, if not louder. This idea is evidently entertained by the writer of the articles in the *Electrician* for May 14, 1886, for he states: "Bells arranged in this manner, however, do not ring so energetically as ordinary trembling bells with a corresponding amount of battery power." I do not quite understand what you mean by expecting to find a spark at the contact breaker (or rather maker); the circuit is not actually broken, is it? For Moseley's improvement on his first bell, see *Electrician*, p. 152, Dec. 24, 1886; in this he places the contact maker between the magnet coils, in the centre of the armature.—M.M.I.SC.S.

[61506.]—**Compound Engine.**—Stroke 18in., revolutions 150 per minute, boiler pressure 90lb. IH.P. = 350, required diameter of cylinders. Assume ratio of cylinders to be 1 to 3, and expansion = 8, back pressure 4lb. per square inch. A = area of low-pressure cylinder, S = stroke of piston, ·385 = multiplier for 8 expansions. Then m.p. = (90 + 15) × ·385 − 4 = 36·4 A ∴ = $\frac{33000 \times 350}{36{\cdot}4 \times s \times 2 \times 150}$ = 705 square inches area for low-pressure piston = 30in. diameter, and $\frac{705}{3}$ = 235 = area for high-pressure cylinder = $17\frac{3}{8}$in. diameter nearly. If it is brake power that is required, then $12\frac{1}{2}$ per cent. should be added to the respective areas.—C. TRATHEN.

[61511.]—**Dynamo.**—You should be able to get nine lamps each 8c.p. actual. These are commonly spoken of as 10c.p. Get 45 volt lamps each requiring ·68 ampère, or, say, 30 watts each. Couple them all in parallel; use Woodhouse and Rawson's lamps—they give a high efficiency and a reasonable life. An Otto gas-engine indicating over 1H.P. should give you the power you require — but you will require about ·75H.P.—on driving-belt to work your lights well, as it will be reasonable to expect so small a dynamo to have only a low efficiency, say, not more than 60 per cent. Run the dynamo with a long belt, and loose as possible, having loose side on top, and put a disc flywheel on dynamo-spindle about 20in. diameter, weighing 70lb. or 80lb. Before buying engine, see it tested, and stipulate for a given power obtainable from belt on flywheel, with a known consumption of gas. An engine tested by me shortly only gave out 48 per cent. of power (in cylinder) at driving-belt; but there are plenty of good and cheap engines now. You should be careful of advice given by correspondents which they cannot submit through the columns of "Ours." It is a great pity so much gratuitous advertising is done in this way.—OHM.

[61518.]—**Gas - Engines.**—Would Mr. Conry please say what he means by over-hot cylinders?—as our experience is that the hotter the cylinder the more powerful the engine—that is, it takes fewer explosions to do the same work. We were told by one of Messrs. Crossley's men to let the cylinder get pretty hot (of course in reason). Who is right? It seems as the gas-engine is a heatengine, and as any heat passing through the walls of the cylinder is wasted, it is anything but economical to keep the cylinder any cooler than is absolutely necessary. What this is we can't exactly say; but cylinder oils can be had to stand 500 or 600 Fahr. We would also be glad to know what parts of a well-made gas-engine are more lightly built than a steam-engine of similar power. The querist may rest assured that if he strains the engine through overheating, he will want a new cylinder and piston, after which his engine will probably be as good as new.—J. M'G. AND S.

[61533.]—**Speed Wheels.**—"A Country Millwright" would buy the MS. of the book if "M. York" would sell cheap; but he would get more off a publisher than I could give.—A COUNTRY MILLWRIGHT.

[61551.]—**Flow of Water through Pipes.**—I do not see how "St. George" gets his $3\frac{1}{2}$in. diam. He seems to forget that the velocity varies with the diameter as well as the inclination.

Let v = velocity in feet per sec.
d = diam. of pipe in feet

$$\text{Then } v = 97{\cdot}05 \sqrt{\frac{d}{4} \times \frac{1}{100}} - {\cdot}08$$
$$= 97{\cdot}05 \sqrt{{\cdot}005} - {\cdot}08 = 97{\cdot}05 \times {\cdot}0707 - {\cdot}08$$
$$= 6{\cdot}7814\text{ft. per sec.} = \text{velocity in large pipe.}$$

And amount of discharge—

$$= v \times d^2 \times {\cdot}7854 \times 60$$
$$= 6{\cdot}7814 \times 4 \times {\cdot}7854 \times 60$$
$$= 1278\,.\,26 \text{ cubic feet per minute.}$$

Now the smaller pipe must be capable of taking the same amount of water.

Let W = cubic ft. per minute of discharge
P = diam. of pipe in inches
H = head of water in feet
L = length of pipe in feet.

Then, from the above formulæ—

$$D = {\cdot}545 \sqrt[5]{\frac{L \times W^2}{H}}$$
$$= {\cdot}545 \sqrt[5]{20 \times (1278{\cdot}26)^2}$$
$$= {\cdot}545 \sqrt[5]{20 \times 1633949}$$
$$= {\cdot}545 \sqrt[5]{32678980}$$
$$= {\cdot}545 \times 31{\cdot}83$$
$$= 17{\cdot}347\text{in.} = 1{\cdot}4455\text{ft.}$$
$$= \text{diam. required for smaller pipe.}$$

Proof. The velocity in the small pipe may be found from the first equation, taking $d = 1{\cdot}4455$, and inclination 1 in 20, and is 12·9636ft. per sec. And substituting this value of v in the second equation, and $d = 1{\cdot}4455$ft., the discharge will be found to be the same as for the large pipe. I will be glad to explain further if required.—ELAG.

[61548.]—**Shipbuilding.**—I am glad to hear that "Novice's" query was not intended to be funny; but, nevertheless, to a "man capable of answering the question," it will appear very funny indeed. For the question is the "method of boring out stern tube, and getting the ship ready for launching." Now, if any stern tube is bored at all, it is bored in the shop before it is taken to the ship; but, as a matter of fact, it is generally a piece of cast-iron pipe! In the navy it is made, I believe, of brass or gunmetal; but even then there is no necessity for boring it, as it is in reality little more than a water casing for the tail-shaft. In the navy the tail-shaft is usually cased with brass or gunmetal, and, therefore, to prevent galvanic action the stern tube is of the same, although it is then encased in an iron cover. The hole in the body post is generally roughly bored before the stern frame is erected, and it is finished when the stern tube is fitted, which cannot be done until the "lines" of the machinery can be accu-

rately centred. The stern tube, too, is fitted with bearings of lignum vitæ, so that the tail shaft does not rub against the interior surface of the stern tube, and there can, therefore, be no necessity to "bore" the latter. The questions are, however, of too special and technical a character to be worth much space in these columns, especially the method of getting the ship ready for launching. Perhaps the querist will state whether or not he found the query in an examination paper, for if he did, it is one of those catch questions which are employed by examiners to test whether the candidate has been merely crammed or has definite and apprehensive knowledge. If after this explanation "Novice" experiences any further difficulty, no doubt some of your readers will be ready to help him.—VIDEO.

[61560.]—**Engineering.**—I think "J. H." has looked at the above question in a very unfair way. He writes from an employer's idea, and not viewing the subject as an unprejudiced person would do. Not only that, but perhaps he will think differently when he reflects that there are both large works and small works. In the former, several descriptions of engines may be constructed during the pupil's stay in the shops, and plenty of each sort may be sent out, thus allowing any pupil ample opportunities for gaining thorough practical knowledge of his subject; but in the case referred to there are not more than 150 men employed, and such classes of work as compound engines, condensers, &c., &c., are rarely seen in the works, and then it is a case of "look, but don't touch." Speaking collectively, pupils to the engineering profession do not get the advantages their premium would warrant; and I may add that it is not a case of gentlemen who wish to be non-workers, as you put it. I quite agree with you that every pupil should do rough work; but I am sure nothing but rough work is rather monotonous, not to say unedifying. I am rather reminded of the Duke's remarks in "Patience" anent "toffee." Perhaps someone else will take this subject up.—DISGUSTED.

[61571.]—**Organ Accordion.**—In reference to the above question asked by "Derfla," and answered by G. Fryer, if Mr. Fryer would kindly send particulars for insertion in the "E. M.," he would confer a favour on another reader who has an instrument sadly out of repair.—JOSEPH E. KEATS.

[61574.]—**The Calculus.**—In common, I have no doubt, with many readers of the ENGLISH MECHANIC, I have read with great interest the explanations of the several correspondents who have attempted to lessen "Tyro's" difficulty, for I have felt, and to some extent still feel, the difficulty he refers to. The numerical illustration of "M.I.C.E." is beautifully clear, and has removed much of the difficulty which, like most beginners, I felt; but I am not able wholly to follow him when he puts his illustration in the dress of the calculus. The following extract contains my difficulty: "The space has, therefore, expanded Δy square feet in $\frac{\Delta x}{3}$ seconds, or $3\,\frac{\Delta y}{\Delta x}$ in one second." How does the increment of x become the divisor in the last expression? Is it too much to ask of "M.I.C.E." that he will explain these symbols in words? Young students of the calculus have to encounter what seem to be very contradictory statements with respect to the notation of the calculus. For example, Young says, p. 5: "The expressions $\frac{dy}{dx}$ and $\frac{dz}{dy}$ have, we see, the advantage over the symbol $\frac{o}{o}$ of particularising the function and the independent variable under consideration, and of thus restricting its signification; and this, it must be remembered, is all that distinguishes $\frac{dy}{dx}$ or $\frac{dz}{dy}$ from $\frac{o}{o}$ for dy, dx, dz, are each absolutely o." Ritchie says, 1st edition, p. 42: "The differential of the independent variable when we are employing real quantities is either a part of the variable itself, or we may take it equal to the whole variable, or even twice, three times, or any number of times of the variable. The differential of the function is also a part of the function, or it may be equal to it, or even greater." To a beginner these two statements appear contradictory.—ANOTHER TYRO.

[61574.]—**The Calculus.**—"Tyro" should try to obtain and read the first volume of Prof. Bartholomew Price's "Infinitesimal Calculus." This is a work which is not nearly so widely read as it deserves to be. Prof. Price being an Oxford man, and the sister university having such a reputation for mathematics, few people care to look farther afield than the Cambridge mathematical textbooks. Most of these latter are so brief and business-like that they become repulsive to the unaided beginner. But in Prof. Price's four goodly volumes "talk," as the Cambridge students call it, is not so much eschewed, and the result is that the work is more readable and intelligible than most of the green volumes we are all familiar with. The work is published at the Oxford University Press.—CALCULUS.

[61575.]—**Indicator Diagram.**—To "T. C., Bristol."—Having done what you suggested some days ago, I inclose results, and hope to have a thorough analysis given of the same, and also to receive any suggestion how to improve matters. I would gladly send samples of diagrams, but they would be useless if served by our editor as he generally serves them—viz., reduce them to microscopic size and never say a word about it; but, still, the full particulars following, which were carefully taken, will, I hope, prove useful to others besides myself:

	First day jacket on.	Second day jacket off.
Total hours run	17·	21½
Average per minute	19·15	19·11
Total coal, gross	3696lb.	5460lb.
Ashes	132lb.	184lb.
Feed water	2358gal.	3700gal.
Evaporation	6·48lb.	6·77lb.
Injection at 50°	52·275gal.	65·415gal.
Av. press. 3 sets of cards	10·69lb.	10·704
I.H.P.	59·36	61·34
Coal per I.H.P. gross	3·66lb.	4·14
" " net	3·55lb.	4·00
Expansions	4·71	4·1
Duty	62·470000	55·440000
Feed per I.H.P. per hour	23·71lb.	27·08lb.
Efficiency	·68	·66

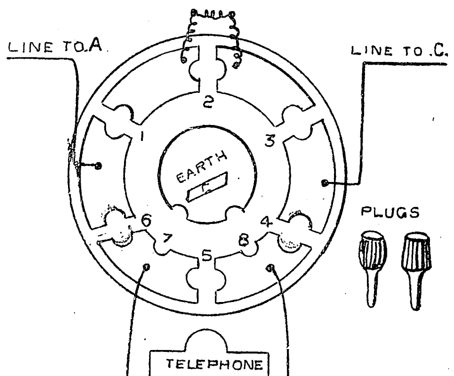
—WATER THUMPER.

[61579.]—**Storage Cells.**—Instructions for forming Planté cells have been given dozens of times. Look up your indices. The process of formation takes weeks, don't forget that; you seem to think it is done in a few hours. Gas is given off during the whole time. It comes away in torrents after the charging has been unduly prolonged. As you do not say what you are charging with or what power, I cannot advise you how to couple up. If your source has high E.M.F. and low current, couple your cells in series. If the opposite, couple in parallel. The soaking of the plates in nitric acid is a very doubtful method, the motive, of course, is to get the lead into a porous condition; but I never found it any advantage. If you are endeavouring to form the plates with a battery, it is almost hopeless; you want a dynamo. —C. D. R.

[61579.]—**Storage Cells.**—"Another Reader" had better place his small accumulators in separate cells, there being always great danger of leakage through partitions such as he describes. When the minium ($2PbO,PbO_2$) on his plates has been allowed to get thoroughly dry, they might be immersed for a few minutes in a very strong mixture of sulphuric acid and water. This process renders the active material quite hard and insoluble, the plates being then in a condition to be placed in the forming solution without danger of their disintegrating. The following method I have found answer remarkably well in the formation of small storage-cell plates: After pasting on the minium, put them in a warm and dry place, and allow to get quite hard; then bind each plate round with ordinary cotton tape, so as to form a mechanical means of keeping the active material from falling down when placed in the liquid. The five plates may then be held firmly together by an indiarubber band or some tape. The poles should then be connected-up temporarily, as in the finished cell; place in a solution of 1 part sulphuric acid and 5 parts water, and send through a current of, say, 1·5 ampère for about 10 hours; then take the plates out and carefully mark them, whether + or −. On removing the tapes, the minium will be found to be quite formed and hard. Next join up poles permanently, and place them in a solution of 1 part acid and 10 parts water, and finish off the charging with the same strength of current—viz., 1·5 ampère. The charging should be continued until the solution assumes a milky appearance. A cell of the dimensions you give, and if the plates are not more than 5mm. apart, should only have an internal resistance of 0·3 ohm. The E.M.F. being fully 2 volts, you would, therefore, get approximately 60 ampères on short circuit, or a safe and steady discharge of 1 ampère for 10 hours. In charging, too large a current causes the plates to break up, and do not forget that a potential of 2·5 volts is required to charge such a cell. To fully charge your five cells in series it would take an E.M.F. of 12·5 volts, and a current of 1·5 ampère, for about 10 hours. If in parallel, 2·5 volts and 7·5 ampères for the same period. Avoid discharging at too rapid a rate, and stop as soon as the potential shows an appreciable fall.—J. T. N.

[61579.]—**Storage Cells.**—What means have you adopted to tell whether you are forming the cells or not? I see you give no particulars except the size of plates and number of cells. You say you have spent "some time with a good current"; but you do not mention what you mean by "some time," or what you consider a "good current." As far as I can gather, you are going on all right, and have simply to continue; but as you do not particularise, I am, of course, unable to say what result you are getting. I know, however, that nearly all amateurs and many young professionals are under the impression that all that is necessary to produce a storage cell lighting a handful of lamps for seven or eight hours is to put a couple of plates of plain lead into an acid bath, and show them a couple of Bunsen jars. Perhaps your current is not nearly sufficient, and unless you charge through an ammeter of some sort, how do you know what you are putting through the cells? A man once showed me a set of E.P.S. cells, and asked me why he could not get any light out of them, assuring me he had been putting 15 ampères through for 75 hours; but when I looked at the dynamo I saw at once, by the absence of even the tiniest spark, that it was spinning but not generating any current. Further examination revealed the little circumstance that one brush, through the spring being too weak, did not make an electrical contact at all unless pressed down with the fingers, and coupling this with the information that the machine had not been touched during the 75 hours, it appeared that during all that time not 1 ampère had been put through the cells. I could mention dozens of instances of this sort. Charging cells without having any measuring instrument in circuit is simply haphazard work, and where the dynamo is driven off counter-shafting having a lot of things on it, the engine will not give any indication, as a separate engine will often do. Storage cells should never be connected in parallel to charge them. Indeed, with most constructions of dynamos and batteries, you cannot charge them in parallel. Even five cells in series is far too small an external resistance for most dynamos or batteries to work with. I should not be surprised if you were wasting three-fourths of your power, as I perceive, from the dimensions to which you made your battery, that you are not accustomed to storage cells. Your cells are too large for pocket batteries, and not large enough for practical lighting work. The gas coming off as soon as you start is quite regular. It always does at the commencement of formation, as you would readily comprehend if you understood the chemical and electrical actions of the accumulator. You do not say if you have reversed your current at all. The best advice I can give you is to refer you to a paper I have written but not published yet, giving an explanation of the construction and nature of storage cells, and the process of "forming." I had so many questions about them that I at last compiled it as being more satisfactory than giving a lot of disconnected scraps of information which might not fit together in the minds of those they were addressed to. If you like to write to me at my address, I can furnish you with this.—EDWARD CONRY.

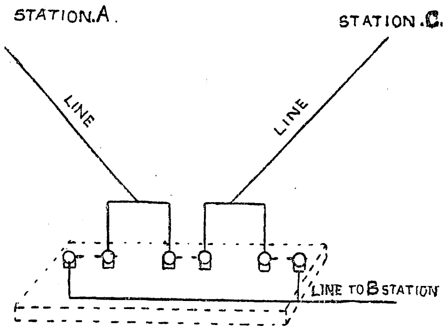
[61581.]—**Telephone Switch.**—Perhaps the following will suit "Enswitched":—Six pieces of brass of any handy size are fixed to the outer edge of a circular base of wood or ebonite, and in the centre is fixed a circular piece of brass, so as to leave ½in. space from outer set of brasses. I ought here to say that you will require another bell, or, preferably, a relay, to be in circuit when A and C are in communication. Two switch plugs must be



made to fit any part of the switch holes, and used as follows:—Insert one plug in hole No. 1, the other plug in No. 3; then A and C are through, and may ring the bell at B when they have finished. Plug holes 4 and 7, then B and C are through; plug holes 6 and 8, then A and B are through; plug holes 6 and 4, then A, B, and C are through, B being intermediate. Now, the central brass plate must remain permanently earthed, as shown,

with other connections, on rough sketch above.—J. FLETCHER, Burnley.

[61581.]—**Telephone Switch.**—"Enswitched" will find that mounting three single-plug switches on a board, and connecting, as in rough sketch,



forms a very simple method of commutation. I have installed three stations, controlled in a like manner, and do not find any difficulty, for B can always ascertain, by switching in his instrument, if A and C are in communication or not.—H. B. EDWARDS.

[61585.]—**Polishing Fretwork.**—Most people in beginning this useful and interesting work fail from one or more of the following reasons:—Not sizing the wood, using too much oil on wood before beginning to polish, beginning before oil has had time to dry in, using too much oil when polishing, or using the polish too thick. I had the same faults to contend with, but got a few hints from an old and clever polisher who was at work on the new pitch-pine seats and fittings of a place of worship. He said to me, You can always get a better polish on wood from the plane than you can after glass-cloth; but you must glass-cloth over after cutting and filing on account of the edges of cut being often rough after saw. He advised me to cut outside with fine saw, and after cutting or filing off any rough places and rubbing over with a piece of partly worn out glass-cloth, to rub over with a pad slightly moistened with oil, and on outside edges, then size over with thin glue size, leave until dry; then do the edges over with varnish, and when thoroughly dry begin to polish. By so doing you avoid the ridge of polish on edges. Use only a suspicion of oil on pad, and let one coat of polish thoroughly dry before applying another.—J. I. S.

[61588.]—**Brass-Cleaning Composition.**—I asked one of the G.N. carriage cleaners at Peterborough what the composition was that was used for cleaning the carriage handles, &c., and he informed me that it was petroleum and Bath brick. —E. E. HIBLING, Peterborough.

[61594.]—**Walcot Battery.**—Perhaps the best method of standardising a tangent galvanometer would be by the electrolysis of silver or copper, preferably copper. If copper, proceed thus: Weigh your gain plates carefully in a chemical balance, note your zero, and keep the galvanometer pointer steady on some fixed point, by means of a rheostat or other variable resistance. Accurately time the duration of electrolytic action, and when finished take the plates out and thoroughly wash and dry them. Weigh gain plates, and note the amount of gain in grammes. The current may then be calculated from the following formula—

$$\text{Current} = \frac{W}{TK}$$

where W is the total gain in grammes
T is the duration of electrolysis in seconds
K is the electro-chemical equivalent of copper

The electro-chemical equivalent of copper may be taken as ·0003287 grammes per coloumb. The time for a trustworthy electrolysis should not be less than one hour; the size of plate to insure a good and adherent deposit should be 50 square centimètres per ampère. The best electrolysing solution is a saturated solution of sulphate of copper, to which is added a few drops of sulphuric acid.—J. T. N.

[61589.]—**Coal Economy.**—The answer of your correspondent, "Nun. Dor.," to my inquiry is exactly what I expected. If in his original letter, of January 14th, he had contented himself with merely expressing his opinion that 900 tons coal seemed a large amount to use in the refining of 1,800 tons sugar, I should not have ventured to intrude upon your space; but when he went further and sneered in a most uncalled for manner at the "hampered industry" of the refiners, and implying that they were ignorant of the very elements of the business, I thought it time to see if "Nun. Dor." had that special knowledge which would warrant him in so doing. It now turns out that he knows nothing whatever about the matter This being so, it is rather uncalled for on his part to attempt to lecture men who are probably quite as well versed in the economy of coal as he is himself. I must apologise to you, sir, for thus troubling you upon a matter which is, after all, of very little interest to your readers, and will conclude by asking "Nun. Dor." not to pass sentence again until he is in full possession of all the "data," to judge "each case on its merits," and, finally, to read carefully the extract from Montaigne which heads your correspondence columns.—SUGAR CANE.

[61599.]—**Gunmetal.**—Soft gunmetal contains 8 tin to 92 of copper; hard gunmetal, 18 tin to 82 copper.—BOGOT.

[61599.]—**Gunmetal.**—"Blacksmith's" query seems to me rather indefinite. Does he wish to know the proportions of copper and tin requisite to make gunmetal; or, only the method employed in mixing them to form the alloy? Gunmetals may be made of all qualities and shades of colour, by varying the proportions of copper and tin. The following are a few mixtures used in the trade: 8 parts of copper to 1 part of tin, 90 per cent. of copper to 10 per cent. of tin, 90 to 90½ parts of copper, and from 9 to 9½ parts of tin. A very good metal for turning purposes is obtained with ⅚ of copper to ⅙ of tin, by weight. The last would probably answer "Blacksmith's" purpose best. Melt your copper in a crucible, then add your tin; keep stirring the while with a poker, so as to thoroughly mix the metals. We used to lift our crucibles, containing the melted copper, out of the furnace, then add the tin, and if hot enough, after mixing (according to the kinds of castings) cast straight away into the moulds. By getting the copper fairly hot, this is easily accomplished.—W. H. KOPE.

[61612.]—**Food for Animals.**—"Thomas" will not be very successful in greatly increasing the framework of the animal beyond what is ordinary unless he goes in for a long course of careful selection in that direction. The power of appropriating food is greater in the pig than in any other animal, hence the reason it thrives on food which would be unsuitable for other animals. The bony framework is best improved by foods rich in ash and albuminoids, such as malt dust and bran. The chaff of wheat, barley, and oats is rich in ash constituents. Very little profit can be made in keeping pigs unless their food is well looked after, and if much meal or other food has to be purchased for them they may soon become a source of loss. Milk greatly aids in fattening. Mr. Mechi, in his "Sayings and Doings," recommends miller's middlings and toppings as a useful food for young pigs. Seeing that he farmed for profit, and had at one time 360 or more pigs, "Thomas" cannot do better than follow his advice.—S. FORD.

[61617.]—**Removing Ink Blots.**—Two correspondents, p. 530, say that a solution of chloride of lime will remove ink marks from paper? Have they ever succeeded in so removing them?—ERASER.

[61627.]—**Boring Hard Wood.**—I have a set of 1in. to $\frac{1}{32}$in. borers, which are fluted, not "twist." They make a splendid hole indiscriminately in hard and soft wood, in iron, and in brass. The evenness, trueness, and smoothness in the hole is remarkable. I should prefer a bit of hard, not soft, underneath the piece being bored.—R. S. T.

[61634.]—**Will o' the Wisp.**—Mr. Conry is, I think, mistaken in putting "St. Elmo's Fire" under this head. It is usually considered as a brush discharge of electricity from the most exposed points of a ship's spars, at a time when there is a considerable difference of electric potential between the earth and air or clouds above the ship. —J. BROWN, Belfast.

[61634.]—**Will o' the Wisp.**—All four replies are quite inconsistent with either of Mr. Conry's two contradictory theories. The "St. Elmo's fire of the sailors," appearing only at pointed conductors, is an electric brush discharge, and has nothing to do with any burning gas; moreover, to produce the marsh flames neither sulphuretted nor carburetted hydrogen" ("marsh gas") will suffice alone, as they would not ignite spontaneously. There must be some phosphuretted hydrogen to account for the ignition.—E. L. G.

[61634.]—**Will o' the Wisp** is due to the ignition of marsh gas evolved from decaying animal and vegetable matter by spontaneously inflammable phosphoretted hydrogen; it has not the slightest connection with or similarity to St. Elmo's fire, which is an escape of electricity from the masthead of a vessel as a brush discharge. "Light sulphuretted hydrogen" is a gas which has not yet been described in works on chemistry; perhaps Mr. Conry will favour us with an account of its preparation and properties.—WM. JOHN GREY, F.C.S., Newcastle-on-Tyne.

[61634.]—**Will o' the Wisp.**—I see that your correspondent, Mr. Conry, suggests that this is "light sulphuretted hydrogen" (I suppose "carburetted" is meant), and is analogous to St. Elmo's fire seen playing round ships' rigging in bad weather. It is rather difficult to conceive how the "light sulphuretted hydrogen" contrives to get round the mastheads, unless the ship has a cargo of rotten eggs on board. Most people regard the phenomenon as being a discharge of electricity. I always thought that the Will o' the Wisp was marsh-gas, or "fire-damp" (CH_4), which is produced by decaying vegetable matter. I have often myself ignited this gas, after stirring up the bottom of a stagnant pond full of dead leaves, thus forming an artificial Will o' the Wisp.—REYMOND.

[61634.]—**Will o' the Wisp.**—We have been rather amused on reading the answers to this question, as it has been a regular occurrence (ever since I can remember) to see the "Jinny Wisp" (as the people call it here). I have seen as many as two or three together bobbing up and down, and last year my father called me out one damp, foggy night to see one in front of our house. There are many ghostly stories told of unwary or half-drunken travellers being decoyed into swamps by the deceitful Jinny. As a child I was very afraid of Will o' the Wisp, and was very thankful to have someone with me when I saw it. I don't think they are so numerous now, nor so bright and glowing; I should think this is owing to the better drainage. But on a damp and foggy night they are still to be seen, and I should say there is hardly a fen man who has not seen one, and who would not think anyone terribly behind hand who had not.—A LINCOLNSHIRE LASS.

[61634.]—**Will o' the Wisp.**—In 1864 I was in a boat drifting down a river in North New Zealand (Kaipara) at about 9 p.m. Approaching the landing in the dark, we had called for a man on shore to bring a light to guide us to the wharf. While waiting I saw a bluish light which I supposed was the candle; but it floated across the river at about 6ft. or 8ft. above the water, not "dancing up and down," but moving steadily. It went into a swamp on the lower bank of the river; but before it disappeared the real candle was brought to the river bank, and the contrast between the two lights was very striking. The candle gave a yellow light, while the Will o' the wisp was decidedly bluish, and looked as if seen through fog. In the dense bush on a very dark night I have also seen a surface more than a yard in diameter shining with phosphorescence, which on examination proved to be decaying leaves dropped from the Ti palm (cabbage-tree). In fresh water rivers trails of phosphorescent light may be seen issuing from weeds under the water, the light seeming like oil leaving the plants and floating down with the current. At a depth of some feet blotches of this light sometimes look ghastly enough, and have no doubt contributed to the Maori's belief in "Taniwhas," or water monsters, especially since the snags on which the water weeds grow frequently upset the boat.—T. F. S. T.

[61642.]—**A Good Illuminant.**—If "Like to Know" would take a little trouble he might easily know all he wants about the Welsbach light, for it was described in No. 1139, and I believe previously, while I notice now that it is referred to in the Scientific News on p. 518. It is for the present the most successful of many attempts to construct a bonnet or cap for a Bunsen burner which can be raised to a state of incandescence without prematurely crumbling up. I notice that one of the professional journals says: "The light itself we have examined carefully, and consider it a most efficient and agreeable form of artificial light"—to which the inventor might reply, "Thank you, for nothing; that went without saying." What is wanted is commendation like that given by the *Times*, which boldly stated that the new light "burns up all the impurities of the gas, giving off no carbon and no sulphur, and comparatively little heat." It will, of course, give off just as much sulphur or sulphurous compounds as the gas enables it to do, for it contains no sulphur in itself, and it can't get rid of what may be in the gas, and as to "comparatively little heat" it depends on what is meant. The heat produced is exactly that due to the consumption of so much gas: it seems little, because, as is well known, all incandescent systems give a powerful light on a small consumption of gas.—NUN. DOR.

[61643.]—**Boiler Query.**—The following formula will give the temperature, T, of steam at any pressure, P:—

$$T = \frac{2938{\cdot}16}{6{\cdot}1993544 - \log. P} - 371{\cdot}85$$

T = for 45lb. = 274·4° Fahr., and
for 65lb. = 298·0° „

It will be seen from the above that the temperature of steam increases with the pressure. Other things being equal, of course the higher pressure would serve your purpose best.—ELAG.

[61643.]—**Boiler Query.**—The boiler at 65lb. would show the greatest temperature by thermometer—viz., 312°F. that at 45lb. being 292·7°F.; but

the total heat in the steam would be nearly the same in both cases, as there is less latent heat in that at the higher pressure, the difference being not more than 1°F. Consequently, the same weight of steam in either case would make the same weight of water boil in an open cistern, an open cistern being intended, I presume. If, however, it were a closed vessel, of course the higher pressure would give the higher temperature.—T. C., Bristol.

[61643.]—**Boiler Query.**—As the pressure of the steam increases, so also does the sensible heat. According to Regnault, the following table shows the increase of the sensible, the decrease of the latent, and the increase of the total heat at different pressures rising by an atmosphere:—

Gross Pressure.	Sensible Heat.	Latent Heat.	Total Heat.
lb.	°	°	°
15	212	966·2	1178·2
30	251	939·	1190·
45	275	922·7	1197·7
60	294	909·2	1203·2
75	309	898·5	1207·5

From this you will be able to answer your other query.—W. HOLDER, Newport, Mon.

[61647.]—**American Organ.**—The 8ft. row of reeds should be voiced to produce a round quality of tone. It requires artistic skill to do this as it should be done. The principal and flute (4ft. set) should be voiced a trifle louder than the 8ft. row. A pleasing variety of tone can be obtained by having the 16ft. treble set voiced to imitate the clarionet. The other 8ft. treble set can be voiced according to taste. In a large number of reed organs the extra 8ft. treble set of reeds are put slightly out of tune with those of the Melodia or other 8ft. treble reeds, so as to form a celeste, or vox jubilante, as it is sometimes called. Different makers attach different names to some of the stops, but the mere name, as a rule, is not much to be guided by. If you make your bellows to the dimensions given below it will answer admirably:—Centre board, 3ft. by 2ft. 4in. by 1in.; reservoir board, 3ft. by 2ft. by 1in.; feeders, each 19in. by 16in. by ⅜in., of good and well-seasoned pine. The reservoir board may be allowed to open from 7in. to 8in. I should not recommend the bellows to be made smaller than the above-quoted dimensions, and it will not matter if the bellows are made a little larger. The best rule is, make the bellows as large as possible, but within reasonable limits.—G. FRYER, Gorse-lane, Swansea.

[61647.]—**American Organ.**—It would be as well if "J. S." procured his rather peculiar "board" before he asks what kind of voicing the reeds are to have. It is to have a full row of 8ft., and another of 4ft. "in front," therefore presumably one on the top of the other, with the two half-rows at the back, one on the other, so as to be in one block. Or does "J. S." mean that the two full rows are to be like an ordinary two-row board, with the half-rows at the back of the soundboard? The latter arrangement will involve the use of two sets of pallets, with the lever arrangement in the chest, whereas, if all the sets are in one block, one set of pallets will answer. It seems strange, too, that he should be thinking of having three octaves of 16ft., and two and a half octaves of 8ft. in treble. Why not have both alike? For his pedal set, too, why not have the full complement of thirty notes, instead of only two octaves? If "J. S." will get such a "board" as he describes, and give the dimensions, no doubt he will obtain useful advice; but I doubt whether so nondescript an arrangement can be obtained, except by special order. However, his 8ft. row should be voiced to the diapason tone, as it is the groundwork of the instrument, and he can then make the half-rows what he likes. As to size of bellows, the golden rule is to make them as large as possible—that is, the size depends on that of the board or of the case. If "J. S." is going to make his own cavity boards, he can make them to suit his designs; but I should think he would find one of the stock arrangements answer his purpose, and I see several advertisers are now prepared to supply them. As he wants pedals, I should advise him to have a C scale board, and then the instrument will at least be useful for practice purposes, if he fails to make it do something more than "pray"—to quote the amusing criticism of our friend the "Country Solicitor." Briefly, I would advise "J. S." to determine what sized board he will have, and then if he will describe its arrangement and dimensions, I have no doubt he will obtain all the assistance he needs.—ORGANON.

[61648.]—**Battery for Lamp.**—The voltage of the bichromate cell as described is about 1·8 volt. Hence, to get the required voltage at least five cells would be required, and as the resistance of the cell is rather large, so that the current is not very large, it would be well to err on the side of excess and use at least six cells. If the carbons are raised as well as the zincs, the battery will remain in good working order much longer than if they be left immersed, as the acid soon corrodes the connections. To carry the current 10 yards without appreciable loss, use No. 14 copper. Ten yards of this will not have a greater resistance than ·06 of an ohm, while 10 yards of No. 16 would measure ·1 of an ohm.—S. BOTTONE.

[61648.]—**Battery for Lamp.**—If the battery was freshly charged, most likely six cells of your battery in series and each cell made up of three in parallel would be found sufficient. The E.M.F. of one of your cells would be about 1·5 volt. The battery would absorb about one volt, and if only six cells in series were used, the E.M.F. at terminals of battery would be about eight volts. The carbons of a bichrome battery do not need to be removed from the solution, as there is no action on them. The fault, however, is that the outer solution diffuses itself through the porous cell, and unless the porous cell be removed when the zinc is taken out, the solution inside and out of it is the same, and therefore it is useless. The leads should be of No. 18 Cu. I.R. and braided; their total resistance will be about ·3 or so of an ohm; this, with a current of two ampères will absorb ·6 of a volt; so to work well seven cells should be coupled in series, especially as the eight-volt Shippey lamps take nine volts to work properly, and, as you know, it is usual to overrun battery lamps slightly.—IOTA.

[61648.]—**Battery for Lamp.**—What a host of queries of this description there are in these columns week after week. There may be a distinction, but scarcely a difference. You say the lamp is an eight-volt one. Now as the E.M.F. of a bichromate battery (or rather cell) is, roughly speaking, two volts, you would theoretically require four of these cells in series; but practically, you must have five. This settles the E.M.F. part. The rest will depend on the porous pots to a considerable extent. If these are in good condition and of low resistance, the five cells in series will light your lamp; but if they won't, then you will know that your battery does not furnish sufficient current, and you must make up another five cells and connect the whole lot in two series of five cells in each series. When you have made your first five cells, connect them to your lamp first with the porous cells in use, and then without the porous cells, and I think that in the latter case the lamp will light well. It is not necessary to lift the carbons out of the solution, and if you are going to lift the zincs out I should decidedly do away with porous pots. No. 20 wire will do, and will not necessitate any additional battery power.—W. HOLDER, Newport, Mon.

[61651.]—**Induction Coil—Testing Continuity.**—Attach one terminal of the secondary to one binding screw of my half-crown galvanometer. Connect the other terminal of the secondary to a single-cell bichromate battery. Now touch the other binding screw of the galvanometer with the free pole of the battery. If the wire is continuous you will get a deflection; if not, the needle will remain motionless.—S. BOTTONE.

[61651.]—**Induction Coil.**—Connect in series the secondary wire, a battery, and an ordinary galvanometer, and if, on making the circuit complete, there is no movement of the galvanometer-needle, the secondary of the coil must be broken. Of course, as the secondary is of high resistance, the battery had better consist of three or four cells coupled up in series, and the galvanometer should have a good number of turns of wire on it.—VIR SAPIENTIÆ.

[61651.]—**Induction Coil.**—I think I can assure "J. P. Aigburth" that his secondary wire is continuous still, or he would get no spark at all. Provided he is using the same battery as formerly, and the connections (especially those with the condenser) are all right and clean, his shortened spark denotes that too much battery power has been used, and that, in consequence, the secondary has burst through its insulation, and the coil is short-circuited. This fault will increase, and the only remedy is unwinding and remaking. As it was made some years ago, was guttapercha tissue used to insulate the secondary layers? If so, the failure of that unreliable substance is at the bottom of the mischief.—B. HARCOURT.

[61651.]—**Induction Coil.**—The fact of your getting a spark at all is sufficient to show that the secondary has not parted. Can you not try it with a telephone or a galvanometer? Or if these are not to hand, you can use the chemical test for weak currents, which consists of dissolving a little iodide of potassium in some water and adding a little starch paste. You have now a very sensitive electrolyte which will turn an indigo-blue colour at the anode when a very feeble current passes through it. But this is not necessery if you get a spark at all. Perhaps the coil is damp; if so, this would account in a great measure for its unsatisfactory performance.—W. HOLDER, Newport, Mon.

[61652.]—**Screw-Cutting.**—Your best plan is to make a template yourself for each pitch. If re-required of exact form, a chaser is far the best plan for finishing cut. You would find it difficult to grind the tools to the special template, as it would be formed of two barely quarter circles united by a straight line, the ordinary gauge, as you know, being a straight line (speaking of one edge of the template only).—T. C., Bristol.

[61655.]—**Gold Size.**—Gold size is prepared from ½lb. of linseed oil with 2oz. of gum animi; the latter is reduced to powder, and gradually added to the oil while being heated in a flask, stirring it after every addition until the whole lot is dissolved. The mixture is boiled until a small quantity when taken out is somewhat thicker than tar, and the whole is strained through a coarse cloth. When used it must be ground with as much vermilion as will render it opaque, and at the same time be diluted with oil of turpentine, so as to make it work freely with the pencil. Somehow I do not think that this is what you want to know; but at the same time it is the only gold size I know of, and you may find it useful.—W. HOLDER, Newport, Mon.

[61656.]—**Amalgamating Copper Wires.**—I always dip wire in nitric acid, then in mercury.—AN A.S.T.E.

[61656.]—**Amalgamating Copper Wire.**—Rub the wire with fine glass-paper moistened with solution of nitrate of mercury. Then rub on some mercury also.—J. BROWN, Belfast.

[61656.]—**Amalgamating Copper Wire.**—Dissolve as much mercury in nitric acid (strong) as it will take up, then add about as much more acid. If the wire is clean, a dip in this will at once amalgamate thoroughly. It must, of course, be at once well washed in plenty of water to remove any acid.—OHM.

[61656.]—**Amalgamating Copper Wire.**—First clean the ends of the wire by rubbing them with emery or glass paper. Then dip the ends of the wire into dilute sulphuric acid (prepared by adding slowly one part of strong sulphuric acid to eight parts of water), and subsequently dip them into mercury, and, by means of a piece of rag on the end of a stick, the mercury can be rubbed on to the wire.—VIR SAPIENTIÆ.

[61656.]—**Amalgamating Copper Wire.**—Clean the ends by means of coarse emery cloth, so as to leave plenty of scratches or crevices in the copper. Then dip into nitric acid for about a minute or two, and finally into the mercury in a test-tube. If you like you can give them a preliminary coating by immersing them in a solution of mercury dissolved in strong nitric acid, and afterwards proceed in the usual way.—W. HOLDER, Newport, Mon.

[61656.]—**Copper Wire.**—The ends of copper wires are easily amalgamated if they are dipped for a moment into an acid solution of nitrate of mercury and then into mercury, which they take up with great ease.—IOTA.

[61660.]—**Picking Lever Locks.**—"J. W. R." should take a term under some "Bill Sykes," who would be the best authority on this subject. It is rather a dangerous vocation, and often leads to a term of retirement in a county institution.—J. I. S.

[61661.]—**Coil.**—TO S. BOTTONE.—Your coil is entirely wrong. First, the clapper must have an iron head, not brass; secondly, the core must not be a "temporary magnet," if by that you mean a soft iron rod; but a bundle of iron wires. The connections from the binders from base to primary screws, should be copper. The quantities of both primary and secondary for a shocking coil are excessive.—S. BOTTONE.

[61664.]—**Partial Silvering.**—Copal varnish prevents deposits occurring on any place it is applied to, and is much used for "stopping off." W. HOLDER, Newport, Mon.

[61666.]—**Non-conductor.**—How would a paste composed of concentrated solution of silicate of soda and ground glass do? It is easily tried, and is inexpensive.—W. HOLDER, Newport, Mon.

[61666.] — **Non-conductor Insoluble in Ether.**—That insolvent (at least simple, so-called "sulphuric ether") will neither attack indiarubber nor guttapercha.—E. L. G.

[61666.] — **Non-conductor Insoluble in Ether.**—Glue is insoluble in ether. I have used the following cement for closing heads in a vessel to contain ether:—Soften an ounce of glue in water, pour off the water and add an ounce of treacle; heat, mix, and apply hot with a brush. It never gets quite dry; but it seems quite impervious to the ether. Querist does not say of what it is to be a non-conductor.—J. BROWN, Belfast.

[61669.]—**Sharpening Carpenters' Tools.**—A friend of mine has a circular oilstone on a lathe; but it is messy and inconvenient. It throws the oil about, and the tool is liable to dig into it. The comparatively small amount of sharpening, or setting, to be done after the tool has been properly ground seems more conveniently done on the usual flat stone.—J. BROWN, Belfast.

[61669.]—**Sharpening Carpenters' Tools.**—I had, and have, a circular (small) Arkansas stone, perhaps a little harder than Turkey. For some purposes it acts well. I tried not only the periphery, but the flat surface. I was not satisfied. I also had a large 9in. or 10in. Welsh stone and made it as true as a die with Carbonado; but I sold the whole thing, as I found a grindstone, and then a coarse flat Arkansas, and then a very fine Arkansas, gave better results.—R. S. T.

[61671.]—**Heating of Wire, &c.**—TO MESSRS. CONRY AND BOTTONE.—A covered wire heats more than an uncovered one. Chloride of calcium is the right thing to use; quicklime is not bad. If you really have half an ampère, you need only put your ammeter in circuit, and notice the deflection it gives, as ½ ampère; so also with the one volt—passed through the voltmeter should give a deflection which must be marked as one volt.—S. BOTTONE.

[61671.]—**Heat in Wire, &c.**—It is quite true that an insulated conductor will carry more current than a wire uncovered and exposed to the atmosphere (see Sprague, p. 300, &c., also Forbes' paper, Telegraph Engineers, &c.) In the newest form of Clarke gas-lighter the drying material is never used; in fact, the form you refer to works just as well without it. Improve the insulator at all points by brushing with benzine or paraffin, and then be careful not to touch with the fingers after cleaning. To calibrate an ammeter, see reply to 61131, p. 352. Having made an ammeter first, then if you have an accurate resistance instrument, you can easily construct a voltmeter.—OHM.

[61672.]—**Electric Lighting.**—TO MR. BOTTONE.—To light twenty 20c.p. lamps, you will need a dynamo (Gramme or Mather-Platt pattern) with a ring armature of about 7in. in diameter. From 1½ to 2H.P. should be ample if the dynamo be a good one. Pulley on dynamo 3in. in diameter. Sheave on engine 3ft. in diameter. Speed of armature from 1,600 to 1,800 per minute. Accumulators not needed. Cable seven or eight strands of No. 20.—S. BOTTONE.

[61673.]—**Dynamo to Light Thirty 20's.**—You will find full instructions for making one of these at pp. 261 and 564, Vol. XLI. of the ENGLISH MECHANIC. I can supply you with a pamphlet if you apply to me.—S. BOTTONE, Carshalton.

[61674.]—**Butterine.**—The simplest method I have found for the detection of animal fats (a method for which, if I recollect, I am indebted to the pages of the MECHANIC) is to rub some of the suspected substance on a piece of calico, set it on fire, and then blow out the flame. If animal fat has been used, the smoke of the smoldering calico will smell like a tallow candle that has been blown out; while if pure butter has been used, it will smell quite sweet. I regret to add there is a strong suspicion that some English farmers have adopted the practice of adulterating their butter with oleomargarine, and we badly want a stringent measure, like that recently passed in America, to protect honest dairy farmers.—DOCTOR MEDICINÆ.

[61675.] — **Cardiac Affections.** — Though "G. F." has not addressed his query to me specially, I will venture to reply. Regurgitation is a purely mechanical matter, and the symptoms are those of "back water." The valves most likely to be affected are the aortic and the mitral. If the former valves become incompetent, the left ventricle will probably increase in bulk and strength, sufficient to compensate for the incompetence, and until it begins to fail there will be usually no general symptoms; when, however, failure of the heart muscle sets in, general dropsy from "back water" will soon supervene. The case of the mitral valve is somewhat different when it is incompetent: the blood at each contraction of the ventricle is driven back upon the lungs, causing engorgement of them and occasional blood-spitting and difficult breathing on exertion. Regurgitation, as I have shown, is not necessarily followed immediately by general or local dropsy. The chief symptoms indicating mitral regurgitation I have already stated. The indication of aortic regurgitation, apart from stethoscopic signs, is the strong pulsation of the enlarged heart; but this may also be due to narrowing of the aortic orifice. Until the heart muscle begins to fail valvular disease may exist without subjective symptom; that is quite unknown to the patient, and is compatible with long life and rude health. Dr. Andrew Clarke gives, in a late number of the *British Medical Journal*, a list of 684 of his patients "in whom there existed chronic valvular disease of the heart, the presence of which was not indicated by symptoms, and did not sensibly interfere with health," and who had consulted him for other ailments. Valvular disease does not tend to produce aneurism, generally speaking. I have endeavoured in the above to avoid technicalities, and to explain the matter simply without going into debatable ground.—DOCTOR MEDICINÆ.

[61678.]—**Violin Bow.**—Drive suitably-placed wire nails in a piece of board, then heat the bow before a fire, and place between said nails until cold. I have not tried this way, but have steamed a bow, with the certain result that the spring or elasticity is not equal to that of a bow shaped to the proper curve as usual.—A., Liverpool.

[61679.] — **Photographs.** — To R. A. R. BENNETT.—Put your positive into a printing frame, film-side upwards, and another dry plate on the top of it, film side downwards, then shut up the frame. Now prop it upright on the table of your dark room, and hold a lighted match just in front of it, and about 2in. or 3in. off, for about 30 seconds, or less, according to the density of the negative. If you use a ruby lamp, simply take the shade off the candle while holding it in front of the frame, and replace it in a few seconds. On developing the plate you will have a negative, bad or good, according to the quality of the positive. This is a good way to make transparencies, using a negative instead of a positive, and some developer that gives black tones. If you want more information, I will do my best to give it you if you will write to me.—R. A. R. BENNETT.

[61681.] — **Electrical Measurement.** — The quantity of electricity conveyed by 1 ampère per second is called one coulomb. The old electrical term veber was exactly the same as the ampère.—OHM.

[61681.] — **Electrical Measurement.** — An ampère per second is the same as the *d* "weber" in its relation to other units; but its exact value is slightly altered, the other units being now the legal ohm and volt, whereas the B.A. unit had a different value, making the ohm ·9889 of what it is now. It is rather difficult to express the difference between an ampère and a coulomb. An ampère per second is a coulomb, and to find the number of coulombs, multiply the current in ampères by the time in seconds. An ampère takes no recognition of time beyond the unit, and it is independent so far of time; but an ampère flowing for n seconds produces n coulombs, or $\phi = C\,t$.—IOTA.

[61681.]—**Electric Measurement.**—The ampère is the practical unit of current, and was formerly called the "veber." The coulomb takes into consideration quantity in this way. It is of the value of one ampère of current per second—thus 10 ampères would transmit in one second 10 coulombs of electric quantity. These units are a never-failing source of annoyance until mastered, and to do that I should advise you to get a little book called "Electrical Units," by J. Swinburne, published by Spon, price about 1s. or 1s. 6d. This will do you more good than any correspondent of the "E.M." can, unless he utilises about four or five columns in explaining the complete system.—W. HOLDER, Newport, Mon.

[61682.]—**Coulomb-meter.**—The exact purpose served by a coulomb-meter is to measure and register the quantity of electricity which may have passed through a circuit in a given time, something after the style of a gas meter. There are two kinds—magnetic and chemical. In the former kind clockwork is brought into play. Do not know price.—W. HOLDER, Newport, Mon.

[61682.]—**Coulomb-Meter.**—A coulomb-meter measures the quantity of electricity that has passed—that is, the current in ampères multiplied by time in seconds (see reply 61681). A simple meter may be made with two copper plates in solution of copper sulphate. The increase of weight of the kathode, divided by the electro-chemical equivalent and by time in seconds, gives the current in ampères, or, if wanted, the coulombs. Ferranti's coulomb-meter is the best, I believe; but it is rather expensive. Any action of the current into which time enters as a factor may be used as a coulomb-meter.—IOTA.

[61685.]—**Spring of Beam.** — What is the meaning of this query? Do you mean how much will it draw the two walls together as the beam gives to the weight?—T. C., Bristol.

[61684.]—**Harmonium.**—The matter of adding a voix celeste stop to any harmonium incurs a certain amount of trouble which very few people care to experience. "H. E. S." gives no description of his instrument; but with regard to the matter of producing a celeste without having the reeds materially out of tune with another set of reeds of the same pitch, the method applies chiefly to American organs, in which case the celeste effect is produced by admitting the air to the reeds in a different direction from the ordinary way. It can be produced in the harmonium by similar means; but it is not quite so effective as in the American organ, although the method is preferable, in some respects, to the usual and objectionable method of putting reeds out of tune in producing the celeste effect.—G. FRYER.

[61687.]—**Water Pressure in Towns.**—In J. and H. Gwynne's Catalogue I have seen drawings of pumps and turbines, or water engines, arranged for water to be sent to a great height from a moderately high actuating source.—S. F. S. T.

[61689.] — **Dynamo.**—All field magnets and cores of dynamo machines are liable to get heated, and this is in every way detrimental to the good working of a dynamo. A machine does not give such a good output when hot as when cold, to say nothing of the risks of destruction by the overheating. Your machine does not get exactly fair play if it is running day and night. If kept perfectly clean it should last for years, but the commutator and the brushes will probably want renewing, as also the bearings. If these points are well attended to, you will not run much risk from the coils fusing: it is a rare occurrence.—W. HOLDER, Newport, Mon.

[61689.]—**Dynamo.**—There is little chance of the coils fusing, unless the dynamo is being driven far beyond its regular output. You should be able to bear your hands on the coils, even when working at its hardest. In case of a short circuit in the leads, and if no safety fuses were in circuit, it would be most likely the armature that would go, and not the field-magnet coils. In some machines the pole-pieces get very hot, and that heats up the field coils. A good machine, taken care of, and cleaned up regularly, should last 20 to 30 years, and many makers guarantee them 15. In rough work, 10 years is not considered bad.—IOTA.

[61689.]—**Dynamo.**—The coils of your dynamo are liable to fuse, but are not likely to do so until, through the continual overheating, the insulation on some adjacent coils is destroyed and a short circuit established. Your machine must be overloaded, or perhaps brushes short-circuiting several bars, or Foucault currents present. Anyhow, give the armature plenty of cold air. A good machine should never get hotter than the hand. A good dynamo, slow speed, should last, with only slight renewals, 40 years. A high speed machine, or one which sparks a good deal, may be ruined in a year.—ARCADIAN, Failsworth.

[61689.]—**Dynamo, Heating of.**—Long before the wire fuses the covering will burn off. A well-made dynamo will last for several years, the plummer blocks and brushes alone requiring renewal, and sometimes the commutator.—S. BOTTONE.

[61689.]—**Heat in Dynamo.**—All dynamos heat, more or less, when at work; but if the heating is excessive there must be something wrong. You should always be quite able to bear your hand on hottest part, and you should not run the machine if the heat exceeds 60° C. Where does the heat appear greatest, in the coils or com.? Any dynamo of good design should be easily maintained at a cost of about 2 per cent. per annum; but, of course, there are dynamos and dynamos.—OHM.

[61690.]—**Improving Coil.**—TO S. BOTTONE.—Rewinding the secondary and basting well with hot paraffin wax, would certainly improve matters.—S. BOTTONE.

[61691.]—**Engine.**—If you have only one ⅝in. hole at each end for posts, they are not near large enough; you should have three such holes. The engine won't be of much service unless you have something like that area. If driven 200 revs. with 60lb. steam and cut off at ¾ stroke, it would give 2½H.P. Flywheel 20in. to 24in. dia., and weight, say, 3cwt.—T. C., Bristol.

[61692.]—**Electric Lighting.**—I think this could be arranged by means of a couple of two-way switches. I will send you a rough sketch of the connections I propose if you feel inclined to advertise your address. In order to avoid such a sneering remark as "C. D. R." made in reference to one of our most talented correspondents, Mr. Conry, I may say that I am not in business, so that it is not to advertise, also that it is not because it would not bear scrutiny, for if "C. D. R." or anyone else likes, I would oblige them with a similar sketch if they really required it.—EVELINE W. HOLDER.

[61693.]—**Water.**—This will depend entirely on the draught you have, and whether you fire easy or hard. Taking the two firegrates combined as 26ft. super., and burning, say, 15lb. coal per foot per hour (that is about 10 tons per week of 62 hours), you would require 70 tons of water, about.—T. C., Bristol.

[61694.]—**Lucigen Light.**—Is not the Lucigen simply creasote blown into a spray by a blast of air, so that a flame of almost any desired height can be obtained? Can anyone give comparative cost with a good arc light?—NUN. DOR.

[61694.]—**Lucigen Light.**—Two can be seen in full operation nightly on some building works opposite the Temple station of the District Railway. Another is at work in Piccadilly at the north-east corner of the Green-park. — R. T. LEWIS.

[61697.]—**Violin Bow Hairing.**—Premising that this requires considerable practice to make a good job, I have seen a professional do it thusly, and also tried it myself; but as the new hair costs, say, 10d., and the sum which is charged here is only 1s., it does not pay an amateur at all to attempt it. First, unscrew bow, dip ends in hot water, and extract the little wood cover by putting on the old hair; take the new lot, place in moderately "warm" water for a couple of minutes to soften it, pinch up the tied end tightly like the letter V and insert the point into the hole, arrange the hair evenly, then replace the wood cover, having a little glue upon it, and leave this until the glue is dry; then wet the hair again in warm water and comb out with a fine comb, tie firmly with waxed thread at the required length, cut off, and burn the end with a lucifer match, which prevents the ends from drawing through the tie; this end is now to be similarly treated as the other was, and fixed into the movable piece of the bow. It is now left to dry thoroughly, and then being screwed up, all loose or crooked-running hairs are trimmed off with a scissors. Never "pull" a hair from a bow, as this loosens the whole of them. Pound a bit of rosin in a piece of paper for the first time of rosining. The new violins are stained previous to polishing with, I believe, umber and sienna, according to taste.—A., Liverpool.

[61700.]—**Nickel Crucibles.**—1. They can be obtained at any tolerably enterprising operative chemists. 2. As far as being unattacked chemically is concerned, they would stand the action of fused alkaline silicates; but have a strong tendency to become covered with scales if heated to such a temperature and in such free contact with air as a muffle affords. If heated in coal-gas flame, they become covered with bulky black flakes if the air be not in large excess. These flakes are mainly composed of carbon, though they also contain nickel; no such formation occurs in the flame of pure hydrogen, so that the carbon evidently comes from the gas, which must therefore be partly dissociated by the action of the nickel. I should expect no such coating to appear if producer gas were used. For more detailed and further information, see the *Chemical News*, No. 1414, December 31st, 1886, and a few following numbers. There you will find several articles and letters, and the whole subject pretty thoroughly discussed.—BERTRAM BLOUNT.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since out last "Practical Ry. Man" has replied to 61083.

61124. Analysis of Lime, p. 333.
61126. L. and N.W. Engines, 333.
61130. Spill-Making Machine, 333.
61135. To Mr. Bottone, 333.
61168. Enamelling on Coins, 334.
61170. Leather-covered Glazers, 334.

61337. Brazing Copper Water Tuyeres, p. 420.
61343. Milling Machine, 420.
61344. Lathe Matters, 420.
61347. N.E. Locos, 420.
61359. Engine Brasses, 420.
61361. Orthographic Lens by Ross, 420.
61364. Driving Lathe, 420.
61369. Gedge's Railway Coupling, 420.
61371. Tempering and Doctoring Steel, 420.
61377. Arc Lamp, 421.

Population of France. — The census taken last May, and published on the 6th ult., shows the population of France to be 38,218,000, whereas in December, 1881, it was 37,672,000. This gives an increase of 546,000, whereas in 1881 the increase in five complete years was 766,000. In Paris the increase is only 75,000—namely, from 2,269,000 to 2,344,000 whereas last time it was 280,000. Lyons has the much larger proportionate increase of 25,000—namely, from 376,000 to 401,000. Marseilles has increased from 360,000 to 376,000, Bordeaux from 221,000 to 240,000, Lille from 178,000 to 188,000, Nice from 66,000 to 77,000. Roubaix has increased by 8,000, and Toulouse and Tours each by 700. The other large towns, with the exception of St. Etienne, which has fallen from 123,000 to 117,000, show an increase in no case exceeding 6,000. The 53 cities or towns having more than 30,000 inhabitants, Paris included, show a net increase of 309,000.

QUERIES.

[61701.]—**Gas-Engine.**—I am working in a small printing office, where there is a small gas-engine, a horizontal one (Crossley's silent Otto), about 2½ or 3H.P. I have only worked there three months. The engine went on very well. I started her every morning easily. Slides and gas holes cleaned once a month. On Saturday evening a man cleaned the slides again. I started her on Monday morning; worked well all day to 7 p.m. Next morning went to start her, turned on gas, adjusted the lights, oiled her, filled the lubricator cup that oils the slides, and I could not get her to start, no matter what I did. There was nothing wrong with the gas. Could you tell the cause? Is there a book of instructions sent with these engines? I want to find out for myself, as this man tells me nothing about her. The number is 3168. With two turns of the flywheel she started on Monday morning.—WILLIAM MOORE.

[61702.]—**Turning.**—How would I turn up the face of a battering ram of cast-iron, 18in. long by 10in. square, in a large screw-cutting lathe, 10in. centre?—WEE LADDIE.

[61703.]—**Tempering Saw.** — Would some kind reader of "Ours" tell me of any method of softening cross-cut saw 6in. long? It is so hard that I cannot set it without breaking the teeth.—WEE LADDIE.

[61704.]—**Cocaine.**—Can any of your correspondents inform me as to the proper strength and quantity of the solution of cocaine used in small operations on the teeth and on other parts by subcutaneous injection? Also proper mode of application to the teeth for stopping operations?—C. E. A.

[61705.]—**Faulty Micro. Prism.**—I have a binocular microscope, and something is wrong with the prism; with the ¼in. and ½in. object-glasses, the field is very obscure, especially at the edges. If I push the prism to the right, so as to favour the upright tube, the left is clouded, and shows very faintly. With the 1in. glass I get better results, especially with opaque objects and using the condenser; but even then there is a lack of light. The fault must be in the prism, as without it, and using the upright tube only, I obtain all that can be desired. Will some reader help me, and say what a prism costs? I am a mechanic, and could do slight alterations myself if I knew how to proceed.—M. SIRP.

[61706.]—**G. and S.W. Locos.**—Would Mr. Stretton, or any other correspondent, kindly give me a diagram of the above?—C. BAYLEY.

[61707.]—**Centre of Pressure.**—I am much indebted to "T. C., Bristol," "Elag," and "Milverton" for their answers to my question on Torricelli's Theorem. Working for the advanced examination in theoretical mechanics, and having no one to coach me, I sometimes get stuck. Can you give me a simple formula for finding the centre of pressure? There is nothing of the kind in Twisden's "Mechanics." Apply the formula to the following: On the vertical wall of a reservoir, a circle is described with its centre on the surface of the water; find the centre of fluid pressure of the part under water.—S. FORD.

[61708.]—**Superphosphate.** — What strength of sulphuric acid is used in dissolving ground phosphates? In what proportions are they mixed to make a superphos. of 30 per cent. Any simple method by which the solubility of same could be tested?—S.

[61709.]—**Medical Electricity.**—Many thanks to W. Holder and E. Conry for replies to inquiry respecting lining for accumulators. I shall be glad if any reader can suggest a means of applying current from accumulators for rheumatism. I have about 20 cells = 40 volts, and would be glad if the current of all or part can be utilised for this purpose. I use the cells for house lighting, so that they are generally charged every day at this time of year.—VOLT.

[61710.]—**Speed Indicator.** — Would one of our Brighton railway correspondents explain working of speed indicators as fixed to Gladstone class, and whether they are of much use?—G. AND S.W.RY. FITTER.

[61711.] —**Solar Microscope and Gregorian Telescope.**—I have a microscope, similar exactly to picture in "Popular Educator" (Vol. V. p. 249, fig. 7). The text states it to be copied from an old work published in Amsterdam in 1776, and alludes to it as a rare and obsolete instrument. Could any correspondent conversant with these matters give me some information as to the use and value of the instrument? It is very well made, and is accompanied by a number of small eyepieces covered with brass caps and marked 1, 2, 3, 4, and a number of other paraphernalia, including slips of ivory, each containing five small glass discs, with objects thereon. I have also a Gregorian telescope, 18in. long, shows the moon apparently 20 times length of usual image, markings and shadows shown very distinct. What power would this be called? Could I purchase higher-power eyepieces ready made, or should they be made specially for the instrument? What powers are necessary to show Saturn's rings, snow cap on Mars, &c., and what would such eyepieces probably cost?—SLANDINGO.

[61712.]—**Chloride of Silver Battery.**—Will Mr. Conry, or some other reader, kindly give me particulars, as to Skrivanoff's chloride of silver battery—full instructions, enabling me to make one? Also give particulars as to the solution and method of renewal when exhausted? Are they of use in house lighting?—INVICTA.

[61713.]—**Ferrules.**—Wanted, instructions to enable me to make stampings out of brass sheet to form ferrules, &c. What kind of metal is used, and what precautions are to be taken to prevent the cracking of metal? How are the different diameters in ornamental tubes allowed for? How are screws punched on in pepper-box caps?—INVICTA.

[61714.]—**Steam Ways and Ports.**—To "T. C., BRISTOL."—Can you oblige me with size of steam ways and ports of single-cylinder launch engine, 1in. bore, 1½in. stroke, and is cast brass as good as spun or riveted for a small dome to stand about 20lb. pressure?—VALVE.

[61715.]—**Faulty Organ.** —Would some of your correspondents kindly furnish me with the following information? There is an organ at our place that is rather annoying. The lowest D of the row of keys (when pressed down) makes a rough, reedy, clattering noise, whatever stop is out. I think that it is something got loose some way between the foot of the pipe and the pallet, or else the slider. It sounds bad and rough. I shall be glad if I could know some way of remedying it. Also, belonging to the same organ, there are two keys (both are D sharp) which cipher very much, and however much the keys are shaken up and down it makes no difference—it does not stop it. I shall be very glad if some one of your readers, who understand the organ thoroughly, will tell me what the causes are, and how to remedy these faults?—CONSTANT READER.

[61716.]—**Electric Light.** — To light four incandescent lamps of 10 or 15c.p. for five hours nightly, what battery is best for the purpose, and what number of cells will be required to maintain the light efficiently for 10c.p. lamps, and what for 15c.p. lamps?—SARDONYX.

[61717.]—**Chemical Precipitate.**—I dissolve 50 grains of nitrate of silver and 10 grains of sulphate of copper in 6oz. of distilled water. I then add strong ammonia until the liquid is of a deep blue colour and quite clear. In a short time a black powder is precipitated. How can I prevent this, or how can I redissolve it?—J. B. BLEW.

[61718.]—**The Leeds Parish Church Organ.**—Would Mr. Audsley oblige by giving the present specification of this organ? I have a cutting from the ENGLISH MECHANIC giving a specification, but this must be of the organ as it existed before the rebuilding a few years ago, as it does not show a manual 32ft. stop. Can Mr. Audsley say if the grand Schulze diapason, to which he refers, is still in its original condition? I certainly did not hear, or, at least, recognize it, when I was there some time subsequent to the rebuilding, and I was told that the present condition of the organ was not generally considered satisfactory by musicians who knew the instrument before the rebuilding.—SANDERSON CORPUS.

[61719.]—**Straightening Wire.**—Can any reader describe the best way to straighten half-annealed Bessemer steel wire? I remember noticing, whilst walking through a large wire mill some years ago, a small apparatus revolving at a very high speed, through which, by means of hollow spindles at each end, wire was easily drawn by a boy and came out perfectly straight. I should now much like to know the internal arrangement of this kind of machine, and whether it has to be adjusted for different conditions and gauges of wire.—H. C. C.

[61720.]—**Photo. Exposures.**—In Burton's Tables, there are good guides as to relative exposures for months and hours of the day. Will someone supplement same by saying probable increase caused by sun being obscured and by a dull day? Thus, by Table iii. we are told if a lens requires an exposure of 1s. at 12 o'clock in June, it will in February require 2s.; this for good sunshiny day. What number will these require to be multiplied by if (*a*) a cloudy day, (*b*) if a dull day?—J. R., Plymouth.

[61721.]—**Quick Writing of Notes.** — Some time since, but I do not know when, I saw an advertisement in "Ours" of a system of abreviated longhand in distinction to shorthand. Can anyone tell me anything of same, or such a system, or of any pamphlet, &c., thereon?—J. R., Plymouth.

[61722.]—**Photography.**—I have seen a print of a distant view, and was struck with its beauty, the object, though nearly half a mile off, being exceptionally well defined, whilst the foreground was distinct and clear—in fact, everything from a yard to half a mile seems to be perfectly in focus. What make of lens is this that possesses such penetrating, as well as defining, power? Is it possible to do such work as this with the ½-plate R.R. Optimus lens? If so, a few hints will oblige—A NOVICE.

[61723.]—**Moulding Rubber Goods.** — I am desirous of making an article of soft rubber, and should be obliged to any reader who would inform me as fully as possible how such articles as tobacco pouches, &c., are made. If any publication is issued which would meet my wants, kindly name.—JOSHA.

[61724.]—**Telephonic.**—Could any of your readers inform me which is the best form of transmitter for speaking telephones?—ZIRCONIUM.

[61725.]—**Photographic Query.**—I have taken a few photographs (8 secs. with four stop), on Derwent plates (extra rapid), of a house, and when developed and fixed are very thin. I use Edwards' developer. Could any of your readers tell me what is probably the cause of it?—SPHYNX.

[61726.]—**Cotton-Seed Oil.**— In last week's issue, under "Exercises in Technical Analysis," referring to a recent decision in Glasgow, I find: "This decision declares olive oil to be an article of food, and the addition of cotton-seed oil an offence under the Food and Drugs Act." As an old subscriber, will you allow me to ask "our" Mr Allen if there is any reason why cotton-seed oil should not be as much an article of food as olive oil? I have used it, and I know many others who are constantly using it for cooking purposes, without (so far as I know) any injurious effects. Should cotton seed be any more injurious than linseed? I have used refined cotton-seed oil which, for flavour and richness, I have thought equal to the best olive oil, at a much less cost than olive, and I think its recognition as a food would be another economical addition to our food resources.—PUBLICOLA.

[61727.]—**Locos.—L. and S.W.**—Will "V. J. B.," or any other correspondent, give me particulars as to date, builder's name, weight in working order, and type of the L. and S.W. locos. Gaul, Dane, Castleman, and Nos. 470 and 521 (no names)? Also G.E.R. loco. 659, and M.R. locos. 1258 and 1692, and L.B. and S.C. locos. Balham, Buckhurst, Clapham?—REINDEER.

[61728.]—**Motor for Small Organ.**—Will any of "ours" kindly help me out of a difficulty? I am making a small water motor, with a cylinder 1½ bore by 5 stroke, and cannot make the valve act. When the piston has moved the valve (a four-way tap) half way the motor stops. I have tried all manner of ways, with springs, &c., but cannot succeed. I have seen some of these machines at work (e.g., Crystal Palace), and the valves seem to work themselves immediately they are touched by the rod. Can anyone explain the action of these valves? A sketch will oblige—PRESSURE.

[61729.]—**Estimating.**—Would any of your numerous readers kindly inform me of a good work treating on the estimating of builder's work?—YOUNG BUILDER.

[The best work of the kind appeared in the leading architectural paper, the *Building News*, and has been republished in book form by B. T. Batsford, 52, High Holborn.—ED. "E. M."]

[61730.] — **Conservation of Energy.** — Would somebody kindly inform me what fraction of the energy contained in coal is made use of by the finest constructed engine? Also, how much of the energy contained in his food is made use of by man?—E. G. M.

[61731.]—**Injector.**—Can any of "ours" give me any information how to make the above work at high pressure, say 60 to 80? I can only get it to work at 35 to 45, which is too low.—G. ROE.

[61732.]—**Models of Buildings.**—I am making a model building of pasteboard, and I want to coat the outside of it with some substance that will remain soft while I mark it to resemble cut stone. Could you kindly give me a recipe how to make such a substance?—J. F., Dublin.

[61733.]—**Oils and Tallow.**—Will someone oblige by giving recipe for detecting vegetable matter, say seed oils, when mixed with animal oils, or with tallow?—TESTER.

[61734.]—**Iron v. Steel.**—(See p. 521, letter 26816, 3rd column, last paragraph). Questions which Mr. J. G. Shepherd will perhaps kindly answer: (1) What is the melting point, F. or C., of wrought iron, malleable iron, and soft cast steel? (2) Does Mr. S. mean "malleable iron" (i.e., cast iron rendered malleable), or does he refer to wrought iron? (3) When wrought (in that sense malleable) iron is used, is not a special melting furnace required? (4) Does Mr. Shepherd mean that the aluminium is added before or after the melting? (5) If added before the melting, would the aluminium not be alumina if a blast used before the iron melts? (6) Must not the aluminium be added before the iron is melted, and how? (7) Would not the Mitis process be more correctly described as making the alloy fusible at a lower heat, so as to have spare heat during the process of pouring?—R. S. T.

[61735.]—**Screw-cutting.**—I have two screws to cut in steel, and shall be glad of a little instruction. One is a buttress screw 12in. long, 1in. diam., ⅜in. pitch, and the threads a quarter deep; the other is a round thread, 12in. long, 1in. diam., ⅜in. pitch; threads, ⅜in. broad and ¼in. deep. I am a new hand at screws, so shall be glad of elementary instruction.—ANXIOUS.

[61736.]—**Harp.**—Is there any published work on the practical construction of the harp?—J. E. D.

[61737.]—**Size of Steam Boilers.**—Wanted, a rule to find the size of boilers that will work given steam engines.—S. CRABTREE.

[61738.]—**Shirt Buttons.** — Would one of "ours" kindly explain how the ordinary mother-of-pearl shirt buttons are made? They appear to be turned; but unless this can be done by machinery automatically, it seems impossible that they can be made at such a low price as they are sold at.—B. H.

[61739.]—**Sand Figures.**—I have been experimenting with Chladni's sand plates, and have been able to obtain several complicated and beautiful sand figures; but completely break down over the production of the 30 odd ones figured in Tyndall's lectures on sound. I should be glad if any correspondents who have investigated this subject would suggest the method of their production, or any book on the subject. I may say that I have got several figures which are not shown in Tyndall's work; but they are poor affairs beside the drawings delineated there.—S. J.

[61740.]—**Frankenstein.** — Can any correspondent inform me whether any modern edition of "Frankenstein" has been published, and, if so, where it is obtainable? I have always understood it was written by Mrs. Shelley in a few hours for a wager; but I have never succeeded in securing a copy of it.—DOCTOR MEDICINÆ.

[61741.]—**Brake Trial at Ipswich.**—I read in a local paper that the Great Eastern Railway have been experimenting last week with a new brake fitted to six coal waggons. Can any reader tell me what the new brake is? It is without doubt a great stride in the brake question that coal waggons should be supplied with brakes that fulfil the Board of Trade conditions. What a change from the time when such brakes were objected to on passenger trains!—RY. STUDENT.

[61742.]—**Railway Signals.**—Has any further step been taken to get railway companies to adopt one code of signal lights, so far, at least, as refers to green or white all-right lights?—INQUIRER.

[61743.]—**Winking and Blinking.**—Can any of your medical or other readers say the cause and cure for this in a boy 14, who has had it for some years?—OPHTHALMIC.

[61744.]—**Emery Wheel.**—What grain emery wheel should I require for taking the stone marks out from razors and small scissors after grinding? Can the same "colour" (polish) be given to the article as with a wooden wheel used in the ordinary way? I am now using a mahogany wheel with No. 80 hole emery and oil.—SELIM.

[61745.]—**Mechanics.** — Would any of our correspondents kindly give an amateur a rough sketch of the feed motion to work the cross slide of a planing machine?—NOVICE.

[61746.]—"**The Last Quarrel.**"—Can any reader give the author of a poem which I am told is called "The Last Quarrel"? The scene is laid in the Isle of Wight, and is between a man and his wife about a letter; the man crosses the Solent and is lost.—ARQUES.

[61747.]—**Moss.**—How is it dried and how treated to give it the fresh green colour it has when seen in the greengrocer's shops?—W. H. B.

[61748.]—**Electric Light.**—Can any reader help me? I want to light my shop by electric light. I have a gas-engine (2-man-power Bischopp). Could I make a dynamo that this would drive, and how many incandescent lamps would it light? I am now using four gas burners, which light it well, as it is only a small shop; but as it is a cutler's, the cutlery gets in such a state from the moisture which condenses on the window. Distance from engine is about 30ft. I am expert with my tools, and could manage to work up castings, &c.—SELIM.

[61749.]—**Lathe Matters.**—Will Mr. Evans, Dr. Edmunds, or someone kindly assist an amateur? I am making an eccentric chuck and cutter frame. The main screw of my slide-rest has eight threads to the inch. Ought I to (1st) make the traversing screw of chuck and cutter with same number of threads? 2nd. Should I, in that case, divide the micrometer on them into 8 or 10 divisions? or (3rd) should I make the screws with 10 threads and divide the micrometer into 10 divisions? I see in Holtzapffel. Vol. V., he makes all his screws 10 to the inch; but then his slide-rest main screw has the same number; hence my difficulty.—E. H. DOWSON.

[61750.]—**The Exact Time.**—Can any of our readers inform me of any source of approximately exact time which is independent of the current from Greenwich? Big Ben is probably generally correct, but cannot be read by sight within half a minute for want of a second hand, which Lord Grimthorpe writes me it would be impossible to add to the clock. After the snowstorm all London was, for want of such a clock, without any exact time for more than a month, whilst the connection with Greenwich was destroyed.—MONTMARTRE.

[61751.]—**Exact Measures.**—Whilst waiting for the fall of the 1 o'clock ball at the Observatory, Greenwich, during the break-down of the electric wires, I one day occupied a few spare minutes in testing the metallic tape measure which I carry in my pocket against the Standard measures of length inserted for the use of the public in the wall of the Observatory, and was greatly surprised to find the tape measure short of the Standard length by nearly an eighth in the foot and over three-sixteenths in the yard. What "standard" do makers use?—MONTMARTRE.

[61752.]—**Dirty Ceiling.**—The ceiling of our best room seems to have been finished with a coating of plaster-of-Paris. Both the moulding and centre-flowers when washed are of a dull grey colour instead of a clean white, and how ever many times we whitewash them we cannot get them to take an even coat, but they always appear to be greasy and streaky. What should be done to kill or overcome this nuisance?—ANNOYED HOUSEWIFE.

[61753.]—**Sympathetic Vibrations of Jet—The Graphophone.**—The "E. M.," Sept. 3rd, 1886, contained an abstract of a paper with the above heading, read by Mr. C. A. Bell before the Royal Society. Owing to absence from home, I have been unable myself to repeat these truly beautiful experiments; but some time ago, I sent the abstract with copies of the drawings to a scientific friend of mine, who was successful in all except the last two, Figs. 6 and 7. No. 6, he says, puzzles him. The drawing represents a water jet under about 15 decimètres pressure. The only result he could get was a great noise of pattering on the diaphragm. How is the electric connection made in Fig. 7? All experiments with jets are so beautiful that probably many readers of the "E. M." have repeated those given in the abstract, and any further light on the subject would, I am sure, be interesting to many. The drawing Fig. 8 is meant to explain Fig. 7, but I fail to understand it. I hope some of your scientific contributors will be so good as to make the matter clear to me, and, I may add, to many others also.—AN OLD SUBSCRIBER.

[61754.]—**Crystals in Leaf.**—I have lately been mounting transverse sections of leaf of Prunus laurocerasus (cherry laurel), and noticed in the spongiform layer of cells numbers of colourless rhomboid plates. Can any of our microscopical readers say what these are likely to be, and whether they have been previously noticed? The sections were floated off into water when cut, cleaned in oil of cloves, and mounted in balsam (power 350 dia.). I thought it might be the glucoside amygdaline, but understood that in P. lauro-cerasus it was amorphous, and would it not decompose with emulsion and water into HCN and glucose? Another suggestion is that they are the "crystalloids" of Nägeli.—REYMOND.

[61755.] — **Medical Battery.** — Will any reader inform me how to connect up a 36-cell medical battery, having two dial collectors, so as to commence at either end of battery? Each dial collector is numbered from 0 to 18 inclusive. The zinc of the first cell was formerly connected to 0. Wish to dispense with double wires, if possible.—CIRCUIT.

[61756.]—**Lame Jackdaw.**—I have a tame jackdaw, and since the cold weather came in he has got very lame on one foot. It has swollen, and on handling seems heated, and pains him on touching it. I showed him to a bird-fancier, who said he had got chilblains, and advised me to bathe in warm water and then oil. This I have done several times, but it is no better. Any hints will oblige, as I do not like to see him limping about.—J. I. S.

[61757.]—**Legal—"Back Letters."**—A rich brother long settled in England for some time assisted me with a yearly gift of money, and I then granted him a bill payable on presentation for the total amount. He thereupon gave me a "back letter," explaining the nature of the transaction to be only in order to enable him, in the event of my death, to rank on my estate, but that even then the bill would not be presented unless he or his family actually stood in need of the money. I understand that a back-letter given in Scotland by a domiciled Scotsman is a legal obligation. Would one granted in England by a person domiciled there be so also? I have heard that back letters were unusual in the latter country.—W. B.

[61758.]—**Legal.**—Owing to the agricultural depression, a rector, being without tenants, is compelled to farm his own glebe land of some 500 acres. In the event of the rector dying, or giving up the living, would his successor be liable to pay him for the ordinary farm valuations, acts of husbandry, root crops, &c., in the same way as is done between ingoing and outgoing tenants of a farm, or would the retiring rector (or, if dead, his executors) be allowed a certain period to retain the farm after the arrival of the new rector, so as to gather in and dispose of all the existing crops, straw, hay, &c., in the event of the new rector declining, or not being liable, to pay for them?—E. A. LITTON.

[61759.]—**Oxygen Gas.**—Can any reader inform me at what pressure oxygen gas may be liquefied at the ordinary temperature of the atmosphere? Oxygen gas has been liquefied by means of pressure and great cold; but I wish to ascertain if pressure alone has yet been able to liquefy it, and, if so, how many atmospheres is that pressure calculated to be; or I would be glad to know the greatest pressure to which oxygen has been subjected without any change in its gaseous state being observed?—D. W. J. R.

[61760.]—**Fan.**—As I have an 8in. fan which I am going to use with a small forge (sometimes with a large blowpipe), I would ask the writer of the articles on Forge, &c., to indicate a good general arrangement for placing the driving pulleys and fan. My fan has a 2in. hole with flange. How much taper shall I want on the pipe connecting it with the tue iron? and which is the best mode of connecting to the latter? Can I purchase a suitable connecting taper pipe, or how shall I have to make a pattern for one in this case?—J. ADAMS.

[61761.]—**Table of Sizes.**—Could any brother reader assist me with the following? How much travel per inch of diameter ought the inside calipers or gauge have so as to insure a good driving fit; for instance, the crank-pin of the screw-steamer *Arizona* is 23in. in diameter, and the crank-pin hole is 18in. deep, what travel would be allowed to insure a good tight fit? I should be glad of any information on this subject, or any reference as to where it can be found. I may add I have a table of sizes from 1in. up to 100in. dia. for working fits, and I have found from experience that 1-16in. per inch of diameter is a good rule to work from, but I have very little experience of driving fits.—TURNER.

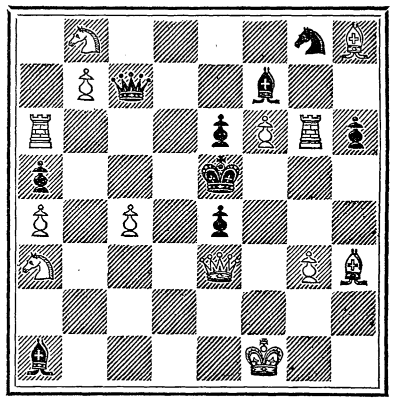
[61762.] — **G. and S.W. Ry. Locos.** — Would "Engine-Fitter," or some other reader, give a description of the way in which these engines are reversed? I have noticed on the express locos., that instead of the ordinary reversing lever a horizontal cylinder is situated on the foot-plate at the driver's right hand, which, when steam is admitted to its piston in some way moves the links. By what mechanism is this effected? Give dimensions of the old outside cylinder single engines, and say by whom they were built. I sometimes see them used for passenger trains.—AMATEUR.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXXI.—BY A. BOLUS.

Black.



White. [13 + 9

White to play and mate in two moves.

SOLUTION TO 1,029.

White.	*Black.*
1. R-Q Kt 7.	1. Q-Kt sq (*a*).
2. Q-B 4 (ch).	2. P takes Q or Kt.
3. Kt or R mates.	
	(*a*) 1. Q takes Kt (*b*).
2. R takes P, &c.	
	(*b*) 1. P Queens (*c*).
2. Q-Q B 2, &c.	
	(*c*) 1. P-K 7 (*d*).
2. Q-Kt 3, &c.	
	(*d*) 1. B-K 7 (*e*).
2. Q takes P (ch), &c.	
	(*e*) 1. Kt-Kt 3 (*f*).
2. R takes Kt (dis. ch), &c.	
	(*f*) 1. P-R 4.
2. Q-B 4 (ch), &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 1,029, by Major (grand problem—one of the finest seen for a long while), V. S. Pochin (several important variations omitted), H. Hosey-Davis (very good key and some pretty play; too many duals), Black Pawn (dual mates dreadfully numerous). Link, A. Bolus (many duals); to 1 028, by Hensing, T. H. Billington, Avon, and Country Boy.

V. S. POCHIN.—You are wrong in your second solution of 1,029. If 1. $\frac{\text{B takes P}}{\text{Q takes B (ch)}}$, so that R cannot play to K B 4 on the second move, as you propose. You are right as to your solution of 1,027; correction made. We will refer to the other problem you allude to.

A. DEAN, F. KRASSER, AND A BEGINNER.—If in 1,029, 1. $\frac{\text{R-K 7}}{\text{Q takes Kt}}$, 2. $\frac{\text{Q-K B 4 (ch)}}{\text{K takes Q}}$, and there is no mate. If 2. $\frac{\text{B takes P}}{\text{Q-Q B 3}}$, and again White cannot mate next move. If 2. $\frac{\text{R takes Q}}{\text{K-Q 5}}$, and K escapes at B 4.

W. HEWSON-KILBEE.—If 1. $\frac{\text{R-Q 7}}{\text{Q takes Kt}}$, and how then?

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 16, and unacknowledged elsewhere :—

MEDICAL BATTERY CO.—Gregory Wright.—R. Lloyd and Co.—Capt. Smithwick.—Victor Nielsen.—W. K. Fulleylove.—E. W. W.—Doubtful.—J. N. C.—Goolwa.—Dyer.—H. H.—C. P. Bartholomew.—Geo. Button.—Arcadian.—T. G. Elger.—J. C. T.—T. F. S. T.—A Fellow of the Royal Astronomical Society.—W. J. S. Barber-Starkey.—S. P.—New Reader.—Beginner.—The Writer of Letter signed "Another Fellow of the Royal Astronomical Society."—Picklock.—Optician.—W. A. Barber.—Joiner.—Spectator.—E. M.

BEGINNER. (You must test it, or get it tested. No one can tell you the candle-power of an incandescent lamp when all the data you give are 2in. in diameter and 3½in. long. See indices or recent back numbers. We believe we answered you on p. 488.)—H. S. (Yes, arc lamps have been fitted to magic-lanterns. See catalogues of dealers, and such books as "Ganot's Physics.")—TYRO, A NEW SUBSCRIBER. (Black for stopping out in magic-lantern slides can be made by dissolving asphaltum in turpentine, and using the solution as a medium for grinding lampblack. If properly ground, and a little mastic varnish added, the result is a fine black, quite impervious to the strongest light. As to lenses, see p. 484 this volume, and on painting slides, if you cannot refer to back volumes, procure the guide by "Sable," published by Mr. Hughes, of Mortimer-road, Kingsland, N.)—THOMAS SMITH. (Medical queries are answered in the *Weekly Times and Echo.*)—TEMPUS. (No. 924 being out of print, another number has been sent containing the information. Try Messrs. Cotterill, Rodney-street, Liverpool.)—SOLDERING IRON. (We do not think it worth "working out." There is no difficulty in tinning a copper-bit, nor in using it when tinned.)—F. H. (At any of the large wire-workers or dealers in such materials. 2. By adding oil or wax to it. Does it not strike you that the candles cannot be made of paraffin? Most likely they are stearin.)—MARINE. (To become a marine engineer you must have been at sea at least one year, and have been employed in the engine-room. That is, assuming you have served three years at least in shops where engines are made. Otherwise four years' service is required. As you have not had any technical training, we imagine you will find great difficulty in obtaining a berth.) — E. P. (Safety paraffin lamps would naturally be the subjects of patents. We are not aware that any prize has been offered for one; but a prize has been offered for a miners' safety-lamp that will comply with certain conditions.)—R. SMITH. (Nos. 1108, 1130, 1132, contain the notes on heating water rapidly.)—M.SC. LOND. (Shred the light-coloured bottle-rubber fine, and put it into bisulphide of carbon.)—MEDIÆVAL. (Brazing has been explained over and over again. The parts to be joined are thoroughly cleaned and covered with borax and brass clippings or "spelter." They are tied together with iron wire, and heated until the brass runs into the joint.)—A WORKING MECHANIC. (A small hole is left in the lid, and a little piece of tin plate underneath, to prevent the solder running through. The tins are then placed in a bath of brine or chloride of calcium, and when all the air has been driven out by steam, the hole is closed with a drop of solder.)—G. M. (They are salted and smoked, or are supposed to be; but too often they are merely dipped in a preparation of pyroligneous acid. 2. If you cannot refer to back volumes, see Heather's "Surveying and Astronomical Instruments." 3. If you take the iron continually it will prove injurious; but how comes the water to have so much rust in it if the supply is constant?)—DICK. (A "perpendicular" line is one drawn at right angles to any given line; a "vertical" line is one that is upright or at right angles to the horizon.)—N. R. (No book specially devoted to the subject. There are articles in cyclopædias and in our back volumes, and in Hofmann's "Paper Manufacture"; but that costs three guineas and a half.)—G. W. L. (Probably a derivative of Rangoon petroleum. Where do you find any mention of it?)—A. H. G., Bristol. (You will find many receipts by looking through back volumes; but if you refer to Cooley's Dictionary, or such a work as "Enquire Within," you will have a choice of a considerable variety of more or less value.)—R. DRAKE. (There is no work on such a subject, nor is it easy to understand how there could be, for the operations required are merely the modified application of the usual processes of the workshop. Methods of hardening steel have been explained over and over again; but it is not easy to teach the use of the file or to impart skill by mere verbal description.)—SUFFOLK. (You must have suitable steel and much practice. See pp. 152, 174, 196, Vol. XLI.; or you will perhaps find the "secret" in No. 741, p. 320, or No. 709, p. 180. There is plenty of information about working mill bills in back volumes; but for definite instructions the kind of steel must be known, as Mushet's requires different treatment to ordinary tool steel.)—L. V. (You can make all sorts of rockwork for aquariums by covering objects with Portland cement; but why not use natural rock and shells? Get the plants to grow well before putting in the fish.)—CUTTER. (The usual tools employed for turning steel. 2. Haydon's cutter-bar, with directions for using it, was illustrated so recently as No. 1071. See also Nos. 1060, 783, 784, and the indices generally. You can get an illustrated circular from the Britannia Company.)—C. TRATHEN. (We do not know what it is you refer to. There have been several articles on triple expansion engines in our columns, and the method of getting the best diameters for the respective cylinders is obviously a matter of calculation.)—CAPTAIN J. (The query you put has actually been dealt with in recent numbers. See p. 430. In the summer the sun is higher up, and this country catches his rays more directly.)—S. G. (Clean with sand, pickle with acid, rinse with hot-water, immerse in a bath of melted grease, and then dip in the molten tin. If you mention what sized articles you wish to tin, more definite directions can be given.)—PILULE. (Directions for coating pills with sugar in No. 966, p. 94. The percentage allowed varies from 30 to 50; but such queries are of little interest to readers.)—LEARNER. (For so small a number of copies it is not worth while using the lithographic process, especially as you must have a press. There is a book, and you will find all necessary instructions in Richmond's "Grammar of Lithography." Wyman and Sons, Great Queen-street, Lincoln's Inn Fields.)—ZINCO. (We are in doubt as to which process you mean; but all have been described in back volumes. See p. 155, No. 1074, and the index to Vol. XXVII. If a rubber stamp will not do, why not print from a block?)—CHARLES MURFITT. (If you are as you say, "An Old Subscriber," what have you done with your back volumes? We were under the impression that nearly every conceivable method of fitting up electric bells had been described in our columns; but you want elementary instruction. If you cannot see back volumes, procure the little pamphlet from Gent and Co., Leicester, advertised on the front page.)—RUSTIC. (It is hotter at the bottom, and consequently rises to the surface, where it becomes cooler.)—T. K. W. (Most likely by boiling both, when they become soft. Then by expanding the hole and squeezing the piece which has to be inserted, the "puzzle" is solved. That is how most puzzles of the kind are done.)—COOPER'S HILL. (Every member receives a copy of any Blue-book or other matter ordered by the House to be printed, and the public can purchase anything of the kind at a price fixed by the cost of production. 2. London, Southwark, and Waterloo were built by Sir John Rennie, assisted by his sons in some cases; Blackfriars, by Joseph Cubitt; Westminster, by T. Page; Lambeth suspension, P. W. Barlow; Chelsea suspension, G. G. Page. Vauxhall was begun by Sir John Rennie and completed by James Walker. 3. Nothing more has been heard since the finding of the Court; but there is no doubt that she had an enormous hole in the side.)—H. T. (Celluloid is polished in much the same way as ivory, with fine glass-paper and with whiting and spirits or water.)—FLEUR-DE-LIS. (Which concertina do you mean? However, the scheme of tuning has been frequently given, and the rest is practice—learning to distinguish the beats.)— ARTHUR. (The information asked for *has been* found generally acceptable to a large number of our readers, as you will find if you refer to the indices. Look through the back numbers of this volume, or say what sized coil you wish to make, and then we may possibly be able to indicate in which back number you will find instructions.)—W. R. (Yes, the dry plate has "almost entirely superseded" the old process. There may, in some special conditions, be an advantage in the wet process; but we imagine it would take a great deal of discovering.)—J. (A physician, certainly. Your medical man will know of a specialist. 2. Medical advice should be sought. Beyond that, exercise in open air, no suppers, and the usual rules for leading a healthy life.)—T. (A Mustel organ is a high-class harmonium, and if you do not recollect seeing any description in our pages, it is because you have not looked for it. You will find a sectional diagram of the instrument in No. 577, and a good deal about that and others in subsequent numbers. See p. 425, Vol. XLII., and the index of that volume.)—READER. (Your question has been answered many times, and can be answered by any teacher of a science class. Replies could only be gratuitous advertisements, and the selections might be invidious, as several publishers issue suitable works—*e.g.*, Longmans, Crosby Lockwood and Co., Macmillan, Cassell, &c.)—R. (Any good book on the subject. See publishers' lists.)—ELECTRA. (Perhaps plaster of Paris will do, or marine glue. 2. Any of the bichromate arrangements, the chloride of silver, or sulphate of mercury cells. See indices for "portable batteries," however, as there are several useful modifications.)—W. E. M. (See p. 418, reply 61291, and many recipes in back volumes.)—R. M. (Impossible to say without analysis; but a first-class tooth paste is made of 8oz. prepared coral, 4oz. cuttlebone, 2oz. mastic, ½oz. cochineal, ¾lb. of honey, a fluid drachm of essence of ambergris, and ½ fluid drachm of oil of cloves. Dissolve in a fluid ounce of rectified spirit.)—PUNCH. (Mushroom-growing indoors and in the open air has been frequently described in back volumes. Procure Mr. Wright's book on the subject from the *Journal of Horticulture* office, 171, Fleet-street, E.C., price one shilling.)—IOTA. (We had had enough of the subject. 2. Yes, as a letter.)—P. WARD. (We cannot make exceptions to the rule; if we do, we are blamed for unfairness.)—E. CONRY. (We are obliged by your kind offices; but your replies reach us so late that we are sometimes unable to use them. This week we have to hold all over.)

USEFUL AND SCIENTIFIC NOTES.

A New Dentifrice.—The *Gazette Hebdomadaire* contains an article by M. Paul Vigier on the "Use of Steatite as a Tooth Powder." Many years back M. Vigier discovered that the addition of powdered talc to water prevented the deposit of calcareous salts in boilers. Applying this fact to dental therapeutics, M. Vigier has devised a new dentifrice, which, he says, prevents the formation of tartar. The formula is as follows:—Powdered steatite, 60 grammes; desiccated alum or cream of tartar, 5 grammes; powdered cochineal, 10 grammes; essence of peppermint, 20 drops. Any other perfume may of course be substituted.

New Books of 1886—The number of new books published in the year just closed was 3,984, and of new editions 1,226—a total of 5,210. This is a falling-off of more than 400 from the publications of the year 1885, which were 5,640 in number. Messrs. Sampson Low, Marston, Searle, and Rivington, to whom we are indebted for these figures, publish, as is their custom, an analytical table of the books published during the year. The table is divided into fourteen classes, and the numbers of each are as follows:—Theology, including sermons, 752; educational, 572; juvenile works and tales, 445; novels, 969; law and kindred subjects, 33; political and social economy, trade and commerce, 246; art, science, and illustrated works, 178; voyages and travels, 221; history and biography, 350; poetry and the drama, 93; year books and serials, 294; medicine and surgery, 171; belles-lettres, essays, and monographs, 479; and miscellaneous, 407. From the table of publications issued every month, it appears that January was the weakest, producing only 205 books. The number rose, with considerable variations, to 445, or more than double, in June, fell continuously to 258 in September, rose to 602 and 642 in October and November, and finally reached 852 in December. Most of the fourteen heads show a decrease. Novels increased from 455 to 755.

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Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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Advertisements *must* reach the office by 1 p.m. on Wednesday, to insure insertion in the following Friday's number.

The English Mechanic

AND WORLD OF SCIENCE AND ART.

FRIDAY, FEBRUARY 25, 1887.

THE BIRTH OF MATTER.

THE old idea of the alchemists, embodied in their views as to the transmutation of metals, has never been altogether excluded from the "scientific use of the imagination," and even the textbooks which give a list of the elementary bodies also contain the intimation that for all we know to the contrary those forms of matter which we call elements may possibly be capable of analysis into one simple substance, if only we had some more powerful means of chemical analysis than we possess at present. We recognise some seventy forms of matter which we are unable to split up into other forms, and which we can mechanically divide to an extent which indicates only further divisibility beyond our powers of vision, and almost beyond our powers of conception. Matter qua matter is indestructible, so far as we know, and therefore when we speak of the birth of matter we refer to its form in its earliest condition—the next stage to Mr. Crookes's protyle, the birth of the elements. It will be remembered (see p. 29 ante) that, at the meeting of the British Association last autumn Mr. W. Crookes, F.R.S., delivered, as president, one of the most remarkable addresses ever heard in the section devoted to chemistry. It was an attempt, made with knowledge and with the scientific use of the imagination, to describe what may have been the genesis of the elements; and, last Friday, before a distinguished audience at the Royal Institution, Mr. Crookes introduced a series of what it is the fashion to call "brilliant experiments," with the object of showing that a belief held by such men as Brodie, Clerk-Maxwell, Dalton, Dumas, Graham, and others equally distinguished, is based upon a solid groundwork of fact. Chemists, as a body, are inclined to the belief that the elements are compounds of simpler substances, perhaps of one; but there has hitherto been little evidence of the truth of the theory, and it has been simply regarded as an hypothesis to be cherished and to be worked with when unexpected results are obtained in the course of an investigation. At the beginning of the present decade we heard a good deal about the primal element hydrogen and the dissociation of carbon, based upon crude observations with the spectroscope; but Mr. Crookes had already obtained some rather inexplicable results with his rare media and his radiant matter, and following on the lines or on those opened out by his researches he was able to give something more than the old reasons for believing that the elements, or some of them at least, are really compound. In concluding a lecture delivered before the British Association at Sheffield in 1879, he said that "we have actually touched the borderland where matter and energy seem to merge into one another, the shadowy realm between known and unknown, which for me has always had peculiar temptations. I venture to think that the greatest scientific problems of the future will find their solution in this borderland, and even beyond; here, it seems to me, lie ultimate realities, subtle, far-reaching, wonderful." At the last meeting of the British Association, at the conclusion of his long address, he said: "Summing up all the considerations, we cannot, indeed, venture to assert positively that our so-called elements have been evolved from one primordial matter; but we may contend that the balance of evidence fairly weighs in favour of this speculation." The more deeply we dive into the mysteries of nature, the stronger becomes the evidence for evolution, not merely in one branch, but in all, even in the very elements themselves. It is not easy to perform a number of "brilliant experiments" before a sectional meeting of the British Association; but in the theatre of the Royal Institution Mr. Crookes was able to show to a critical audience the facts on which he based his far-reaching hypothesis. The steps by which the present position has been reached may be traced by referring to the records of the researches of Mr. Crookes in Vol. XXVIII. p. 383, on an ultra-gaseous state of matter; in Vol. XXIX. p. 512, molecular physics in high vacua; and p. 639, radiant matter. On Friday last he was able to boldly lecture on the "genesis of the elements," and to show that there was reason to suspect that he had broken up the "element" yttrium into perhaps six new "elements." He produced a glass tube containing air of only the fifty-millionth of an atmosphere in density, and holding within a capacity of about five cubic centimètres (little more than ·3 cubic inch) one hundred million million molecules. The yttrium broken up or dissociated in an atmosphere of about one-millionth by means of the electric current, and examined by the microscope, produces fine examples of the phosphorescent glows to which Mr. Crookes has introduced us, and pushing the examination further, in still higher vacua, appearances are obtained which lead to the conclusion that the yttrium has been formed by the combination of six simpler substances, possibly derived direct from the original protyle, and caused by varying states of electricity, or what we call electricity, and heat to shape themselves into the "element" yttrium. The "genesis of the elements" sketched out by Mr. Crookes in his famous paper would not be confined to our little solar system, large as that seems, but would doubtless follow the same sequence of events in those centres of energy which are visible to us as stars; probably also in those which, though invisible, there is reason to believe exist in numbers through the immensity of space. Photography has already disclosed the existence of stars which the eye cannot discover through powerful telescopes, and we can only conjecture that in those centres of energy similar cycles of change are progressing as in our own solar system. We can by means of the spectroscope form some idea of the composition of the sun and of the fixed stars, and we may take it for granted that so far as the spectroscope can disclose the constitution of bodies so far away, it is certain that some of the "elements" which we recognise in the sun are also present in the stars, in nebulæ, and in comets; but their discovery scarcely lends so much weight to the hypothesis of the compound nature of the elements as the remarkable results which Mr. Crookes has been able to show by operating on terrestrial elements in high vacua.

Turning to another branch of the subject, the origin of living matter, we find in the Rev. Dr. Dallinger an experimentalist and a patient investigator, who has no superior in the division of biology which relates to the origin and development of the minute forms of the animal and vegetable life. In his address as President (for the fourth year) of the Royal Microscopical Society, Dr. Dallinger gave an account of his *magnum opus*, which he modestly described as a "fragment"—a research which has required something like ten years of unremitting and careful observation. All the world is aware of the work done by Dr. Dallinger in the study of microscopic organisms, and most of those who are familiar with Darwin's views know that he long ago expressed the opinion that if we would learn how animals accommodate themselves to changed environments, and so produce what we call new species, we must study the minuter forms of life with unremitting attention. It is obvious that temperature must be a potent factor in the life-history of any organism, and especially, perhaps, in those which are little more than a cell containing protoplasm. Already familiar with the life-history of the monads, Dr. Dallinger determined to watch their behaviour under gradual increments of temperature, and although a new generation comes into existence every four minutes or so, it took years of observation to raise the temperature to the rather high point of 158° Fahr. The apparatus employed was kept in a room at a fixed temperature, and the water in which the organisms existed was in constant communication with the microscope stage, so that the minute forms of life could be observed at any minute, and the temperature of the surroundings could be raised by degrees or by half degrees, the thermostats now working controlling the variation to one-sixth of a degree Fahr. in twenty-four hours. Commencing at the normal temperature of 60°, four months were occupied in raising it to 70°, without, however, affecting the monads, which still went on with their multiplication by fission as vigorously as before. When a temperature of 73° was reached, however, an adverse influence seemed to be exerted on the organisms as regards their vitality and productiveness; but by keeping the temperature constant for two months the new generations became acclimatised, so to speak, and in another five months the temperature was gradually raised to 78°. Here, again, a long pause became necessary, while the process of adaptation went on, and during the interval a marked development of vacuoles was observed, on the disappearance of which it was possible to again raise the temperature. Long pauses, vacuolation, slow advance, were the three stages well marked in the life-history of the monads and these experiments, until the high temperature (for monads) was reached of 158° Fahr., at which point the experiment was unfortunately terminated by an accident. As the object was to carry the experiments on to a point at which the organisms would fail to respond to the change in their surroundings, the accident terminated the research; but it is, perhaps, scarcely necessary to mention that Dr. Dallinger has started another, which has been in progress for about a year with satisfactory results. Although the premature ending of the investigation was unfortunate, the work done remains, and the patient searcher after truth is enabled to tell the scientific world that by a gradual changing of the temperature he found that organisms which flourished at 65°, and were killed at 140°, were in the course of half a million generations capable of flourishing at a temperature of 158°, and were killed by a return to the original temperature of 60°. Here, then, we have proof that organisms can adapt themselves to changing conditions of a rather "trying" character, and another evidence lending support to the Darwinian theory. The great law of the origin of species is accepted by nearly all biologists nowadays almost as a demonstrated fact; in truth, the wonder is that it was not earlier seen that adaptation to changes of environment is the keynote to the grand music of Nature. It may be urged that the experiments having been made on organisms so minute as monads, there is no proof that similar changes could occur with higher animals and plants. There is no proof, it is true, but the inference is strong. We cannot observe the effects of a change of environment on half a million generations of the higher forms of life; but as they are all merely vast aggregations of cells, comparable in many respects to the monads, what reason is there to suppose that, given the time and the requisite conditions, we should not see as

much adaptation to circumstances in the higher forms of life as in these lowly monads? Nearly every fact that patient research drags to light makes for evolution, and those that appear to be in contradiction are probably only apparently so, needing but the touch of the master hand to make them fit in with the grandest theory ever formulated by the mind of man. The researches of Mr. Crookes and those of Mr. Dallinger have been known more or less fully to the scientific world for some time; but their results have been made public within a few days of each other, and by their combined effect cannot fail to induce scientific workers to dive still more deeply into the mysteries of Nature, and if possible to drag more of her secrets to the light. There is a limit beyond which we cannot go; but these researches, the results of which we have briefly described, lie at the commencement of the last stage, and point the way for future travellers.

FITZGERALD'S IMPROVED BATTERY PLATES.

AMONGST recent improvements in battery plates, mainly for use in secondary batteries, those recently patented by Mr. D. G. Fitzgerald, of 6, Akerman-road, Brixton, are noticeable for their general utility in voltaic cells. The invention at present referred to consists in the manufacture of plates, slabs, and masses, mainly composed of peroxide of lead in a dense and coherent form and suitable for use as negative elements in voltaic batteries without contact with any oxidisable material. In the negative element of lead secondary batteries of the ordinary form, wherein contact with the oxidisable metal—lead—obtains, the two substances mutually destroy each other, the peroxide oxidising the lead support and the latter converting the valuable peroxide into the inert monoxide. The elements to be described have the great advantage of being free from this cause of deterioration. It has before been proposed to employ glycerine in admixture with oxide of lead for the manufacture of negative elements for voltaic batteries, but the patentee has experimentally found that a mixture of glycerine with about twice its volume either of water, or of a half-saturated solution of sulphate of ammonia, or of one of the other solutions specified in his Letters Patent (No. 4671 of 1885), or, again, of a solution of an acid forming an insoluble or nearly insoluble salt of lead (such as sulphuric or phosphoric acid), gives better results than glycerine alone in admixture with oxide of lead. The advantage is to be attributed to the fact that with the aqueous mixtures the resulting compound of lead is hydrated, whereas when glycerine alone is used the resulting compound is necessarily anhydrous. In carrying out his invention the patentee mixes oxide of lead with glycerine and water, or with glycerine and the solution of a suitable salt, or with glycerine in admixture with a suitable acid, and forms plates, slabs, or masses of one of these compositions, which speedily harden and may be afterwards converted into peroxide by "browning" by means of hypochlorite of magnesium or other suitable chlorine compound, and completing the conversion by electrolysis. The invention also relates to the production of a compound peroxide of lead element consisting of a central core or support of either of the glycerine and oxide of lead compounds above referred to, with an external layer or layers of one of the more porous and more readily convertible oxide of lead compositions. The method of construction adopted is as follows:—First, there is formed in a suitable mould a plate, *a*, with apertures or perforations (as shown in face view in Fig. 1), composed of oxide of lead made into a paste with any of the glycerine mixtures above referred to. Secondly, when this plate has hardened sufficiently the plate is converted, at least superficially, into peroxide of lead. Thirdly, the patentee attaches to the peroxidised plate, by means of ebonite screws passing through the apertures *b b* and b^1 b^1 and secured by ebonite nuts, the contact piece, of which an inside face-view is shown in Fig. 2. This consists of a thin strip of ebonite *c* (or other suitable material not acted upon by dilute sulphuric acid and not readily oxidised), to which may be attached, by cementing or otherwise, a piece of metal, *d* (which may be copper protected from corrosion by an insulating material), to which strips, *e e*, of platinum are metallically connected, the strips extending along inner face of the ebonite strip so as to be thereby pressed into direct contact with the peroxidised plate. The strips lie across notches, *f*, in the ebonite strip, so as to expose a portion of the outer surface of the platinum strips for contact with the external layer, *g*, of lead composition. Fourthly, the patentee coats to any required thickness one or both of the sides of the superficially peroxidised plate with a layer, *g*, of any of the porous and readily peroxidised oxide of lead compositions. This composition, which also covers the contact piece, is pressed through the holes or notches *f* to make contact with the platinum strips, as shown on an enlarged scale in Fig. 3, which is a cross section of part of the compound structure.

FIG. 1.

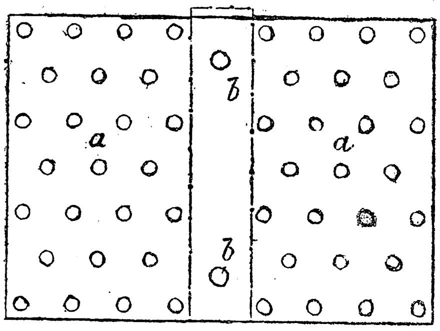


FIG. 2

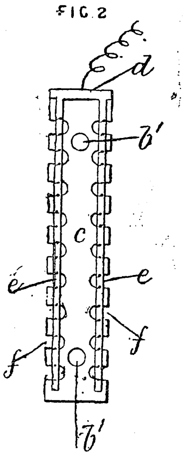
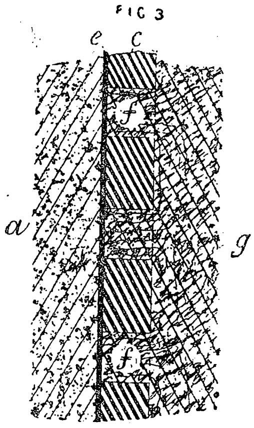


FIG. 3



It may be applied either in the form of a paste or as a powder which, after being subjected to a slight compression, is moistened by suitable means—as by water spray, water condensed from steam, or by imbibition through porous plates by which the mixture may be confined. Lastly, the porous composition is converted into peroxide of lead by being made the anode in a suitable electrolyte, as is well understood. By making contact directly with the superficially peroxidised core as above described, a conductive surface of large area is obtained, from which the subsequent conversion of the external layer may be rapidly initiated. In practice it is found advantageous to prepare or coat that portion of the surface of a peroxide of lead element where contact is to be established with plumbago, or blacklead, the minute quantity of plumbago thus employed filling the pores in the plate and rendering it easy to establish a more perfect contact with the plate than would otherwise be possible, whether such contact be effected by platinum strips as above described or by means of a contact piece made of carbon.

LAKE TAHOE, long regarded as the deepest fresh-water lake in the United States, must now take the second place. Captain C. E. Dutton, of the U.S. Geological Survey, made, in July, 1886, a series of soundings at Crater Lake, Oregon, with unexpected results. The mountain wall that surrounds the lake is 900ft. high, the average depth is 1,500ft., and the maximum 1,996ft.

ASTRONOMICAL NOTES FOR MARCH, 1887.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 12 33·39 P.M.	22 48 27	7 35 22S.	22 35 53·82
6	0 11 28·08 ,,	23 7 5	5 40 13,,	22 55 36·58
11	0 10 12·05 ,,	23 25 32	3 43 11,,	23 15 19·34
16	0 8 48·34 ,,	23 43 51	1 45 1,,	23 35 2·10
21	0 7 19·73 ,,	0 2 5	0 13 31N	23 54 44·86
26	0 5 48·49 ,,	0 20 16	2 11 39,,	0 14 27·62
31	0 4 16·86 ,,	0 38 27	4 8 37,,	0 34 10·38

The method of finding the Sidereal Time at Local Mean Noon at any other Station will be found on p. 382.

On rare occasions a spot, or spots, may reward the sedulous observer of the Sun.

At 10 p.m. on the 20th the Sun, as it is said, "enters Aries," and this is the supposed time at which Spring commences. He is really at that point in the Constellation Pisces, where the Equator, the Ecliptic, and the Equinoctial Colure intersect. This, too, is the theoretical date of the Equinox; but the nearest approach to the equality of day and night will occur in London on the 19th, when the Sun will be 12 hours above the horizon, and, of course, 12 hours below it. The Zodiacal Light may now be seen in the West after sunset on every clear, moonless evening.

The Moon

Enters her First Quarter at 1h. 7·8m. in the early morning of the 3rd, and is Full at 8h. 33·9m. p.m. on the 9th. She will enter her Last Quarter at 1h. 42·1m. p.m. on the 16th, and be New at 4h. 9·7m. in the afternoon of the 24th. High tides may be looked for on and about the 9th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	6·6	5 0·2 p.m.
6	11·6	9 28·7 ,,
11	16·6	1 18·3 a.m.
16	21·6	5 49·7 ,,
21	26·6	9 55·3 ,,
26	1·8	1 28·9 p.m.
31	6·8	5 26·2 ,,

The Moon will be in conjunction with Saturn at 2 p.m. on the 5th; with Jupiter at 8 p.m. on the 12th; with Mercury at 3 a.m. on the 24th; with Mars at 5 a.m. on the 25th; and with Venus at midnight on the 26th.

Mercury

Is an Evening Star, in the sense of Southing after noon up to the 21st. He attains his greatest elongation East of the Sun (18° 9′) at 11 a.m. on the 5th, and, travelling then pretty rapidly to the Westward, comes into inferior conjunction with the Sun at 3 a.m. on the 22nd. During the first week or ten days in March, Mercury may be caught by the naked eye glittering over the Western point of the horizon just after sunset. His diameter increases from 6·4″ at the beginning of the month to 11·2″ by the 22nd, diminishing to 10·6″ by the 31st.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	23 51·2	0 0·4 N.	1 15·1 p.m.
6	0 10·5	3 21·8 ,,	1 14·7 ,,
11	0 18·3	5 17·1 ,,	1 2·7 ,,
16	0 13·9	5 21·9 ,,	0 38·7 ,,
21	0 0·9	3 43·5 ,,	0 6·2 ,,
26	23 46·6	1 10·9 ,,	11 32·2 a.m.
31	23 37·5	1 11·1 S.	11 3·5 ,,

The whole of the pendulum-like path indi-

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
2	Aldebaran	1	5 47 p.m.	Dark	182	182	6 4 p.m.	Bright	205	210
4	130 Tauri	6	2 30 a.m.	Dark	8	43	‡2 38 a.m.	Bright	351	25
5	f Geminorum	6	12 41 p.m.	Dark	91	131	1 40 „	Bright	248	289
8	18 Leonis	6	4 1 a.m.	Dark	28	67	4 39 „	Bright	297	337
8	45 Leonis	6	6 24 p.m.	Dark	107	68	7 14 p.m.	Bright	222	185
8	ρ Leonis	4	8 50 „	Dark	91	61	9 54 „	Bright	231	211
8	49 Leonis	6	†10 53 „	S.S.W.	339	332				
11	γ^1 Virginis	2½	3 7 a.m.	Bright	126	145	3 40 a.m.	Dark	186	210
11	B.A.C. 4277	6	†4 22 „	N.N.E.	157	186				
14	γ Libræ	4½	3 56 „	Bright	83	82	5 10 „	Dark	241	252
27	μ Ceti	4	6 42 p.m.	Dark	70	108	7 35 p.m.	Bright	320	359
29	71 Tauri	6	†8 38 „	S. by E.	7	47				
29	θ^1 Tauri	4½	9 17 „	Dark	76	117	10 13 „	Bright	295	335
29	θ^2 Tauri	4½	9 26 „	Dark	51	91	10 8 „	Bright	320	0
29	75 Tauri	6	†9 46 „	N. by W.	186	226				
29	B.A.C. 1391	5	10 16 „	Dark	119	159	11 7 „	Bright	251	288
29	85 Tauri	6	†11 12 „	S.	5	42				
30	115 Tauri	6	12 9 „	Dark	137	173	‡12 45 „	Bright	225	258

‡ The stars have set. † Near approaches. A description of the construction and use of this table, with an illustration, will be found on p. 383.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	II	Sh I	5	3	a.m.	13	I	Sh I	2	3	a.m.	21	III	Sh E	12	43	p.m.
2	*II*	*Ec D*	11	16	12 P.M.	13	I	Tr I	2	54	„	22	I	Tr E	1	18	a.m.
3	II	Oc R	3	47	a.m.	13	I	Sh E	4	15	„	22	III	Tr I	1	47	„
4	III	Ec D	1	4	15 „	13	I	Tr E	5	5	„	22	III	Tr E	3	4	„
4	III	Ec R	2	57	29 „	13	I	Ec D	11	25	1 P.M.	22	I	Oc R	10	36	p.m.
4	III	Oc D	5	18	„	14	I	Oc R	2	24	a.m.	26	II	Sh I	2	1	a.m.
4	I	Sh I	5	41	„	14	*III*	*Tr I*	10	21	p.m.	26	II	Tr I	3	18	„
4	*III*	*Oc R*	6	38	„	14	I	Sh E	10	44	„	26	II	Sh E	4	38	„
4	*I*	*Tr I*	6	40	„	14	I	Tr E	11	32	„	26	*II*	*Tr E*	5	47	„
4	*II*	*Tr E*	10	51	p.m.	14	III	Tr E	11	38	„	27	II	Oc R	11	58	p.m.
5	I	Ec D	3	3	27 A.M.	17	II	Ec D	4	26	1 A.M.	28	I	Ec D	3	11	47 A.M.
5	*I*	*Oc R*	6	11	„	18	II	Sh I	11	28	p.m.	28	I	Sh I	12	18	p.m.
5	I	Sh I	12	9	p.m.	19	II	Tr I	1	1	a.m.	28	I	Tr I	12	52	„
6	I	Tr I	1	7	a.m.	19	II	Sh E	2	4	„	29	I	Sh E	2	31	a.m.
6	I	Sh E	2	22	„	19	II	Tr E	3	30	„	29	III	Sh I	2	36	„
6	I	Tr E	3	18	„	20	I	Sh I	3	56	„	29	I	Tr E	3	3	„
6	I	Oc R	12	38	p.m.	20	I	Tr I	4	40	„	29	III	Sh E	4	40	„
10	II	Ec D	1	50	59 A.M.	20	*II*	*Oc R*	9	40	p.m.	29	*III*	*Tr I*	5	9	„
10	*II*	*Oc R*	6	10	„	21	I	Ec D	1	18	22 A.M.	29	I	Ec D	9	40	12 P.M.
11	III	Ec D	5	2	40 „	21	I	Oc R	4	10	„	29	I	Oc R	12	21	„
11	*II*	*Tr I*	10	42	p.m.	21	I	Sh I	10	25	p.m.	30	*I*	*Sh E*	9	0	„
11	II	Sh E	11	31	„	21	III	Sh I	10	38	„	30	I	Tr E	9	29	„
12	II	Tr E	1	12	a.m.	21	I	Tr I	11	7	„						
12	I	Ec D	4	56	43 „	21	I	Sh E	12	37	„						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

Approximate Greenwich Mean Times of the Greatest Eastern Elongations of the Five Inner Satellites of Saturn.

Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.	Day of Month.	Satellite.	H.
2	Enceladus	1·8 a.m.	12	Enceladus	12·8 p.m.	23	Mimas	12·1 p.m.
3	Tethys	4·7 „	14	Dione	10·8 „	24	Rhea	4·5 a.m.
3	Dione	12·1 p.m.	15	Rhea	3·6 a.m.	24	Mimas	10·7 p.m.
4	Enceladus	7·5 „	19	Enceladus	9·2 p.m.	25	Tethys	8·3 „
5	Tethys	2·0 a.m.	20	Tethys	4·4 a.m.	25	Mimas	9·3 „
5	Mimas	3·7 „	22	Tethys	1·7 „	25	Dione	9·6 „
6	Rhea	2·8 „	22	Mimas	2·9 „	26	Mimas	8·0 „
6	Enceladus	4·3 „	23	Mimas	1·5 „	28	Enceladus	2·6 a.m.
6	Tethys	11·3 p.m.	23	Dione	3·8 „	30	Enceladus	8·4 p.m.
8	Tethys	8·7 „	23	Tethys	11·0 p.m.			
8	Enceladus	10·1 „	23	Enceladus	11·9 „			

An illustrated explanation of this table will be found on p. 384.

cated in the above ephemeris lies in a region in Pisces destitute of any conspicuous stars whatever.

Venus

Is an Evening Star throughout the month; but presenting merely a gibbous disc increasing almost imperceptibly from 10·8″ on the 1st to 11·6″ by the 31st, she is comparatively destitute of interest as a telescopic object. Like Mercury, she may be caught glittering over the Western horizon after sunset.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	0 8·0	0 20·2 S.	1 31·9 p.m.
6	0 30·5	2 15·7 N.	1 34·7 „
11	0 53·0	4 50·5 „	1 37·4 „
16	1 15·6	7 22·8 „	1 40·3 „
21	1 38·4	9 50·9 „	1 43·3 „
26	2 1·4	12 13·5 „	1 46·6 „
31	2 24·7	14 28·8 „	1 50·2 „

Hence it will be seen that, starting from a point at no great distance from the (so-called) "First Point of Aries," Venus will traverse the Eastern half of the Constellation Pisces, and terminate her path in Aries.

Mars

Is still invisible.

Jupiter

Viewed in relation to his Southing, is a Morning Star; but he rises soon after 10h. 30m. on the night of the 1st, and at about half-past eight o'clock in the evening of the 31st. He is, however, but indifferently situated for the observer. His equatorial diameter increases from 38·2″ on the 1st to 40·8″ by the last day of the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	14 15·6	12 6·7	3 41·1 a.m.
6	14 14·9	12 2·1	3 20·7 „
11	14 14·0	11 56·1	3 0·1 „
16	14 12·7	11 48·7	2 39·2 „
21	14 11·2	11 40·1	2 18·0 „
26	14 9·4	11 30·2	1 56·6 „
31	14 7·5	11 19·4	1 35·0 „

The short retrograde arc shown above lies a little to the North of the 5—4 magnitude star λ Virginis.

Saturn

Is visible during the whole of the ordinary working hours of the night, but should be looked at soon after dark to be seen to the greatest advantage. His great height above the horizon at this time places him in a peculiarly favourable position for the observer. As we have recently remarked, it will be noted that the South Pole of the planet entirely covers Cassini's division, and is, in fact, practically coincident with the outside edge of ring A. His equatorial diameter decreases insensibly from 17·6″ to 16·8″ between the beginning and the end of the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 8·5	22 26·1	8 31·2 p.m.
6	7 8·0	22 27·5	8 11·1 „
11	7 7·7	22 28·6	7 51·1 „
16	7 7·6	22 29·4	7 31·3 „
21	7 7·6	22 29·8	7 11·7 „
26	7 7·9	22 29·9	6 52·3 „
31	7 8·4	22 29·6	6 33·1 „

This almost imperceptible pendulum-like arc is described a little to the West, and just to the North, of δ Geminorum.

Uranus

Is now visible during the major part of the working night, as he rises between 8 and 9 p.m. at the beginning of March, and between 6 and 7 o'clock in the evening at the end of it. He comes into Opposition to the Sun at Noon on the 31st. Of course, having South declination, the nearer he is to the meridian at the

time of observation the better. His angular diameter is 4″ throughout the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 44·1	3 57·3	2 5·8 a.m.
6	12 43·4	3 53·1	1 45·4 „
11	12 42·7	3 48·6	1 25·0 „
16	12 42·0	3 43·8	1 4·6 „
21	12 41·1	3 37·9	12 44·3 p.m.
26	12 40·3	3 32·9	12 23·8 „
31	12 39·5	3 27·9	12 3·3 „

Whence it will be seen that Uranus describes a short retrograde arc to the South-east of γ Virginis.

Neptune,

To be seen at all, must be looked for the moment it is dusk, as he rises and Souths in bright sunlight. As, however, he does not set until after midnight, we give an ephemeris of him for the first fortnight in March, after which it would be simply a waste of space to continue it.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 33·2	17 26·0	4 56·5 p.m.
6	3 33·5	17 27·4	4 37·1 „
11	3 33·8	17 29·0	4 17·9 „

Hence Neptune is still to be found in that blank region of the sky a little more than 6° to the South and West of the Pleiades.

Shooting Stars

May be looked for between the 1st and the 4th, and again on the 16th.

Greenwich Mean Time of Southing of Eleven of the Principal Fixed Stars on the Night of March 1st, 1887.

Star.	Souths. h. m. s.
α Leporis	6 50 43·69 p.m.
α Orionis	7 11 58·70 „
Sirius	8 2 57·52 „
Castor	8 50 3·32 „
Procyon	8 56 2·06 „
Pollux	9 1 2·16 „
β Cancri	9 32 56·21 „
α Hydræ	10 44 23·57 „
Regulus	11 24 36·05 „
α Ursæ Majoris	12 18 51·42 „
δ Crateris	12 35 44·89 „

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above List for any other night in March, as also that of determining the Local instant of its Transit at any other Station, will be found on p. 384.

PAPIER-MACHE.

THE manufacture of papier-mâché (literally, "chewed paper") forms an important branch of the paper industry. Who does not remember those projectiles of our school days which we called "spit-balls," and which when thrown at a wall or ceiling adhered thereto with tenacity? What was most striking about these balls was their extraordinary hardness after they became thoroughly dry, this being the more marked in proportion as the chewing had been more perfect. It was through observing such hardness that the idea occurred to some one to employ paper pulp in the manufacture of various objects. Yet the substance employed in the industry is not a "mashed" paper in the absolute sense of the word, but is a paper converted into a soft cardboard by mechanical processes. In the manufacture of papier-mâché, the raw material used is a bluish-grey, unsized, strong, fine-grained paper. The sheets may be compared (whiteness, which is of no account, being excepted) to Annonay lithographic paper. Cotton forms the basis of it. These sheets are pasted together by means of a layer of dextrine or starch, applied with a steel spatula. When the desired thickness has been obtained, the mass is put into a hydraulic press that operates in a highly heated drying room. Under the immense pressure of this apparatus there forms a solid block, which is as hard as boxwood or ebony, and which is perfectly plane or has the form of the mould in which the raw material, so ductile when moist and so hard when dry, was compressed. It can be moulded into any shape whatever, that of table legs, chair arms, rose-work, mouldings, &c. This sort of wood, without pores, sap, fibres, and knots, is capable of being worked with the saw, the gouge, the rasp, and the lathe. It can be polished, if need be, although this operation is reserved for the thick black varnish that is applied to it in several coats, with an intervening stay of a night in a very hot air-heated drying room. When it comes from the latter the varnish is very hard, and is free from blisters and cracks. It is possible that many of the objects that are offered to us as being finished with Japan or Chinese lacquer are merely impregnated and covered with a mixture of gum copal, bitumen, tar, resin, and other hydrocarbons impregnated with lampblack and colour in certain proportions. The baking is the important point. When this operation has been too greatly prolonged, the varnish scales off and cracks; and when it has not been carried to a sufficient extent, the surface remains sticky. It is not necessary, then, to exceed a certain temperature, always higher than 100°. This moulded and pressed paper can be easily turned in the lathe, and made into light indestructible balls and beads, or be fashioned into inkstands, caskets, and cylinders. It is from this substance that are manufactured all those bracelets of large black beads studded with imitation diamonds, all those necklaces, pins, clasps, and trinkets of all sorts that are taken for jet or some precious wood. Again those handsome bracelets composed of semi-lucid and opaline globules that seemed to have been cut out of a stone formed of concentric layers, like certain precious stones, are merely of papier-mâché, cemented with white varnish and coated with the same. So, too, those beautiful nacreous, painted, and gilded trays, round tables, and caskets that are known as Japanese work are merely papier-mâché. The Japanese know but one kind of gilding, while we have two—the dead and the brilliant. We have, likewise, a liquid nacre taken from the scales of the aiblette (bleak) that well imitates the white currant and certain transparent berries. The nacre is solidly inlaid by means of the hydraulic press, and finally the surface is finished with pumice-stone in order to make it perfectly even, and covered with a colourless varnish of the first quality.—*Bull. des Fabricants de Papier.*

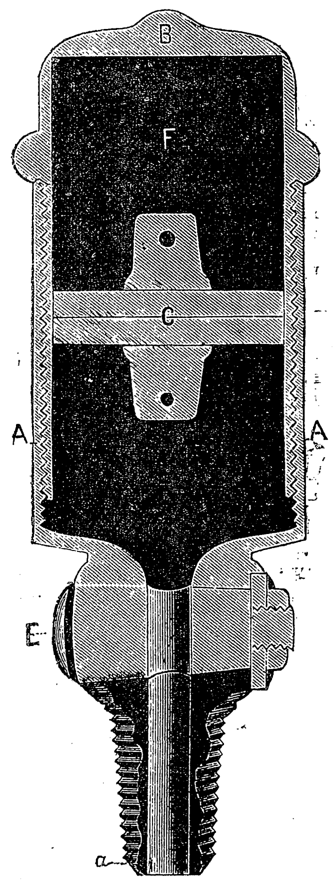
THE POTATO AT REST.

WE are so accustomed, at this season, to think of the potato as an inert object when at rest, that we are apt to overlook the fact that the rest is only partial, whilst underneath that impassive and immobile looking skin a good deal of work is going on—at least, whenever the temperature is above freezing. Some knowledge of the nature of that work is desirable for us as practical men, because upon the way in which it is done depends, in great measure, our success in storing potatoes for consumption, and the vigour and health of our crops for the future. Much of the complaint made of late as to the degeneracy of the potato, and as to its inferior quality as compared with past times, is probably due to the way in which these changes are effected. These again are dependent upon the way in which the plant was able to do its work in the preceding summer. This brings us to the questions whether the newer varieties are as well adapted to our climate as the older ones, and whether the exhibition table has not something to answer for by fostering good looks at the expense of constitution; at any rate, these matters are worth consideration. If an ordinary grower of, or dealer in, potatoes were told that the tubers he rightly sets such store by breathe as human beings do, he would probably think that some facetious hoax was being played upon him. The fact, however, remains that, although they have no lungs, potatoes, in the ground or out of the ground, breathe. We do not mean to say that they palpitate, draw long breaths, or heave deep sighs, but they breathe nevertheless. They inhale and exhale through their skin gases of various kinds, just as every one knows that under certain conditions they exhale moisture or "sweat." The conversion of the sugary juice called glucose, derived from the foliage, into the solid starch stored up in the tuber, is associated with the emission of gases, while the reconversion of that starch into soluble sugar requisite for the maintenance and nourishing of the tissues of the tuber, and for the shoots when growth commences, is also attended by an emission of carbonic acid gas and watery vapour, this latter process being more or less analogous to that which constitutes the respiration of animals; and thus it is that potatoes breathe. Starch grains are practically insoluble, and are too large to be conveyed in their solid form from the leaves in which they are formed to the tubers in which they are to be stored up; hence the necessity for their conversion into glucose, or some analogous liquid matter by means of which the transit may be made, and from which the solid starch may be again deposited as occasion may require; so that potato tubers, whether still in the ground, or removed and placed on the exhibition-table, or in the cellar, are, in a certain way, breathing.

The chemical changes we have alluded to go on probably through the agency of some ferment in the detached tuber in the same manner, but to a less extent, than when it is still attached to the plant. A kilogramme (2lb. 2oz.) of potatoes when the temperature was 20° C. (68° F.) gave off in August 6·5 milligrammes of carbonic acid per hour, and in January and February, at the same temperature, 10 and 11 milligrammes per hour. When exposed, however, to the freezing point in the laboratory, whether in August or in the winter months, the proportion of carbon dioxide, *alias* carbonic acid gas, was reduced to about two milligrammes per hour. As the temperature rises, more and more sugary juice is found in the tubers, less and less starch. A time comes when the sugar is no longer used up in the course of the respiratory process, and no longer converted into starch. An excess of sugary juice then occurs, which flows to the eyes or buds, and the period of comparative rest is at an end. The practical inference is that which careful practitioners have long arrived at from experience—viz., to store the potatoes in a uniform low temperature, in a dry condition, and in the dark, so as not to excite those chemical and physical changes associated with growth, and consequent upon the conversion of starch into sugar. Mr. H. Müller, who has investigated these matters, has extended his researches to the buds of trees, in which exactly the same phenomena take place as in the tubers of the potato. When the flow of sugary juice from the leaf ceases at the end of autumn, and is deposited in the form of starch in the buds, bark, and young wood of the tree, growth ceases. In the spring a little of the sugary juice left over in the bark flows towards the buds, which forthwith begin to swell and lengthen into shoots.—*Gardeners' Chronicle.*

COMPRESSED-AIR GREASE CUP.

THE great merits of the grease cup shown in the accompanying sectional view are its simplicity of construction and its automatic and



continuous feed. It is designed for the manipulation of grease or "dope," a composition which, for some purposes, is superior to oils. The cup feeds the grease continuously till emptied, and requires no attention whatever beyond the mere filling from time to time. The cup A A is provided with a regulating valve, E, above the outlet orifice *a*. B is a hollow cap, provided with an air-tight piston, C, with hydraulic packing. The operation is as follows: The cap being removed, the piston is drawn in to supply air to the air chamber F. The packing of the piston and the inside of the cap are

slightly greased, to reduce the friction to a minimum. The piston is then replaced in the mouth of the cap, when the cup is filled completely with grease. The cap is then screwed down the entire length of the threads. As the piston C, located within the cap, is forced inward, it is evident that a quantity of air will be confined and compressed in its rear, in the chamber F. It will be seen, therefore, that upon the opening of the regulating valve E sufficiently to permit the proper amount of grease to escape, the compressed air in the rear of the piston is allowed to expand, exerting a constant and even pressure upon the grease to force it from the cup, this action being automatic. As the attendant has absolute control of the outflow of the contents, by means of the valve, the economy and convenience of the cup are assured. This cup, according to its size, will manipulate its contents in from six days to two months. No matter in what position the cup may be placed, the grease is always forced to the bearing, making it most valuable for loose pulleys. Any further information may be obtained Mr. John C. Grout, 17 Newberry and McMillan Building, Detroit, Mich., who is the sole manufacturer of these cups.—*Scientific American.*

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday evening, the 16th inst., at the Institution of Civil Engineers, 25, Great George-street; Mr. W. Ellis, F.R.A.S., President, in the chair. Mr. E. T. Edwards, Mr. D. Fitzgerald, C.E., Mr. T. B. Groves, F.C.S., and Mr. W. W. Midgley were elected fellows of the Society.

The adjourned discussion on the Hon. R. Abercromby's paper on "The Identity of Cloud Forms all over the World, and on the General Principles by which their Indications must be Read," was resumed, and the following papers were read:—(1) "Remarks Concerning the Nomenclature of Clouds for Ordinary Use," by Prof. H. H. Hildebrandsson, Hon.Mem.R.Met.Soc. (2) "Suggestions for an International Nomenclature of Clouds," by the Hon. R. Abercromby, F.R.Met.Soc. Both Prof. Hildebrandsson and Mr. Abercromby have paid great attention to the question of the forms of clouds, and having recently conferred together, they have agreed to recommend for international use the following ten principal varieties—viz., High-level Clouds: Cirrus, Cirro-stratus, Cirro-cumulus; Middle-level: Strato-cirrus, Cumulo-cirrus; and Low-level: Cumulus, Stratus, Strato-cumulus, Nimbus, Cumulo-nimbus. (3) "The Influence of Weather on the Proportion of Carbonic Acid in the Air of Plains and Mountains," by Dr. W. Marcet, F.R.S., and M. A. Landriset. The authors give an account of some experiments which they have made in the proportion of carbonic acid in the air at Geneva and on the summit of the Dole, the highest point of the Jura chain, the difference in altitude being 4,193ft. The results of these experiments show (1) that in fine, clear weather on a mountain chain of moderate Alpine altitude and in the adjoining valley or plain the atmosphere holds the same mean proportion of carbonic acid at both places; and (2) that when the summit of a mountain chain is in a fog, a circumstance which frequently happens in an Alpine district, the air in the fog contains a smaller proportion of carbonic acid than it would hold in fine, clear weather.

The Secretary, Dr. Tripe, read a letter received from Sir F. Abel, Organising Secretary to the proposed Imperial Institute, inviting the Society to draw the attention of the Fellows to the undertaking, with the view of their contributing towards it.

The President stated that copies of the letter and of the accompanying paper, explanatory of the scheme, would be forwarded to each Fellow.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE usual monthly meeting was held on Monday, 14th February. The chair was occupied by Mr. W. D. H. Deane, M.A. Seventeen members were elected, and 23 candidates proposed, and His Imperial Majesty the Emperor of Brazil was elected an Associate of the Society.

The Secretary said he had an important matter to put before the meeting. The Pernambuco branch had now become so extended as almost to form a society in itself. At present, owing to the uncertainty and delay of postal communication, it was quite possible for a candidate not to receive official notice of his election until nearly five months from the date of his nomination, and, of course, the difficulty was felt in other ways. Under these circumstances they had asked for the power of electing their own members and a president and local executive, so that they might be enabled to hold meetings and pass such by-laws as might be found necessary for their welfare. It was understood that all decisions were to be subject to the confirmation of the home council. Strictly speaking, this was a matter which rested with the council only; but, though they were not unwilling to grant the concession, the question was of so much importance that they preferred its being discussed at a general meeting.

The President, in a letter, had expressed his pleasure at finding that the South American members deemed themselves strong enough to form a local branch. Although perhaps some might say that such a course was inexpedient, yet, for his part, it seemed that as the objects they had in view were the growth of their science, nothing could be more in keeping with the Society's aim than the formation of local and quasi-independent branches. Whilst preserving its attachment to the old society, the new branch would itself be a centre from which in due course other branches might be put forth in South America. The constitution of such a branch as was contemplated would need care, and should be so formed as to consolidate their relations, and, at the same time, to leave perfect freedom to each other. He, Mr. Espin, would suggest that the head of the new branch be not called "President"—because the head of a society like the L. A. S. is, *ipso facto*, president of all its branches—but *vice* president, and, as such, being head of the especial branch, and at the same time having an office in the home society next to the president himself.

Mr. James Gill was strongly in favour of granting home-rule to all the branches. Without some form of local government it would be impossible for distant members to hold meetings, and so to encourage each other in a study of the science. As long as their regulations were subject to the control of the home council he did not see that there could be any objection.

Mr. C. A. Defieux said the isolated position of the South American members gave them every claim to their sympathy. He thought it might well be left to the discretion of the members what title they gave their officers, since it would only have a local significance, and would not affect their status in the home society.

Mr. J. L. Coxon asked whether the course that had been proposed would affect the amount of their subscriptions, as he understood that this was already too small to cover the expenditure.

Mr. Davies replied that the difference would, if anything, be in their favour. Foreign correspondence was rather a costly luxury, and there would also be some saving in the carriage of parcels. The local expenses would of course be borne by the members themselves, but it was only fair that each branch should be supplied with stationery, and other necessary items. It was not, however, entirely a question of economy. The Society had now become so widespread that some such division was absolutely necessary if the work was to be carried on. He did not think the responsibility of the Society ended with supplying publications, which, however valuable they might be in other respects, were not always suited to the requirements of beginners. Astronomy appeared to be rather backward in South America, and there was, besides, a scarcity of astronomical works. To make up for this there was plenty of enthusiasm, and monthly circulars were issued by the more advanced members, containing a glossary of astronomical terms, and such other information as they thought might be useful. A taste for their science had evidently been awakened, and it lay with the members of the home society to say whether it should be encouraged.

The Chairman said if there were no other remarks he would put it to the meeting in the form of a resolution, which, being done, was unanimously adopted.

Mr. W. H. St. Q. Gage submitted a list of coloured stars which he had observed during his late residence in India. The observations had been made with a $4\frac{1}{4}$ refractor at an altitude of 6,000ft.

A paper was read on the proper motion of 40 (o^2) Eridani, by Mr. J. E. Gore. In addition to the binary companion to this interesting ternary system, two other faint *comites* had been measured, and from these measures he had computed the proper motion of the principal star. This afforded a mean result of 4·07″ annually in the direction of position angle 212·4°.

Miss E. Brown called attention to a possible transit of Vulcan across the semi-disc during its approaching node, which, according to Oppolzer, was due on the 18th March.

Papers were also read on the variability of LL. 14551 (U Puppis), by Mr. Herbert Sadler; on the Merope nebula, by Mr. W. H. Wesley; on the lunar formation Straight Wall, or "Railroad," by Mr. T. G. Elger; on some typical sunspots, by Major E. E. Markwick; on a suspected variable in Ursa Major, by Mr. S. M. Baird Gemmill; on secular change of climate, by Mr. M. Fergus, and Mr. W. F. Denning continued his series of papers on telescopes and telescopic work.

SCIENTIFIC NEWS.

ANOTHER faint comet has been discovered by Mr. E. E. Barnard, of Nashville, Tennessee. On Feb. 15, at midnight, local time, its position was R.A. 8h. 4m. 8s., S. Dec. 16° 10′; moving rapidly north-west. It will be comet D 1887. Nashville is in lat. 36° 8′ 58·2″ N.; long. 5h. 47m. 12·77s. W.

From Dun Echt Circular No. 136 we learn that Dr. H. Oppenheim, of Berlin, has calculated elements and ephemeris of Barnard's comet (C 1887) from observations made at Cambridge, Mass., Paris, Vienna, Padua, and Scarborough: T = 1886 Nov. 26·46785, Berlin M.T.; $\pi - ☊$ 30° 1′ 49·2″; ☊ 257° 48′ 17·4″; i 85° 30′ 25·2″; log. q 0·16398. The position at Berlin midnight is given as—

	R.A.	N. Dec.
Feb. 26	20h. 51m. 20s.	45° 44·1′
28	20 58 34	46 50·6

Prof. Jules Béclard, the well-known Dean of the Faculty of Medicine, and perpetual secretary of the Paris Academy of Medicine, died rather suddenly recently of pneumonia, at the age of 69 years. His principal work is the "Traité de Physiologie Humaine," which is in its seventh edition, and is the standard textbook for French students.

Dr. Pebal, Professor of Chemistry at the University of Graz, was assassinated last week by a discharged servant, who afterwards committed suicide.

At a recent meeting of the Linnean Society Brigade-Surgeon J. E. T. Aitchison read a paper on the "Fauna and Flora of the Afghan Boundary," the zoological specimens obtained comprising about 20 species of mammals, 130 species of birds, 35 species of reptiles, 7 species of fish, and over 100 species of insects—many new to science. The botanical specimens amount to 800 species, over 100 being new to science.

The Statistical Society has received a royal charter, dated January 31, by which it is incorporated under the style of "The Royal Statistical Society."

The Society of Science Bronze Medal for Inventions has been awarded to Mr. E. R. Dale, of Christchurch.

At the Royal Institution on Saturday (to-morrow), Lord Rayleigh commences a course of six lectures on "Sound."

Mr. H. C. Russell, Government astronomer, New South Wales, will represent that colony at the Conference of Astronomers to be held in Paris next April.

The Cunard liner *Etruria* has eclipsed her own best performance, for leaving the bar of the Mersey on Saturday, Feb. 12, at 4 p.m., she arrived at New York bar at 6 a.m. on the following Saturday—a passage of 6 days 19 hours. The route taken was, as usual with the Cunarders, the most southerly and longest, to avoid icebergs, and the performance must represent a mean speed of 19 miles an hour. Some of the vessels of the Cunard line are being fitted with gun platforms on the turtle decks, fore and aft, so that they can be at once converted into armed cruisers should an emergency arise.

The official trials of some torpedo-boats built for the Turkish Government by Mr. de Vignes and Messrs. Maudslay, were made recently in Long Reach, when mean speeds of 21·7 knots were obtained, the highest speed being 23·4 knots, or nearly 27 miles an hour. The vessels are 126ft. long, with 15ft. beam, and have three cylinder compound engines.

According to an American paper, the revolution impending in the construction of locomotives—the use of four cylinders instead of two, one pair for each driving-wheel axle—is due to the success of the triple expansion engines on ocean steamers. Not that compound engines are to be used for locomotives; but because a number of cylinders aggregating the same power will save coal. The fact that the present system is not the best has been well known for a long time. The transmission of power through the connecting-rods to the two drivers is an uneconomical way at best. We presume the "revolution" refers to American practice.

The Bill empowering the North Metropolitan Tramway Company to employ electricity on

their lines has passed the House of Lords, and it is expected that in a short time Mr. Elieson's electric locomotives will be in regular work on the Romford-road between Stratford and Manor Park.

The Sprague Electric Railway and Motor Company are running thirteen elevators in Boston, Mass., both freight and passenger. One of the freight elevators is the largest in the city. They also have fifty other motors in operation.

In making comparisons between gas and the electric light in New York it is not unusual to refer to the high price of gas in that city. It should be remembered that the illuminating power is rarely less than 20 candles, while about half the companies supply gas of 25 to 30 candle-power.

The Gasmotoren Fabrik, of Deutz, near Cologne, have recently constructed a two-cylinder Otto engine which gave about 60 horse-power on the brake when driven by Dowson fuel or water-gas. They have in course of construction a four-cylinder Otto engine, which is to develop over 100 horse-power and have an impulse at every stroke.

A correspondent of one of the daily papers has been making a comparison of the sunshine records as taken at Kew and St. Leonard's, and gives his results for the present month. For the week ending 2nd February—Kew, 7 hours; St. Leonards, 21·2 hours; 9th February—Kew, 12 hours; St. Leonards, 25·6 hours; 16th February—Kew, 13·5 hours; St. Leonards, 30·2 hours. Total—Kew, 32·5 hours, against 77·0 hours at St. Leonards, or in proportion of 5 to 12.

From observations made by Herr Schiller, a German architect, it appears that the radius of the circle protected by a lightning-rod is not more than twice the height of the rod.

The German Chamber of Commerce having been asked recently by the German Fishery Association to assist in the destruction of seals by putting a premium on them, has refused. The seals consume enormous numbers of herrings; but we suspect that they are more valuable than the fish they eat.

The international jury appointed by the King of the Belgians to award his prize of 25,000f. (£1,000) for the best work on the means of popularising the study and developing the teaching of geography, has awarded it to Mémoire No. 7, by Prof. Anton Staubers, of the Royal Gymnasium, Augsburg. The president of the international jury was Lieut.-Gen. Liagre, formerly Belgian Minister of War, the Secretary of the Royal Belgian Academy of Sciences, the other members of the jury being Commandant le Bon, of the French Legation, Colonel de Tchitchagow, of the Russian Legation, Sir Travers Twiss, Q.C., member of the Royal Society of Geography of England; His Excellency Valera, Minister of Spain at Brussels; Prof. Van Beneden, of Louvain; and Major-Gen. Wouvermans, President of the Royal Society of Geography of Antwerp. It is to be hoped that this essay will be translated and published in a variety of languages.

The permission to grow tobacco for experimental purposes, under the usual regulations and guarantee to the Inland Revenue Department, has been extended to the present year.

At a recent meeting of the Berlin Geographical Society Herr Standinger, a member of the last Flegel expedition, gave an account of the journey from Benue to Kano, Sokoto, and Gandu. While waiting at Saria, an expedition was made to Kano—a six days' journey. Many villages lay on the road, which was so frequented that women found their living on it by offering food to sell. Shells are used as money. Kano is a well-fortified place, of imposing appearance. The king, who received the expedition with hospitality, is considered a mighty prince. His palace is a high dome-shaped edifice, the walls of which are decorated with brass basins. It is wonderfully built of mere clay; bricks are unknown. There is a flourishing trade with the North, carried on by means of dromedaries. On returning to Saria the expedition were much incommoded by curious visitors and sick people wanting medicine. There is a well-developed industry in leather and braided goods, the dyeing of which is a secret.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of he* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

JUPITER'S SATELLITES—SOME VERY UN-"NATURAL PHILOSOPHY"—THE AGE OF THE EARTH—WHAT CAUSES DAY AND NIGHT?—A PLUMB-LINE TRANSIT INSTRUMENT—THE IMPERIAL INSTITUTE—THE "JOURNAL" OF THE ROYAL MICROSCOPICAL SOCIETY—THE LIVERPOOL ASTRONOMICAL SOCIETY—REPORT OF THE HARVARD COLLEGE OBSERVATORY: AND OF THE "WARNER" ONE AT ROCHESTER, N.Y.—THE STELLAR WORK OF MR. EDWIN F. SAWYER—THE PRESIDENT'S ADDRESS AT THE ANNUAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY—PHOTOGRAPHS OF STARS AND ANONYMOUS WRITERS—THE ACHROMATISM OF LENSES—GREGORIAN TELESCOPE.

[26868.]—FELLOWS of the Royal Astronomical Society will doubtless recollect a valuable paper which appeared in Vol. XLV. of our *Memoirs* by Professor Souillart, of Lille, on the "Théorie Analytique des Mouvements des Satellites de Jupiter." In the year (1879) when this appeared the French Academy increased the value of the Damoiseau Prize to 10,000 francs, to be awarded for the best solution of the problem of the theory of the movement of the satellites in a more general and complete form, making it include the construction of fresh tables for each satellite. Pursuing his research, M. Souillart has arrived at results of a nature such that (albeit the numerical calculations are not quite complete) the committee regard his theoretical conclusions as of sufficient importance to entitle him to the prize; which they have, consequently, awarded to him. I shall look forward anxiously and curiously to the completion of the merely numerical work, inasmuch as, this once finished, we may reasonably hope that the director of our own *Nautical Almanac* will lose no time in availing himself of the results of this gifted and indefatigable Belgian savant.

As "Blair's Grammar of Natural and Experimental Philosophy" is a work with which I am unfamiliar, I cannot, of course, judge whether the whole of its statements are as trustworthy as that quoted by "T. C. H." in letter 26812 on p. 520. If so, though, he might spare his copy to his housemaid for the purpose of lighting the fire, without any appreciable loss whatever. The earth was in perihelion this year on January 2nd at 8 p.m., at which date (and for some days before and after it) the apparent diameter of the sun was 32′ 36·4″. At 9 a.m. on July 2nd the earth will be in aphelion, and for some days about that time his diameter will subtend an angle of 31′ 32·0″. So much for Mr. Blair's stuff about the sun's diameter. As to his extract from Sir Wm. Herschel, what that great observer really did see was, in all probability, two or three craters of sufficiently reflective power (like, for example, Aristarchus) illuminated by earth-shine on the moon's dark limb. Selenographers do *not* observe burning volcanoes on our satellite nowadays.

Would it be asking "E. L. G." (letter 26832, p. 524) too much if I were to beg him to favour us with some evidence that "this earth was ages older than the sun," and "that there are many worlds having time marked by days, evenings, and mornings, though without a sun as yet"? I only crave a little information on these two points to begin with. As for the fresh sea that fell from the sky 50 centuries ago! your able, if slightly eccentric, contributor has gone on repeating this until I am convinced he really believes it himself.

With reference to the query with which Mr. West concludes reply 61307 (p. 525), the smaller the hole and the farther the plumb-line is from it, the more likely he will be to attain accurate results. Were the wire only 4ft. from the eye-hole, a very small lateral movement of the eye would cause a sensible parallactic displacement of it.

I have received, in an official capacity, a circular from Sir F. Abel (couched in terms which may be summarised in "Your money or your reputation for loyalty"), requesting me to head a movement in my own neighbourhood for raising funds for the Imperial Institute, which is, I gather, to be erected at South Kensington. What this means it is needless to insist on here; but I should like to ask if my correspondent is the same Sir F. Abel who was so active with a Sir Somebody Bramwell in planting the central building of the City and Guilds of London Institute in the midst of the Brompton Ring—and if so, what are the chances of the innumerable berths in connection with the "Exhibitions" and "Technical Education" (which form part of the scheme of the Imperial Institute) falling into the hands of the members of that Ring? No information on this point is vouchsafed from Sir F. Abel's office; so I put the question here in the hope that some brother reader may be sufficiently behind the scenes to enlighten me. I certainly shall decline to part with my own money, or to appeal to anyone else for his, without some very specific assurance on this point.

I complained last year (letter 25273, Vol. XLII. p. 446) of the delay in the issue of the Title-page and Index of the Volume of the *Journal* of the Royal Microscopical Society for 1885. Such delay, I am sorry to say, seems apparently becoming chronic, as here we are getting towards the latter end of February, and the index for the volume for 1886 has never made its appearance. On the cover of Part I. (for February) for the current year there appears this notice: "The Index Number is delayed from exceptional and unavoidable causes; but will be issued shortly." Now, my modest protest in January twelvemonth elicited a letter (25329, Vol. XLII. p. 474) from "One Who Knows," who fell foul of me for omitting to inquire before I penned my remonstrance; so I thought that this year I would follow his advice, and *did* inquire accordingly: with the result that I was informed by the attendant that "he didn't know, but perhaps Mr. Crisp had been too busy to attend to it"! With the utmost deference to "One Who Knows," I can hardly regard the result of listening to his counsel as absolutely satisfactory.

I notice with sincere satisfaction in your "Scientific News" on page 540, that the Emperor of Brazil has been enrolled in the ranks of the Liverpool Astronomical Society. Nothing can possibly be more gratifying to all interested in the diffusion of sound knowledge of the chief of all the sciences than to note the rapid progress and brilliant success of this admirable association of amateur astronomers since its management has been taken from the hands of persons who were rapidly bringing it into a moribund condition, and reverted to those of its zealous, able, and indefatigable originators.

Some of my American friends have kindly forwarded me Reports of Observatories, &c., for 1886, which contain a great deal that is interesting to the astronomer, both amateur and professional. Among them the place of honour must be given to Professor Pickering's account of the work done at Harvard College Observatory during the year which has just closed. The photometric observations of the Eclipses of Jupiter's satellites have been continued, the total number of eclipses thus observed being now 358. It is quite needless to insist upon the very great value of these observations to the investigator of the Jovian system. Comparison stars for variables and the Novæ in Orion and Andromeda have been observed, star spectra photographed, places of comets obtained, and no less than 59,800 separate photometric comparisons made with the meridian photometer. In connection with this last branch of research, it may be interesting to note that a comparison of the 700 stars common to the observations of Wolff, Pritchard, and the Harvard Photometry showed an average difference between Harvard and Wolff (after allowing for systematic differences) of ·140 of a magnitude; and between Harvard and Pitchard, of ·145 of a magnitude, Wolff and Pritchard differing ·192 *inter se.* In the case of 55 stars, proposed by Professor Pritchard as standards, the average deviation from the Harvard Photometry was only ·104 of a magnitude. Comparisons have also been instituted between star magnitudes observed at Harvard with the meridian photometer, and at Pulkowa with a Zöllner's photometer, with the result that the average difference in brightness between stars observed at both places did not exceed ·1 of a magnitude. It is worth while to remark that Professor Pickering begins his report with a reference to a sum of 164,198dol., which has accrued to the Observatory under the will of Mr. R. T. Paine, raising the funds available for the support of work at the observatory to 398,046dol. A further fund of 13,380dol. has

also become available. Now, when one reads of so worthy an exercise of private munificence as all this indicates, one is tempted to ask why are such endowments for astronomical research so scanty in England? I do not think the answer is far to seek. In leaving money to Harvard College Mr. Paine and those like him know that they are providing means for legitimate work of genuine scientific interest, to be carried out by noble and absolutely disinterested workers toiling for the sake of knowledge, like Pickering and his compeers; whereas every scientific man in this country knows full well that the Ring who are clamorous for "the endowment of *their* scientific research" are simply endeavouring to secure a genteel form of permanent out-door relief from the Consolidated Fund. What private donor, with the slightest knowledge of science, would contribute one farthing to the support of such an organisation as the Solar Physics Committee for example?

The next report before me is from the Warner Observatory, in which Mr. Lewis Swift gives an account of the nebulæ discovered there between the years 1883 and 1886, amounting to no less than 540. Shorter accounts of miscellaneous observations also appear, and there are plates and descriptions of the observatory itself, and of the 16in. Alvan Clark equatoreal, which is its chief instrument. Appended to the volume are reprints of the "Warner Prize Essays." The first, on "Comets," by Prof. Lewis Boss, which, as a précis of our existing knowledge of these errant bodies, is excellent, may be held to have legitimately earned the premium conferred upom it. Mr. Boss's essay is succeeded by four on the "After- (and fore-) glows," which created so much discussion in 1883 to 1886. The initial one, by Prof. Kiessling, of Hamburg, contains a quantity of interesting information as to the distribution of colours at sunset and sunrise; the second, by Mr. J. E. Clark, of York, in this country, largely follows Prof. Kiessling; while with the fourth, by the Rev. Sereno Bishop, I have already dealt in these columns. These three essayists seem to have got all their facts and arguments (?) from *Nature;* and write as though the origin of the remarkable atmospheric phenomena they discuss must of necessity have been in the Krakatoa eruption. How people may blunder from confining their references to articles written in one single journal to support a foregone conclusion is evidenced by the fact that every one of these gentry is apparently in hopeless ignorance that Mr. Neison, the Government Astronomer in Natal, was drawing these astonishing after-glows in February, 1883, while the Krakatoa eruption did not happen until the subsequent August. By far the most sensible and scientific of the four essays which secured prizes is that by Mr. H. C. Maine, of Rochester, N.Y., albeit he places more confidence in Prof. Balfour Stewart than he would find any independent English man of science able or willing to do.

Before dismissing American astronomy I may just refer to the excellent work done by Mr. Edwin F. Sawyer, of Cambridge, Mass., in the observation of variable stars; and in the determination of the relative magnitude of the stars between the Equator and 30° S.D. not fainter than the 7th mag., the latter being a revision of so much of Dr. Gould's "Uranometria Argentina" as is included in those limits. Here is another illustration of the perennial value to science of the labours of those who undertake investigations for the sheer love of truth, and who do not approach the eye-end of a telescope making a mental calculation of how much they shall get by it!

I am sorry that your report (on pp. 538 and 539) of the discussion at the Annual Meeting of the Royal Astronomical Society, on the policy of medal-giving, extends to such a length as apparently to have excluded anything but so short a *précis* of the President's address; because I regard that address as a really admirable example of the manner in which a brilliant mathematician can, on occasion, render the most abstruse and technical results intelligible to numbers to whom they would otherwise be an absolutely sealed book. Far be it from me to institute invidious comparisons; but I cannot but feel that it is some time since the dignity and reputation of the Society have been more worthily sustained than they are by the present occupant of the presidential chair.

As one of the "anonymous writers" presumably referred to by Mr. Watson in the concluding sentence of letter 26834 (p. 541), I should really like very humbly to inquire who Mr. Roberts is, that, when he makes a preposterous statement before a large public audience, the utter folly of such statement should be exempt from criticism? I have not the pleasure of Mr. Roberts's personal acquaintance; but had I known him ever so well, I should not have felt that my friendship imposed any obligation on me merely to say smooth things; nor, whatever Mr. Watson may think, should I have altered my language one iota, had I signed my comments *proprio nomine*. A great deal of nonsense has been talked about Mr. Roberts's photographs. They are simply the result of very protracted exposure. If Mr. Common or the MM. Henry choose to expose their plates as long as Mr. Roberts did, unquestionably their results will be equal or superior to his. And I am thoroughly certain that neither of these gentlemen will take pictures of 20 planetoids at a time, 30° from the Ecliptic!

I must ask "Orderic Vital" (letter 26863, p. 546) to wait until I go to London, or otherwise obtain a sight of Professor Harkness's work; which, I regret to say, is not on my own library shelves.

In reply to the latter half of query 61711 (p. 552), any telescope which gave an image of the moon of 20 times the diameter of our satellite as seen with the naked eye, would be said to magnify 20 times. A power of 100 would show Saturn's ring and the snow-cap on Mars (when he is in opposition). An 18in. Gregorian would scarcely bear a higher one. It ought to cost about 15 shillings.

A Fellow of the Royal Astronomical Society.

NOTES ON NEBULÆ.

[26869.]—IN my last "Notes on Nebulæ" (p. 533) may I be allowed to point out a few mistakes which have occurred in the printing?

No. G.C. 880, for "700 than 100," read 200 than 100; also, in footnote to 2851 G.C., for "Duner," read D'Arrest. **Herbert Ingall.**

PHOTOGRAPHS OF STARS—η CASSIOPEIÆ—ALPHA FORNACIS.

[26870.]—IN my reply on p. 198 I did not allude to the engravings in the pages of *Knowledge*, to which Mr. Watson refers in letter 26834, p. 541, as these cannot be considered to be actual photographs. If Mr. Watson will take the trouble to compare, for instance, the copy of the part of Cygnus which appears in *Knowledge* for May, 1886, with the actual photograph of the same portion of the sky obtained by MM. Henry, he will find many minor points of difference between the two.

I am much obliged to Mr. Tarrant (letter 26838, page 541) for his measures of η Cassiopeiæ, though I am somewhat puzzled at his arithmetic, which hardly seems "according to Cocker." The measures of η Cassiopeiæ in the Star Guide are given for January, 1886 (cf. p. ix. of the Introduction), and as η Cassiopeiæ is a binary, it must necessarily happen that my data will be discordant with the later measures. When due allowance is made for this, they accord very satisfactorily with Mr. Tarrant's results.

The following determinations of the magnitude of the suspected variable α Fornacis may be of interest to Mr. Stanley Williams (letter 26839, page 542). Piazzi, $3\frac{1}{2}$ (both catalogues); Johnson (at St. Helena), $3\frac{1}{2}$; Armagh I. (1830-35), $3\frac{1}{2}$; Cape Cat., 1840, $3\frac{1}{2}$; Cape Cat., 1850, $3\frac{2}{3}$; Jacob$_2$ (1852), 5·3; B.B. vi. (1864, 3·0; Cape Cat., 1880 (1878), $3\frac{2}{3}$. These are all meridian observations. The following are determinations made during micrometrical observations:—H_2, 1835, 1836, $3\frac{1}{2}$; Jacob, 1847, 1852, 4; 1851, $4\frac{1}{2}$; O. Stone, 1877, $3\frac{1}{2}$; Howe, 1877, 4; Hall, 1879, 4; Burnham, 1879, 4. It is $3\frac{1}{3}$ in Behrmann's, and $3\frac{1}{2}$ in Houzeau's Uranometria. Mr. Williams's comparison stars seem rather distant, and he does not say whether he applied any correction for atmospheric absorption of light or not. Sir W. Herschel, of course, did not.

Feb. 19. **H. Sadler.**

GC. 2091 — STELLAR PHOTOGRAPHY.

[26871.]—AS I see with great pleasure that Mr. H. Ingall is continuing his most valuable series of papers on Nebulæ, I trust he will allow me to call his attention to the little nebula GC. 2091, in order that he may include it in his working list, as it is now becoming favourably placed for observation. As pointed out in my note on the nebula of 29th May, 1885 (letter 24271, p. 276), there seems a great probability of the little star at $235° \pm 9'' \pm$ being variable, and also a *possibility* of proper motion on the part of the nebula itself from the data furnished by Mr. Sadler in his note on the same subject. It is a very faint object even with the full aperture of my telescope, and I tried vainly during the last season to obtain a satisfactory view of it; but the air was never sufficiently transparent.

Having carefully examined the photograph of 42 M Orionis, by Mr. Roberts, which has caused so much controversy, and being acquainted with the circumstances under which it was sent to the R.A.S., I can most fully indorse the concluding portion of Mr. Sadler's letter. Moreover, the photograph is unquestionably an interesting one (despite the over-exposure of the central part) if only as an example of the wonderful amount of light transmitted by a 20in. mirror in 67 minutes; it also shows an extension of the nebula which, so far as I am aware, has never been previously photographed, although it is shown in Tempel's drawing. Regarding the "asteroid theory," no one who has seen the photograph can for a moment doubt the origin of the lines there shown, and had it not been for the unfortunate speech of the Astronomer Royal for Ireland reported in the Liverpool papers, probably nothing further would have been heard of it. It has always seemed to me a great pity that matters of a personal character should be imported into discussions of this sort, especially when, as in this case, they do not bear directly on the question at issue. It seems, at times, as if the fact that no one is infallible is overlooked, and surely no good end, or lasting gain, to astronomy, will be attained by such a means.

Kenneth J. Tarrant.

Letchford House, Pinner, 19th Feb.

THE EFFECT OF REFRACTION ON STAR DISCS.

[26872.]—I AM sorry to require so much space; but I must beg to be allowed to state that "F.R.A.S.," in letter 26807, has entirely misapprehended the point of my correction.

That I should be foolish enough to imagine (as he supposes) that the effect of refraction upon the shape of a star disc is a measurable quantity, would indeed be, as he elegantly expresses it, "rather a large order"; but I do maintain the position taken up in my letter (26782), and am prepared to prove that the elongation, due to refraction, of star discs in the photograph in question amounts to an appreciable quantity—viz, to 8''.

From the current number of the *M. N. R. A. S.*, it will be seen that this negative was exposed for 67m., from S. T. 4h. 13m. to 5h. 20m. The R.A. of θ Orionis is about 5h. 29m., the exposure therefore was begun when the nebula was 76m. E. of the meridian, and concluded when it was nearly due S.

The meridian altitude of an object in Dec. − 5° 30', for latitude 53° 30·5', is 30° 59·5', and its altitude at 19° E. is 28° 51', and the elevation due to refraction in each of these positions is about 96'' and 104'' respectively, and the difference of these two numbers, 8'', is the quantity, to which I referred, by which the star discs would be elongated in a direction very nearly N. and S., in a negative taken by an *accurate* driving clock, such as Mr. Roberts's Cygnus and Sappho charts show that he possesses, in spite of the accidental stoppage which abruptly terminated this particular exposure, and of the assertion to the contrary of a "Third F.R.A.S." in letter 26788.

As 8'' on the original negative is equal to about the $\frac{1}{200}$in., and on the enlarged proof shown at the R. A. S. meeting to $\frac{1}{40}$ of an inch, it is an appreciable quantity, and is the cause of the very manifest ellipticity in the discs in this particular photograph.

Another Fellow of the Royal Astronomical Society.

LIFE OF THE SUN.

[26873.]—IT appears to be assumed by Sir W. Thomson in his lecture on the Sun, an epitome of which is given in the "E.M." of 28th January, in estimating the probable duration of the sun as a heat-giving body, that the solar radiation proceeds continuously in all directions. What is the ground for this assumption? The heat is said to be dissipated in space; but where does it go to? It does not heat the interplanetary space, as we are assured that that is a vacuum dark and cold, and we may reasonably assume that the solar rays are not absorbed into the inter-stellar space beyond.

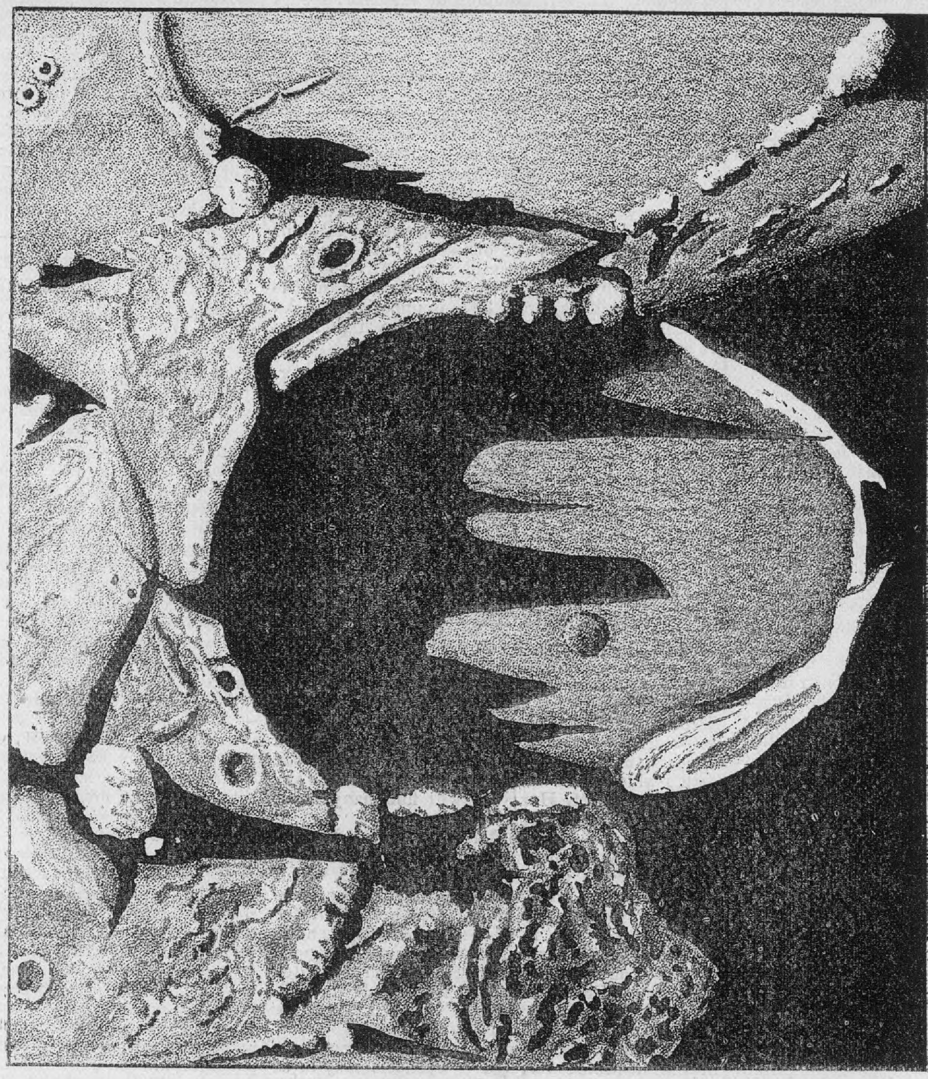
Judging, therefore, by effects, if we cannot account for the disposal of heat otherwise than where it is intercepted, may it not be that the solar rays only break through the dark, cold void to pass to other bodies, attracted thither by the force of gravitation. If this were so, the life of the sun would be practically illimitable.

I only venture to suggest this view, I am afraid, in a very rude form, in the hope that it may produce some argument pro and con. by your scientific readers. **E. T.**

THE LUNAR WALL-PLAIN PLATO —DR. HERSCHEL'S BURNING VOLCANOES—TO "T. C. H."

[26874.]—A SHORT time ago I was asked by a correspondent of "Ours" to give a recent sketch of Plato. Bad observing weather and other hindrances have hitherto prevented me from complying with his request; but the night of February 1st proving favourable, I was able to make the inclosed drawing, which will, perhaps, be acceptable to him and others interested in this remarkable formation, though it by no means includes all the features which a moderate aperture is competent to reveal under the best conditions.

On the evening in question a phenomenon was noted in connection with the shadows of the lofty peaks on the Western wall, which, though occasionally remarked before, has never been satisfactorily accounted for. When they occupied the position shown in sketch (viz., at 6h. 0m.), they exhibited an ill-defined, smudgy outline, strongly contrasting



SUNRISE ON PLATO, FEB. 1, 1887, 6h. 0m.

in this respect with those outside the border, which were clean cut and temptingly measurable. During the past twenty years I have watched the progress of sunrise on Plato very many times; but have only rarely noticed this appearance, the peak shadows, in spite of the dark surface on which they fall, being, as a rule, perfectly distinct when they have retreated as far westward as they are shown in the drawing. I offer no explanation to account for the phenomenon. Hypotheses relating to such appearances are worthless, till we have a wider range of well-authenticated facts on which to found them.

Observations of Plato having been mainly confined to the noteworthy details on the floor, the study of the wall has been, to a great extent, neglected, though no other lunar formation presents a more remarkable and suggestive border—e.g., the wide cleft or valley traversing the south-west rim, the broad gap in the west wall, and the curious depressions on the east wall; but the most interesting feature of all is the great fracture or "fault" which roughly bisects the formation from north-west to south-east, and is marked on the north rim by the intrusion of a massive wall of rock running at right angles to the border, and on the south by a series of breaks or small openings. Traces of this fault may, under favourable conditions, be traced partly across the floor soon after lunar sunrise. The two craters shown a little west of the border were very distinct on February 1st, as was also the much larger object of the same class on the south-west wall. There is a largs shallow ring a little north of this which is not shown in any lunar map.

In reply to "T. C. H." (letter 26812), no one now believes that the volcanoes described by Herchel I. were more than spots on the unilluminated portion of the disc, reflecting, by reason of the nature of their surroundings, a greater proportion of the light received from the earth than other lunar features. **Thos. Gwyn Elger.**

Kempston, Beds., Feb. 12th.

DOES A PETROLEUM LAMP DO WORK?

[26875.]—YES, that it does. Now, I do not wish to pose before your numerous and intelligent readers as a second Newton; but I feel quite arrogant enough to fancy that I have hit upon an idea hitherto unsuspected by everybody living, even in the ranks of science, and that is saying something for an obscure creature like myself. Perhaps, however, I am deluded. not knowing the extent of modern ideas; but as far as my knowledge goes, I am of opinion that the idea of a fire doing work when unobstructed by any boiler is not so very prevalent to-day. The petroleum lamp is such a fire, and if it be true that it does work, then the heat which proceeds forth from the chimney is not the full expression of the energy contained in the oil as generally thought, and which is liberated by combustion. Neither is it. A small portion of the whole energy has been spent in mechanical labour, and escapes, therefore, thermal recognition.

That a lamp does work is evidenced by the gaseous matter moving within the glass. No particle of matter can move without the performance of work, we know. But in what way does the work of a lamp expend itself? Well, we apprehend that it is spent in displacing the atmosphere to suitably accommodate the expansion of a quantity of air that is acted upon by the heat of the lamp. Suppose, for instance, we introduce a lighted lamp into a chamber, having at one side an elongated tube attached, in which works a piston, fixed for the moment, and that the chamber be instantly sealed directly the lamp is in position. Now, after burning one minute, say (provided the air present be sufficient to support it), let us fancy it extinguished. In that chamber now, supposing it to be constructed of non-conductive material, is the whole energy expended by the lamp in that time. Release now the piston, and it rises, and comes to rest when the pressures on either side are equalised. The work now done amounts to the product of the area of the piston into the height raised into the atmospheric pressure on every square inch of surface, plus the weight of the piston itself, in doing which a fraction of the heat disappeared from the vessel. Evidently the lamp performed this work. Now, precisely the same work, we hold, is done by the same sized light in the same time when the lamp is burning upon the table. Fresh supplies of air (the bulk in the form of heated CO_2, if so we are allowed to put it) are continually being raised in temperature to accommodate the ensuing expansion of which the atmosphere is raised up, and becomes charged to a certain extent with potential energy which, becoming kinetic through the impulse of gravitation, succeeds in raising the heated air. As fast as this potential energy is resolved into kinetic the supply is renewed again from the lamp, and thus increments of heat as converted motion are constantly leaving it. Let the lamp stop burning and the atmospheric disturbance rights itself at once. The work of the lamp as manifest to the observer is that portion of the whole work which is represented by the force of the draught, and which is the result of the difference between the weight of the column of air at any instant within the glass, and a similar column externally. That is the amount of displacement in that section of the atmosphere only. But there is potential energy in every other section above, which would continue to raise the heated air if it could be kept together as in a fire balloon. Still, the same stored-up energy continues to raise it when it has left the glass chimney, for it still displaces heavier air that has been lifted up therefore.

We have said enough, perhaps, not to be greatly misunderstood. Now perhaps you will have no objection to me saying that should a more searching explanation of this phenomenon be demanded, it can be found in a sixpenny pamphlet which either myself or my brother (102, Great Lister-street, Birmingham) is now ready to issue forth, entitled, "Science in a Petroleum Lamp." The pamphlet discusses many interesting features.

Bulkington, Rugby. **W. K. Fulleylove.**

MICRO OBJECT-GLASSES.

[26876.]—FOR bacteriological work two lenses are absolutely necessary and a microscope fitted with a condenser. I consider the condenser so important that I would rather have an indifferent lens with a condenser than a first-rate lens without. A cheap and excellent combination is Seibert Nos. 3 and 7—viz., a $\frac{1}{2}$ N.A. ·32 and water imm. $\frac{1}{16}$ N.A. 1·07. These two glasses cost a little under £5, and if you know how to test them you can get two first-rate lenses. A third lens is very useful, as the interval between a $\frac{1}{2}$ and $\frac{1}{16}$ is rather wide. The best lens to put in is a Reichert No. 7a; this is a $\frac{1}{7}$ of N.A. ·84. I think its price is about £2. The next series of three, costing about £9, would be Zeiss A.A., D.D., and G. These are a $\frac{2}{3}$ of N.A. ·31, a $\frac{1}{6}$

No.	Fabrication Number or Brand.	Designation.	Refrctive. Index for Line D.	Mean Dispersion C and F.	$v = \frac{n-1}{\triangle n}$	Partial Dispersion.			Specific Gravity.	Remarks.
						A′ and D.	D and F.	F and G′.		
23	O. 152	Silicat Glass	1·5368	0·01049	51·2	0·00659 0·628	0·00743 0·708	0·00610 0·582	2·76	
24	S. 8	*Borat Flint*	1·5736	0·01129	50 8	0·00728 0·645	0·00795 0·704	0·00644 0·571	2·82	To be used only in dry and protected places.
25	O. 164	*Boro-Silicat Flint*	1·5503	0·01114	49·4	0·00710 0·637	0·00786 0·706	0·00644 0·578	2·81	
26	O. 214	Silicat Glass	1·5366	0·01102	48·7	0·00690 0·626	0·00781 0·709	0·00644 0·584	2·73	
27	O. 161	*Boro-Silicat Flint*	1·5676	0·01216	46·7	0·00762 0·627	0·00860 0·707	0·00709 0·583	2 97	
28	S. 7	*Borat Flint*	1·6086	0·01375	44·3	0·00864 0·628	0·00974 0·708	0·00802 0·583	3·17	To be used only in dry and protected places.
29	O. 154	Light Silicat Flint	1·5710	0·01327	43·0	0·00819 0·617	0·00943 0·710	0·00791 0·596	3·16	
30	O. 230	Silicat Flint (higher Ref.)	1·6014	0·01415	42·5	0·00868 0·613	0·01009 0·712	0·00843 0·595	3·40	
31	O. 184	Light Silicat Flint	1·5900	0·01438	41·1	0·00882 0·613	0·01022 0·712	0·00861 0·597	3·28	
32	S. 17	*Dense Borat Flint*	1·6467	0 01591	40·6	0·00990 0·622	0·01128 0·709	0·00937 0·589	3·51	To be used only in dry and protected places.
33	S. 10	*Dense Borat Flint*	1·6797	0·01787	38 0	0·01097 0·614	0·01271 0·711	0·01062 0·594	3·81	Do. do.
34	O. 118	Ordinary Silicat Flint	1·6129	0.01660	36 9	0·01006 0 606	0·01184 0·713	0·01008 0·607	3·50	
35	O. 167	„ „ Flint	1·6169	0·01691	36·5	0·01026 0·606	0·01206 0·713	0·01029 0·608	3·60	
36	O. 103	„ „ Flint	1·6202	0·01709	36·2	0·01034 0·605	0·01220 0·714	0·01041 0·609	3·63	Corresponding to the dense flint of Chance Brothers.
37	O. 93	„ „ Flint	1 6245	0·01743	35 8	0·01053 0·604	0 01243 0·715	0·01063 0·609	3·68	
38	O. 102	Dense Silicat Flint	1·6489	0·01919	33 8	0·01152 0·600	0·01372 0·714	0·01180 0·615	3.87	Quite like the extra dense flint of Chance Brothers.
39	O. 192	„ „ Flint	1·6734	0 02104	32·0	0·01255 0·597	0·01507 0·717	0·01302 0·619	4·10	
40	O. 41	„ „ Flint	1·7174	0·02434	29·5	0·01439 0·591	0·01749 0·718	0·01521 0·625	4·49	Corresponding to the double extra dense flint of Chance Brothers.
41	O. 113	„ „ Flint	1·7371	0·02600	28·4	0·01526 0·587	0·01870 0·719	0·01632 0·627	4·64	
42	O. 165	„ „ Flint	1·7541	0·02743	27·5	0·01607 0·585	0·01974 0·720	0·01730 0·630	4·78	
43	O. 198	Very Dense Silicat Flint	1·7782	0·02941	26·5	0·01719 0·584	0·02120 0·721	0·01868 0·635	4·99	
44	S. 57	*Densest Silicat Flint*	1·9626	0·04882	19·7	0·02767 0·567	0·03547 0·726	0·03252 0·666	6·33	

N.A. ·82, and a $\frac{1}{9}$ N.A. 1·16. These also require selecting.

Let me caution you against cheap oil immersions; they are usually inferior to cheaper water immersions.

With regard to condensers, Baker fits a hemispherical for 15s., and an Abbé 1·2 N.A. for 35s.

Edward M. Nelson.

THE NEW OPTICAL GLASS OF MESSRS. SCHOTT AND CO.

[26877.]—I MUST remark that the numbers 23 and 26, though occurring among the flint glasses, are, I believe, belonging to the crown glass series; but are placed in the order named because their dispersive power is greater than that of the flint glasses which precede them. This will make the list equally divided between the crown and flint—viz., twenty-two of each.

In will be observed that the above table differs in many respects from those generally given. The aim is to show at a glance the exact optical character of any glass, and I think it answers the purpose remarkably well. In giving the necessary explanatory remarks, I shall try to keep as close as possible to a translation which has very kindly been made for me.

"For the determination of the optical properties of the different kinds of glass, the five bright lines of the spectrum, which can always be easily obtained by means of artificial sources of light, are here employed—viz., the red potassium line (Ka), the sodium line (Na), and the three bright lines of the hydrogen spectrum, $H\alpha$, $H\beta$, $H\gamma$. Since three of these are identical with the Fraunhofer lines C, D, F, of the solar spectrum and both the others, $K\alpha$ and $H\gamma$, lie very near the Fraunhofer lines A and G, these lines in the following pages will be denoted by the letters A′, C, D, F, G′ The wave-lengths of these lines are—

A′ Mean of duble lines	C	D Mean of duble lines	F	G′
0·7677	0·6563	0·5893	0·4862	0·4341

"The results of the spectroscopic measures, which have been made according to the method of Dr. Abbe, have been arranged together for comparison in such manner that the absolute value of the refractive index is given for the D line only; but for the determination of dispersion, the *differences* of the refractive indices for the four intervals, C F, A′ D, D F, and F G′ are employed. The dispersion values corresponding to the accuracy of the measures, are given to five places, whilst the refractive index for D is determined only to four places of decimals.

"Since the interval C F comprises the middle and most brilliant part of the spectrum, the mean dispersion of the different kinds of glass will be sufficiently characterised by it; and by its relation to the value of $n_D - 1$, since the line D lies very near to the brightest part of the visible spectrum, a definite numerical expression for the so-called *relative dispersion* $\left(\frac{\Delta n}{n-1}\right)$ is obtained. In the table, for the sake of brevity, the reciprocal of the latter, indicated by the letter v, is introduced in the column near to the mean dispersion. The whole series of different kinds of glass is arranged throughout according to the amount of this number v, from the greatest value to the least, thus proceeding from the least relative dispersion to the greatest: and as the conditions for achromatising one kind of glass by means of another, are essentially determined from these values and their differences, the optical character of a kind of glass with reference to its achromatising power can thus at once be expressed by that number v.

"The dispersion values for the three intervals—A′D, D F, F G′—furnish an accurate estimate of the character of the dispersion, that is, of the relations of partial dispersion in different parts of the spectrum; and afford the requisite basis for determining the degree of achromatism, attainable by the combination of any two kinds of glass. To facilitate a convenient inspection of the whole, those numbers which are found when the relative partial dispersion is divided by the amount of the mean dispersion for the interval C F, have been introduced beneath the dispersion values in the same column in smaller figures.

"A comparison of these quotients for the two different kinds of glass usually employed—viz., crown and flint, enables us to perceive what is the kind and magnitude of the secondary spectrum, which the mutual achromatising of these two kinds of glass must leave outstanding. A greater value of the first quotient (belonging to the interval A′ D) indicates a relative lengthening of the red—a greater value of the third quotient (belonging to the interval F G′)—a relative lengthening of the blue, in the spectrum of the glass in question. The differences of corresponding quotients for the two kinds of glass thus give the measure of the greater or lesser *disproportionality* of their dispersions; on the other hand, their equality indicates the possibility of an achromatising *without secondary* colour-aberration, provided the values of v in the kinds of glass employed, are sufficiently different to permit of their combination as crown and flint glass. We here call attention to the fact, that for the first time kinds of glass are here offered to opticians, which, along with an approximately equal relative dispersion (or of the number v) show generally *considerable* differences in the relations of partial dispersion (compare, for example, the numbers O. 138 (9) and S. 52 (10), O. 152 (23) and S. 8 (24), S. 7 (28) and O. 154 (29) of the catalogue): and such as give approximate proportional dispersion, along with *considerable difference of mean relative dispersion*, which thus render possible achromatic combinations *without secondary spectrum* (that is, an accurate union of *three* different colours of the spectrum); as, for example, the pairs O. 225 (1) and S. 35 (21), S. 40 (2) and S. 35 (21), S. 30 (3) and S. 8 (24), O. 60 (8) and O. 164 (25)."

I have been induced to give the preceding rather lengthy extract from Messrs. Schott's catalogue, because the arrangement of the optical data is in many respects new, and it seemed undesirable to condense the very explicit directions which are given for its interpretation and use. I shall conclude the present paper with the translation of a note appended to the introduction to the table.

"An accurate investigation of the numbers in the Table leads to the conclusion, that the employment of a much greater number of chemical elements, than have ever previously been used in the manufacture of optical glass, has not introduced, strictly speaking, a proportional dispersion in the composition of the glass of any notably different values of v. In the case of the above-mentioned combinations, which allow of three colours being united, a slight aberration of the blue remains outstanding, when the red is combined with the two middle colours; or an aberration of the red, when the blue is made to coincide with the middle colours; whilst the first and third quotients never simultaneously assume identical values. The *tertiary spectrum* arising from this aberration may, however, be considered as practically eliminated, compared with the great secondary spectrum, which the pre sen available crown and flint, made from the sili cate series, leave outstanding."

This paper and the preceding one will enable the reader to intelligently peruse the new list of glasses for optical work; probably, I may send a few remarks on theoretical matters connected therewith at an early date. **Orderic Vital.**

DR. SCHOTT AND DR. ABBE'S NEW OPTICAL GLASS.

[26878.]—IN reference to some of my brother-readers (letters 26685, "F.R.A.S"; 26796, W. G. Penny; 26759 and 26824, "Orderic Vital") in discussion about Dr. Schott and Co.'s new optical glass, I can inform them that that most eminent optical firm, Reinfelder and Hertel, in Munich, have already made some 5in., 6in., and 7in. double objectives of the new Jena glass, with a very fine result. They give no secondary spectrum—only a tertiary, which is small in respect to the secondary spectrum.

I possess a very fine 5½in. Reinfelder and Hertel refractor with glass from Feil in Paris, which gives a stark blue secondary spectrum. I have ordered a 3¾in. refractor from the same firm, with Jena glass. As soon as I have received and mounted it, I shall give a few words about its performance.

Victor Nielsen.

Copenhagen V., Sofievei 22.

DIPSOMANIA—GRAVITATION.

[26879.]—IN answer to "T. C. H." (letter 26812, page 520), I have heard nothing more of Mr. Edge's case. I should be very glad to give "T. C. H." any help in my power; but I fear I can tell him nothing more than I told Mr. Edge—viz., that "T. C. H." might try to mesmermise his friend himself, and if he fail, try to get some man of firm character and uprightness to do so. If "T. C. H." does not understand how to proceed in the operation, I will lend him a book on the subject, if he will advertise his address, or write to me to "Ordnance Office, Enniskillen." After all, it is but a poor method of curing a man of a vice whereof his own will should cure him.

I should like to say a few words as to the influence of gravitation (*vide* reply of "F.R.A.S." to "W. T. N.," on page 519). Gravitation is the only force which appears to act absolutely instantaneously. It is also the only force as to the transmission of which, so far as I know, no theory whatever has been, or probably will be, ever formed. Lastly, it is the grand force which holds together the whole visible universe, to the furthest telescopic double star. I would ask those, then, who, like myself, believe in the existence of an Omnipotent and Omnipresent God, why should we not, in the universal power of gravitation which we see around us, recognise not only a great law of nature, but an active manifestation of the direct power of God, never resting nor changing, but holding worlds, and suns, and systems in their appointed order, as the great flywheel of a manufactory controls the speed of every pulley and axle in the building. Take away the flywheel, and its source of power, and every wheel and engine will stand still. Take away God, or let Him rest but for a moment in His work, and planets, suns, and systems will fly off into space to wander aimlessly for ever therein. And while the great work of God goes on, are not some of us to be compared to an ephemeral insect which flits about the manufactory in its life of a few hours, and seeing the whirling wheels, thinks that it is their nature to go round, that they have always done so, and always will do so? Nay, more: suppose that the whole work of the manufactory was devoted to securing the life and comfort of that insect and his fellows, and that, nevertheless, they should agree that there was no controlling power behind it at all, and that, because they could see that two pulleys were so connected by a strap that when one went round the other must (which, after all, is as much as we know of light, electricity, or chemistry, and more than we know of gravitation), they should consider that they had solved the whole secret of the mechanism; would we not smile at their folly? Yet, as I understand it, that is the position of a scientific atheist. I am sorry for such. I believe some day they will have to learn by sore experience the source of the power. Meanwhile, I give my theory of gravitation for what it is worth—without apology, for is not the origin of the motion of the flywheel as scientific a subject as the mechanism it moves?

Garrison Gunner.

DIPSOMANIA.

[26880.]—IN reply to letter 26812 (page 520), if "T. C. H." will obtain some rack root, and make tea of it, he will find it a perfect cure for drunkenness. This is said to be one of the ingredients in Epps's curacene, which stops the craving for alcohol. **Reclaimed.**

PRODUCTION OF ALUMINIUM — A CHALLENGE — COTTON-SEED OIL—OXYGEN GAS.

[26881.]—MR. WILLIAM WHITE (letter 26815, page 521) makes the definite statement that metallic aluminium can be deposited from a solution of aluminate of soda by the aid of a current of the intensity of 6 volts. He further states that some years ago he left with the editor of the *Chemical News* a strip of copper with half its surface coated with aluminium. Many years since I myself received a piece of metal said to be electro-plated with aluminium, and it is quite possible that it was to Mr. White himself that I was indebted for it. Unfortunately, I did not convince myself that the thin coating was really one of aluminium. Assuming Mr. White to be correct in his statement, and I am by no means satisfied that he has not deceived himself, how is it that there has been no practical outcome of the invention during all these years? I am not suggesting that a method of depositing a thin film of aluminium has much practical value; but how is it that if a thin film can be deposited by electrical means, that a second film cannot be deposited on that, and a third on the second, and so forth, until any requisite thickness is obtained? Seeing how cheap and abundant the sources of aluminium are, and how cheaply metals can now be electro-deposited by the aid of a dynamo, there is no apparent reason why metallic aluminium should not be cheaply produced, *if*—and it is a big if—the statements made and implied in Mr. White's letter are correct.

To put the claim to a pratical test, I hereby declare myself willing, for one month from date, to buy or find a market for any quantity of pure metallic aluminium, whether produced electrolytically or otherwise, at the rate of 2s. per pound. There is a fair offer to the various claimants to the possession of secret methods of reducing aluminium. Why, with handsome fortunes at their command, they content themselves with written descriptions, and the production of thin films, is a mystery it lies with them to solve.

In reply to "Publicola" (query 61726, page 552), I consider refined cotton-seed oil one of the purest oils in commerce, and admirably adapted for cooking and use as food. It is, indeed, already largely used for these purposes, and I believe is quite unobjectionable. On the other hand, it is an established principle that when a person asks for a certain article, the vendor has no right to palm off on him another and cheaper article without acknowledgment. The unacknowledged substitution of butterine for butter, and of a mixture of chicory and coffee for unmixed coffee, are well-known breaches of the Sale of Food and Drugs Act. The substitution of cotton-seed oil, or a mixture of olive and cotton-seed oil, for genuine olive oil is clearly a fraud of the same kind.

"Oxygen Gas" (query 61759, page 553) cannot be liquefied by any pressure, however great, at ordinary temperatures. Extreme cold is a necessary condition of the liquefaction.

Alfred H. Allen.

Sheffield, February 19th.

AS TO THE DEPOSITION OF ALUMINIUM.

[26882.]—MR. J. BAYNES THOMPSON has kindly supplied me with the following details of his process:—

Solution.—Aluminate of sodium in solution of sodium hydrate, 10 per cent. Aluminium trihydrate may be used, and, if so, a stronger solution of sodium hydrate will be required—say, 12½ per cent.

Electricity.—Any source at six volts intensity. If battery, a six-cell Daniell will do very well.

Positive Electrode.—Iron does well. Platinum may be used; but not carbon, which disintegrates. Whatever is used, it must be larger than negative—at least, double.

Heat of Solution.—150° Fahr.; *not* 500°, as has been twice stated. It is hard to imagine how anyone could make such a mistake; for who does not know that with an aqueous solution in an open vessel 500° is an impossibility? It represents high-pressure steam.

This method is only of use for a thin coating of aluminium. It is too slow for electro-plastic. It is quite as slow as iron from ferrous sulphate, or magnesium from Epsom salts.

Cheshunt, Feb. 21. **Wm. White.**

LUMINIFEROUS ETHER.

[26883.]—IN your No. 1143, p. 542, appear two valuable contributions by "A. X." and "Sigma" respectively, on the "Luminiferous Ether." "A. X." asks: "Why may we not go one step farther, and suppose that these same molecules are capable of taking up and passing on that kind of motion which produces the phenomenon of light, &c.?"

This is exactly the theory which Büchner and other German scientists uphold. In "Force and Matter," p. 79, Büchner says: "All the so-called imponderables, such as light, heat, electricity, magnetism, &c., are neither more nor less than changes in the aggregate state of matter—changes which, almost like contagion, are transmitted from body to body. Heat is a separation, cold is an approximation of the material atoms. Light and sound are vibrating undulating bodies." "Electrical and magnetic phenomena," says Czolbe, arise as experience shows, like light and heat, from the reciprocal relations of molecules and atoms." For these reasons, these scientists define 'force' as a mere property of matter."

To myself, at least, then, it appears clear that whatever the properties or forces of "ether" so-called may be, whether it is ordinary matter in a fourth state, as some call it "ultra-gaseous," or whether it is an unknown element, it must still be "matter" possessed of force or forces.

It seems to me impossible that light and heat could pass from the sun, or other cosmical bodies to the earth, without a "material" intervening and connecting medium. We know also that disturbances in the sun, as observed by the faculæ, stand in direct relations to magnetic disturbances, such as "Auroras" on the earth, so that there can be no doubt that this medium is capable of transmitting to the earth besides heat and light, solar electricity. But, principally, I cannot conceive how gravitation could act between cosmical bodies, unless by or because of this "material" connecting medium, to which we give the name of ether.

The idea of "force" as of something residing somewhere, outside of matter, by itself in vacuo, doing nothing, or of matter devoid of properties and forces, and residing in some other vacuum, having in some occult way, forces "superadded" to it, appears to me "chimerical." On the other hand, "ether" representing the ultimate state of "matter," filling the universe infinitely distended, yet possessed of inherent forces residing in its minutest particles, becoming manifest and phenomenal by concentrations, such as the mutual attraction or repulsion of its atoms would cause, seems to me at once a more natural explanation of the action of "ether," the ultimo ratio of which is, at least at present, beyond the grasp of the finite brain power of man. **F. W. H.**

THE STRUCTURE OF EUPODISCUS ARGUS.

[26884.]—RESPECTING the "white dots" on the inner layer of this diatom (26857), like "T. F. S.," I am of opinion that they are really perforations. I have a slide of "selected" valves of this diatom from Tampa Bay, Florida, where the upper membrane and areolations are worn or rotted away in the central part, thus leaving the inner membrane exposed in the centre. On examining these valves, I find some of them have the inner membrane cracked, and in one specimen, the membrane is higher on one side of the crack than on the other. These cracks run from hole to hole, and not round them as they would do if they were "dots," and, in the specimen particularised, the edges of the cracked membrane, with semi-circular gaps, is very noticeable. Speaking roughly, these holes are arranged in lines radiating from the centre of the valve outwards.

I think if Mr. Nelson examines his diatom again that he will find reason to modify his opinion about the structure of this valve so far as relates to the "white dots."

I am not prepared to follow "T. F. S." in his views *re* structure of "angulation." **H. M.**

VERY LIBERAL.

[26885.]—BY a somewhat curious coincidence, this Jubilee year happens to be the bicentenary anniversary of the first issue of Sir Isaac Newton's much-lauded book "The Principia." Would it not be a graceful tribute to his memory if any competent authority would, for the first time, publish a short essay showing the grounds on which his theory was originally founded, and the facts by which his solar system has been subsequently confirmed?

Although it has been the textbook of all the elementary science now taught in all the schools throughout the kingdom, yet no one, during the last 200 years, has ventured to prove that his theories were based upon facts.

With a view to encourage someone to undertake a reliable exposition of the principles enunciated in "The Principia," I am willing to offer and guarantee a premium of £100 for a complete and conclusive illustration of the truth of the various conditions of the truth of Newton's solar system.

Those who are willing to compete for it will please give me notice of their intention.

Balham, S.W. **John Hampden.**

CONTINUOUS BRAKES ON SLIP CARRIAGES.

[26886.]—A COLLISION occurred at Werrington Junction on the Great Northern Railway on the 14th instant, which directs attention to the use of continuous brakes on the slip portions of trains. The slip portion of the North express became detached, and some platelayers who observed the break-loose waved a red flag. The driver applied the non-automatic vacuum brake, and brought his train to rest, when it was run into by the slip-

portion, which was not worked with any continuous brake. If slip-carriages are to be worked, the brake should fulfil the following requirements:—

1. The driver must have control over the whole of his train (including the slip portion) up to the point of slipping.

2. The guard of the slip portion must (to fulfil the Board of Trade conditions) be able to apply the whole of the brakes so long as his portion is attached to the train.

3. When slipped the continuous brake must be left in perfect working order, both upon the train and slip portion.

4. The guard of the slip-portion must be able to take off and put on the continuous brake upon his portion in order to regulate it in running to the platform.

The train which was examined and worked at the recent Railway Congress at Brighton was fitted with brakes which fulfilled all these requirements, and there can be no doubt that, if the train at Werrington Junction had been fitted with a proper automatic continuous brake, the breaking loose of the slip-carriage at a point where it was not required to be slipped would have applied such automatic brake on both parts of the train, and brought both safely to rest without any accident.

Clement E. Stretton,
Consulting Engineer Amalgated Society of Railway Servants.
Peterborough, 21st Feb.

RAILWAY SIGNAL LIGHTS.

[26887.]—THE recent accident at Sedgley Junction on the London and North-Western Railway adds another to the long list of similar cases which have occurred through mistakes in signal lights, both fixed and hand, and confirms the opinion that a white light should not be an all-right signal.

Numerous errors and accidents have been caused by a street lamp on a bridge, a lamp in the window of a house, a white back-light on a signal post, or a hand-lamp carried by a person walking on the railway being considered by a driver as an all-right signal for him to proceed. No such mistakes could occur if the green light were on all lines made the only all-right signal light, and green should not be employed as a back light, as in practice it is often mistaken. The white light can, with advantage be used as a back-light to indicate to the signalman that his signal is "on," and the absence of such back-light that it is "off." So long as white lights are retained as all-right signals, so long, I fear, mistakes similar to that at Sedgley Junction may be expected to occur.

Clement E. Stretton,
Consulting Engineer Amalgamated Society of Railway Servants.
St. Pancras Hotel, London, N., 19th Feb.

ACHROMATISM.

[26888.]—I AM glad to find that your able correspondent, "O. V.," recognises the necessity of a different formula for the achromatism of an eyepiece to that which is used for a telescope. But he will assuredly find that it is the one which he gave in a previous letter, with a little alteration, which is the *eyepiece* formula, and that the one given by myself—

$$\frac{w_2}{w_1} = \frac{d - F}{f - d}$$

is the telescopic formula, or that for parallel rays.

In your columns, a few years ago, $Ff + (F-d)^2 = 0$, was proposed as the formula for an eyepiece —i.e., for the case in which the image formed by the first lens has to lie in the focus of the second. And it shows that unless F and f have different signs, d is impossible for an e.p.

If I rightly understand his question in letter 26863, I am afraid that the constants in his list cannot be determined by any theory whatever, inasmuch as they must be quantities which must essentially depend upon observation.

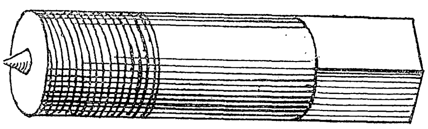
I have unfortunately lost my copy of Airy's Tracts, and can only therefore speak from memory; but I believe he only gives the relative magnitudes of the same star as seen in different telescopes, but not those of different stars seen in the same telescope—e.g., those of Vega and its companion seen in a 3in. glass.

If "F.R.A.S." or "O. V." has seen any formulæ applicable to this latter purpose, perhaps he would kindly give it.

Feb. 18. **W. G. P.**

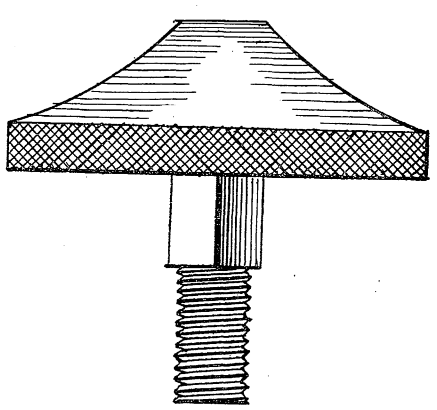
SOME SMALL ADDITIONS TO FACE-PLATES FOR AMATEURS.

[26889.]—FOR a long period I used to think affixing work to my face-plates a tedious and troublesome operation, particularly as regards "truing the centres." I have now succeeded, by a very simple tool, in overcoming my difficulties. I will describe it. Turn a cylinder of very hard wood, preferably pear, about 4 or 5in. long of the exact gauge to receive a screw. My face-plates have a thread of 1in., therefore I finished the cylinder in my case to a trifle over an inch; then I tapped one end for about an inch, so as to fit the screw-hole of said face-plate exactly; at the other end of this wooden plug for about 2in. I removed enough wood to make it square. Its appearance then closely resembled a "plug tap" of extreme length; then in the exact centre of the screw end I pierced a small hole with a hand-drill, and entered a sharp-threaded piece of $\frac{3}{16}$in. steel to the depth of about half an inch. In the lathe this projecting metal point was finished off fine, till it stood only $\frac{1}{4}$in. from surface.



To mount your work, put the square portion full depth into the jaws of your parallel vice, screw up till the plug stands straight and immovable; now take your face-plate, and revolve it on the end screw slowly till you can see the sharp point. Having gauged the centre of any piece you wish to attach to your plate, drill a tiny hole with a hand-drill. You will find your mounted face-plate is turned into a pleasant little table, with all its holes presented to you for action, and great freedom of scope in setting and handling your bolts and nuts. Now place the tiny hole in your piece over the screw-hole, and gently turn the plate till you find the centre point has entered it, taking care to screw back again till the plate and work make exact touch. They will not easily part company, as the little spike prevents a slip. I hope this will prove intelligible, added to the rough sketch.

I have lately added a pair of vice jaw bolts to my largest face-plates; these are well suited to hold pieces of square, oblong, or irregular shape—in the latter case, using lead wedges to block them.



Half-size Jaw Bolts.

I made mine of the best Cumberland soft iron, and then case-hardened them, as I do with all appliances requiring armour.

In a future paper I will tell your amateur readers about other face-plates, and my way of fixing spring centre points, much time and incorrect work being saved thereby. **Eos.**

"THEORY OF MACHINES."

[26890.]—ON p. 490, 6th par., 3rd col., the talented author says: "There are twenty movements which cannot be imitated, &c, &c." The statement is no doubt correct, so far as sewing machines are concerned; but the author has overlooked a very ingenious machine made in Switzerland, and used there and in this country for machine embroidery.

It is too complex to be fully described in a short paper; but in general principle it is a large (about 12ft. long by 8ft. high) square tambour frame, placed vertically, and it is hung in the more massive fixed framing of the machine.

This frame (with the silk, or other material strained as for hand work) is practicable, and is actuated by the manipulator from a pantagraphic action on the left hand of the machine, with the result that the work is moved about the needles, instead of, as in hand work, the needle about the material.

The needles are $\frac{3}{4}$in. long, *pointed at both ends*, and the eyes are in the centre of their length, and they are threaded by girls, just as ordinary needles are threaded. The number for each machine varies with the designs and character of the work. They are placed $1\frac{1}{2}$in. or 2in. apart in the 12ft. length.

On either side of the framing is a horizontal travelling bar, supported at each end on a railway which is fixed at right-angles to the framing of the machines. On the bars at the above-mentioned spaces are fixed some spring clutches, two (one on each bar) for each needle.

These clutches have the action and somewhat the appearance of the thumb and first finger when in the act of pulling something, say a pin, out of a vertical plane.

The operator works the machine as follows:

One of the horizontal bars is drawn as far away from the face of the work as possible, the ready threaded needles are placed in the clutches (one to each) a sufficient depth to be held firmly, the worker makes the bar travel to the work; all the needles enter the work simultaneously and project on the opposite side, the other bar is then brought forward, and the clutches on it are made to grasp the projecting points of the needles. The clutches first in action are then actuated—they release the needles; the bar (and clutches which now hold the needles) is then drawn back; the needles will then have passed completely through the work; the thread is drawn to its proper tension by the action of the bar; the frame is now shifted in position the distance required for another stitch, and the movements just described are repeated, but from the opposite direction, and so on, backward and forward until the work is finished, the whole of the operations being performed by the worker from his seat on the left of the machine. Hand and feet are both used.

Although it is used only for embroidery, two fabrics could be stitched together, but for many purposes would be a waste of time, as a diagram must be made giving the exact form of the stitching required. **W. A. Barber.**
92, Cleveland-street, Feb. 14.

AMMETERS AND VOLTMETERS.

[26891.]—A FEW weeks ago I promised to test and report upon a pair of the above instruments, and have now much pleasure in doing so. The voltmeter was compared with one by Cardew, which has been recently calibrated and known at time of tests to be accurate. The ammeter was compared with one of Siemens' dynamometers newly checked by electro-deposition; the resistances were all measured by a resistance instrument adjusted on Rayleigh ohms from a coil compared and certified at the Cavendish Laboratory:—

MR. BOTTONE'S AMMETER AS SUPPLIED AT 5S.

Current in Ampères Dynamometer.	Current on Ammeter N. W. Quadrant.	Current in Ampères Dynamometer.	Current on Ammeter S. W. Quadrant.
1·66	2	1·47	2
2·43	3	2·05	3
3·40	4	2·62	4
4·17	5	3·35	5

MR. BOTTONE'S VOLTMETER AS SUPPLIED AT 5S.

Volts on Cardews's Voltmeter.	Volts on Voltmeter N. W. Quadrant.	Volts on Cardew's Voltmeter.	Volts on Voltmeter S. W. Quadrant.
1·37	1	1·5	1
2·3	2	2·8	2
3·4	3	4·7	3
4·7	4	6·4	4
5·7	5	8·4	5

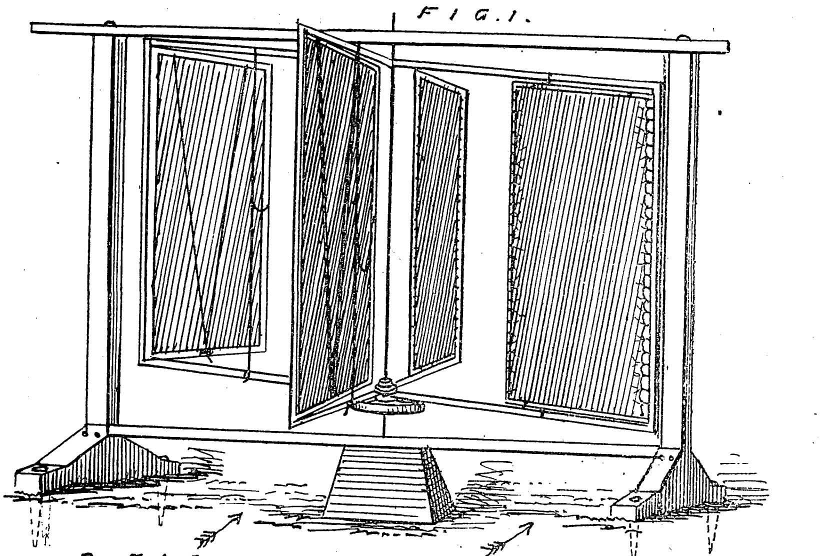
The ammeter is marked as R = ·00034 ohm; I find it has a resistance = ·0045 ohm at 12° C.

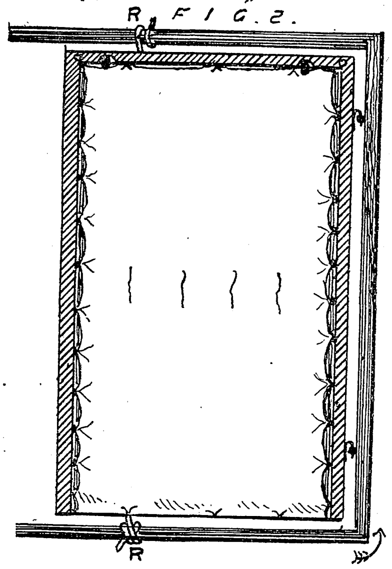
The voltmeter is marked R = 300 ohms; I find it has a resistance = 168·5 ohms at 12° C.

I leave these figures to speak for themselves. I may say that I would have been very pleased had they agreed more closely, as a cheap and fairly accurate meter is much wanted; but I am afraid they cannot be combined. If Mr. Bottone thinks it necessary, I shall be pleased to give him my name; but I think he will accept my results in the spirit in which I give them. **Ohm.**

HORIZONTAL WINDMILLS.

[26892.]—HAVING worked for many years at the subject of windmills, I have followed with great interest the various articles which have lately appeared in your valuable paper, and I was much pleased to see in your last number a descrip-





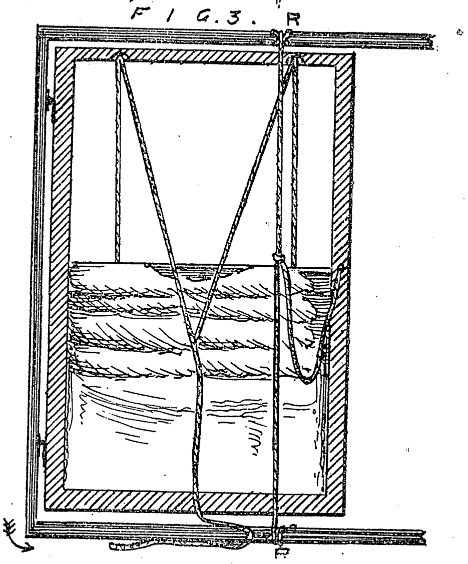


Fig. 1.—General view of Mill in action. Fig. 2.—Sail up to full power pressing against rope R. Fig. 3.—Opposite view of sail run up to half power.

tion and drawing of windmill as made by Mr. Russell.

About a fortnight ago I made a model on the same principle as Mr. Russel's mill, and I venture to send a sketch of one I am making on a large scale, in case some of the points of construction may be of interest to others. The points I have chiefly considered are to avoid unnecessary friction

FIG. 4.

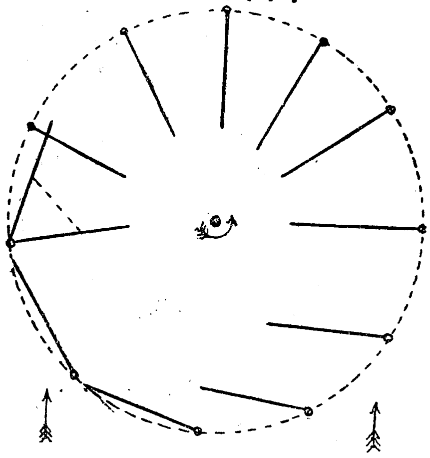


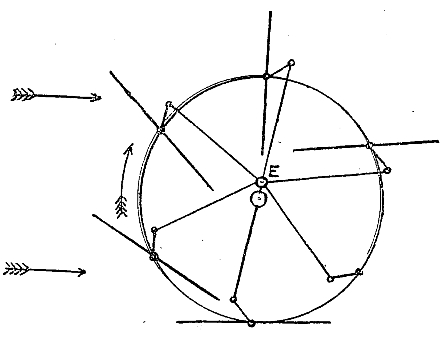
Fig. 4.—View showing position of sail at the different points.

and strain in the running of the shaft; to be able to regulate the amount of sail to the power of the wind, and to prevent a sudden shock when the framework carrying the sail strikes the arms, this latter point being effected by causing the framework to come in contact with a rope, R, stretched between the arms.

I have been working at windmills with the hope of ultimately using them for storage cells, for which I am at present obliged to use a steam-engine. I find it absolutely necessary to be able to furl the sails in a gale, as my last mill was completely destroyed, and it was by watching a piece of the torn canvas streaming from one of the arms which alternately wrapped round and released itself from the axle as the arm rotated, which gave me the idea of my present mill, which in principle appears somewhat similar to that made by Mr. Russell. **W. I. S. Barber Starkey.**

HORIZONTAL WINDMILLS.

[26893.]—I VENTURE to send details of a mill which in model form has given very good results, in the hope that some of our experimenters will give it a trial and report on it. In designing it, it has been my object to so place each sail that at all



points of revolution it shall give off its maximum of power. This it does for seven-eighths of its circumference, the dead point occurring at the back—that is, the lee side.

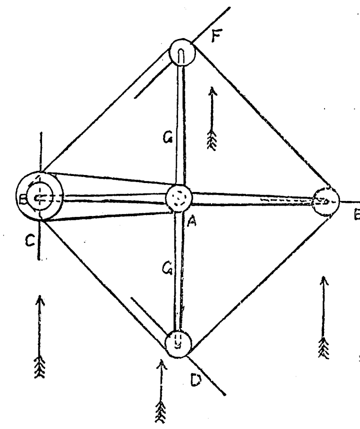
The accompanying sketch will explain its action. A small eccentric operates the striking rods connected with the levers, said levers each being fixed at an angle of 45° with face of sail; a vane on top of mill keeps eccentric always in one relative position to the direction of the wind.

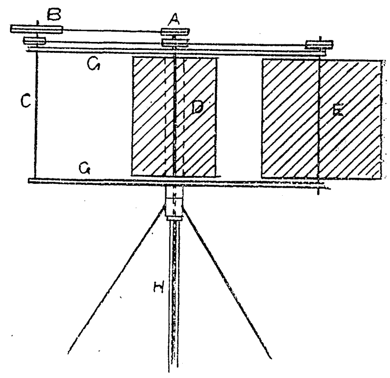
Mr. Vallance has succeeded in running his mill with one sail. Mine will not run with one, but it will with two.

One model ran so fast as to appear solid, at the same time it was perfectly silent. Mr. Wells is advertising these models in the Sale Column, and one of them explains itself better than a page of print. **Geo. Button.**

[26894.]—IN reference to the discussion on horizontal windmills, I inclose a plan and elevation of what I consider one of the best forms of a horizontal windmill.

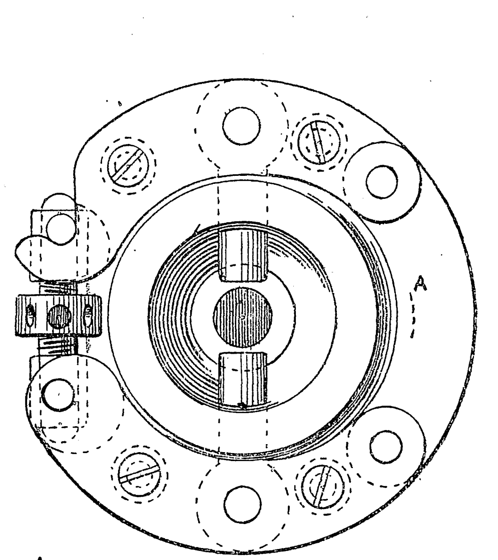
Although there are many ways in which this may be fitted up, I have only given one way in order to show the principle on which it works. G G are eight arms fixed on to a boss, which is a working fit on spindle H. Four arms are fixed on each end of boss at a suitable distance apart; at the extreme end of these arms are placed the four

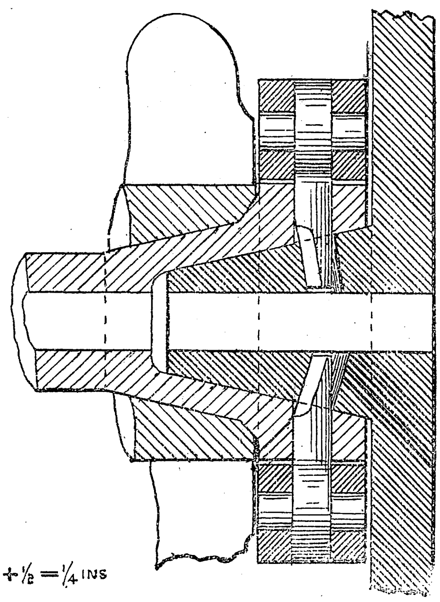




blades C D E F, which blades are kept in a position for getting the best results from the wind by means of gearing of whatever form may be thought best. I have shown it worked with pitch chain for simplicity of explanation. The spindle H is movable, so far that it can be easily shifted to the direction of the wind, either by hand or automatically by a vane on top. On top of spindle is fixed the chain wheel A, which imparts motion to the wheel B, which is fixed on to blade C. B is double the size of A, so that when the mill takes a whole turn the blade takes only half a turn. On blade C, as also on other blades, is fixed another wheel, which is connected by another chain, so that it can be seen, whatever motion is imparted to C, the other blades have a corresponding motion. I think the illustration will explain the rest; the arrows show the direction of the wind. On plan, E is shown at its best power, while F is still utilising the wind, C is coming up against the wind edge on, while D is doing fair work at that point; in fact, the blades commence to do work immediately after passing the point C, and continue to do so until they again approach the same point. **Tul.**

[26895.]—I HAVE been watching this discussion with some interest, and should like to add a few words. I agree with "A. Liverpool," that the idea of a horizontal windmill is not new. Indeed, it is almost "as old as the hills"; it is mentioned in the "Theatrum" of Leopold; and more recently Smeaton exhaustively experimented on them in 1759, and unconditionally condemned them. In his paper read before the Royal Society (1759), Smeaton, on this subject, says, "Observations upon the effects of common windmills with oblique vanes, have led many to imagine that could the vanes be brought to receive the direct impulse, like a ship sailing before the wind, it would be a very great improvement in point of power, while others





A IS A SINGLE LINK: NEEDS CLEARANCE SHOWN ÷ ½ = ¼ INS

attending to the extraordinary effects of oblique vanes have been led to imagine that oblique vanes applied to water mills would as much exceed the common water wheels, as the vertical windmills are found to have exceeded all attempts towards a horizontal one. Both these notions, but especially the first, have so plausible an appearance, that of late years there has seldom been wanting those who have assiduously employed themselves to bring to bear designs of this kind."

The disadvantage of horizontal windmills does not merely consist in that each sail when directly exposed to wind is capable of a less power than an oblique one of the same dimensions; but that in a horizontal windmill little more than one sail can be acting at once, whereas in the common windmill all act together; and therefore supposing each vane of a horizontal windmill of the same dimensions as each vane of the vertical, it is manifest the power of a vertical mill will be greater than the power of the horizontal one. This disadvantage arises from the nature of the thing; but if we consider the further disadvantage that arises from the difficulty of getting the sails back against the wind, we need not wonder if this mill has been found to have not much above one-eighth the power of the common sort.

As regards the mill shown in F. Russell's sketch recently, in addition to the above inherent defects, it would probably thrash itself to pieces in a fresh breeze of wind, and would ordinarily make as much noise as a stamping mill. **J. Q. D.**

[26896.]—WE have been much interested in this discussion; but as there seems little chance of the merits (or otherwise) of the horizontal being proved by discussion only, we have decided to erect one large enough to do useful work. We have begun making it, and hope to have it finished in about a month, and will then send drawing, description, and give results (Editor permitting). Is not the case of horizontal v. vertical mills somewhat similar to that of paddle v. screw? A ship in strong head-wind may have her screw revolving at full speed, and yet make no way; but a paddle under same conditions goes ahead or her engines stop. **B. and G.**

LATHE MATTERS.

[26897.]—THE weak points of my proposed mandrel nose are noticed by "F. A. M." as I expected; but I do not think they are so serious as he puts them.

It never occurred to me, however, that it was complex: then it has the advantage of the screw, it being a simple surface, and in freedom from wear. Further, a screw in spring temper is no easy thing to cut with sufficient truth. The holes in bosses of chucks could be accurately marked off, or drilled through a ring gauge with a flange, to be bolted through hole to pull up to face and fasten. The same Morse drill could be used for all cylindrical holes, and set aside for extras when needed. One gauge might serve several lathes.

It is not quite true that the two cone-points only touch at a *point* each, as the contact is theoretically a line; and the line would develop into a surface of just enough area to stand the pressure the first time the points fixed a chuck. A little might perhaps with advantage be scraped or filed away in the holes in mandrel, on the contact line, so as to leave a double surface. I think their holding power would be sufficient for the purposes of the lathe when the points were made of full-size—as they did not come out in the sketch. They have not to stand back-gear; nor yet the full power of the lathe, as that is given off from the grooved face-plate. If well set, the strain then put on them would be very unlikely to be increased by work in the lathe, even with long over-stands, as the cone would act approximately as a cylinder. However, a plan that has cylindrical surfaces in contact in the teeth and holes, and is more likely to suit, perhaps, as it takes up less room—though it is a little more inclined to number of parts—is appended. It is a neater device than the dog, but is not so easily transferred from one chuck to another when used with a nose on mandrel, also it may affect the oval chuck. In the matter of the tail-stock fastening proposed by self, it occurs to me that a handle on bolt at the back of head would be a handier and better gear than that shown. It would not be so inclined to twist the bolts while slack, and could have a square socket on bolt to stop that tendency; also the handle would be easier to get at towards tail of bed, and the action of bolt end on underside of bed would be nicer and freer from wear. **Vulcan.**

New Small Calibre Repeater Rifle in Denmark.—The Danish War Department has for same considerable time been directing its attention to a small calibre rifle, and a series of experiments have taken place with this object in view. The result is giving great satisfaction. The department have not only succeeded in producing a thoroughly satisfactory repeater model, but the difficulties from the small calibre have been satisfactorily overcome, and an 8-millimetre cartridge, has been adopted. By coating the leaden ball with copper, and by pressing the powder in the cartridge a velocity of 150ft. above that mentioned by the Austrian Minister of War has been obtained. There is no depositing of lead in the barrel, and the wear and tear from a bullet coated with copper is of course very small. The accuracy of the shooting continues unaltered without cleaning the barrel—even when as many as 50 to 100 shots have been fired. The accuracy of the fire is proved by the fact of more than half of the shots at a distance of 1,200ft. being covered by a belt about 6in. broad, and the distance between the highest and the lowest hit being only about 8in. as far as half the shots were concerned. At a distance of 3,200ft. this figures were only increased to 2¾ft. and 2⅝ft. respectively.—*Engineering.*

Coal in the Southern States.—Coal covers an area of 5,000 square miles in Tennessee, with from one to three workable seams, the best coking seam being the Sewanee, which is 500 square miles in extent. In Alabama it covers an area of 6,000 square miles, embracing the Warrior, Cahawba, and Coosa fields, with three or four workable seams each from 4ft. to 7ft. in thickness, and mostly coking coal. Of these the Pratt seam has hitherto furnished by far the greatest amount of coal; but the good coking qualities of the other veins have been proved. The production of the Pratt mine is now 2,500 tons per day, and that of the Sewanee mine 1,500 tons per day.

THE rage for high towers has now taken effect in Belgium, and a design for a wood tower of Flamboyant type, and 300 mètres in height, has been made by MM. F. Hennebeque and E. Néve, and proposed for erection in connection with the Brussels Exhibition of next year.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.***

[61059.]—**Photography (U.Q.)**—The angle covered by the Dallmeyer R R is about 60°. The "Rectigraph" I have no knowledge of; but no doubt it is on the usual rectilinear or symmetrical lines, and most probably useful. The process recommended by Schnauss is something like the patent (lapsed) process of Kennett, and by it excellent results no doubt can be obtained, as with the old Kennett pellicle perfect plates could be produced with the very slightest effort.—G. J.

[61124.]—**Analysis of Lime (U.Q.)**—The details of the process mentioned by Lunge are not given in the query, and I have not the pocketbook to refer to. I presume that the lime is to be suspended in water and then titrated; if so there is little reason to wonder at the reappearance of the pink colour of the phenol-phthalein, simply because the lime not being nearly all in solution, but mostly in suspension, the acid does not act on its particles instantaneously, the more so because of the insolubility of the calcium oxalate which is produced, and which therefore forms a protective coating round them. Thus the indicator may show that the acid has been added in excess, when as a matter of fact there is still plenty of free lime; this coming slowly in contact with the acid neutralises it and reverses the colour of the indicator. Moreover, the process depends on the indicator used (either litmus or phenol-phthalein) being *quantitatively* sensitive to CO_2. Litmus is certainly not so, nor, I think, is phenol-phthalein—not quantitatively, that is. If my supposition that the method is as I have stated be correct, it is quite untrustworthy. The best way to determine the amount of free and carbonated lime in a commercial specimen would probably be as follows:—A known weight is dissolved in a known quantity of saturated HCl or HNO_3, which is in excess of that necessary for neutralising the whole of the lime, and the excess of acid determined by titrating back with standard alkali, either carbonated or caustic, using methyl orange as an indicator. This gives the total lime, caustic and carbonated. Another portion has its CO_2 estimated by means of the calcimeter, thereby providing the rest of the data requisite.—BERTRAM BLOUNT.

[61236.]—**Colliery Winding Engines.**—In reply to this query, it is impossible to give the desired information without some further particulars. Owing to the peculiar circumstances under which colliery winding engines have to work, the use of steam will not be so economical as in an ordinary stationary engine; but, generally, I find the point at which steam in winding engines is cut off is about two-thirds of the stroke.—G. WORLANDS.

[61131.]—**Electric Cautery — Bottone's Ammeter.**—The instrument forwarded to me by Mr. Bottone is, according to the letter which accompanied it, the "very one" tested by Mr. Conry, and reported upon by him in your issue of the 11th inst., and one which is so highly valued by Mr. B. that he uses it "as a test instrument wherewith to calibrate others." In the original query (Dec. 10) I asked for the means of measuring with scientific accuracy—not roughly—the current employed to heat my cautery. I append the results of a careful testing of the above instrument, leaving your electrical readers to judge whether the requirements of my query are met by this instrument or not:—

MR. BOTTONE'S 5S. AMMETER.

The readings on the instrument, 90 from zero to 5 on each side.

Value on Right.	Figures on the Instrument.	Value on Left.
8·00	5	6 88
6·3	4	
4·5	3	
3·1	2	2·82
1·482	1	

Resistance marked in pencil on bottom of instrument .... = 0·00034
Resistance determined .... = 0·0063

—A. DUNLOP STEWART, M.B.

[61131.]—**Electric Cautery.**—I was rather surprised to see in issue of Feb. 11 *re* Mr. Conry's test of the Bottone ammeters that the scale is graduated to 1/10 of an ampère. I got an ammeter and voltmeter about two months ago, and there is no division under 1 ampère or 1 volt. Would Mr. Bottone kindly explain why he says they are calibrated to tenths, and yet when I buy one I find only units on the scale? Mr. Conry's test merely

seemed to show the sensitiveness of the instruments; but it does not appear if he tried whether the scale was actually right. Besides, the moment of the needle is apt to change, and this throws the graduation out. A few tests a medical electrician made with me the other day may be of service generally. Platinum wire heated in air till fully red-hot and fit for cauterising.

Dia. in mm.	·42	·63	·53	·73	·44	·49	·74
Current in ampères	7	22	12	20	7·5	10	22

There is something peculiar about the ·63 wire; the current registered is abnormally large. I think it was impure—at any rate, it took 22 ampères to heat it red-hot. I may be allowed to point out that a formula into which resistance of cautery enters is of no use, as for every temperature R varies, and also the radiation of heat is different in air, and in a tumour, &c., to be operated on. It would be interesting if Dr. A. D. Stewart would tell us if he has found his way out of the difficulty, and what means he now uses to work his cautery. —IOTA.

[61250.]—**Telescope O.G., &c. (U.Q.)**—The lenses, if placed 4in. apart, would make a doublet of 26in. focus, the rule being to multiply the focal length of one lens by that of the other, and divide by the sum of their focal lengths, less the distance in inches apart, thus: $\frac{62 \times 42}{104 - 4} = \frac{2604}{100}$ = say 26. It is probable that there would be considerable difference between the visual and chemical foci, which could be determined by experiment; but altogether I think you would get better photographs by using a Lancaster single lens, having regard to the great focal length of the combination, as it would necessitate a camera about 3ft. pull of bellows.—G. J.

[61291.]—**Ageing Wood Carvings.**—I had hoped our mutual friend, Mr. S. Bottone, would have picked this up; but, as he has not, I am afraid I cannot be of much assistance to you. It was not mentioned at time query was asked what wood was used. As it now appears cypress wood was selected, it is questionable if any amount of fuming will give a really satisfactory result on account of the small amount of tannin it contains. When it is desired to produce any fumed work, it is necessary to be careful in the selection of the wood, which is nearly always oak or mahogany (the former preferred). There is even a great difference in samples of these woods, some assuming the desired shade after about two hours' exposure in the fuming-box, while others require two or three days, or even a week. Very often, when satinwood is to be used, and there is plenty of time, the wood is "got out" for the job—"jacked" over, and stood in a loft immediately over a stable to dry, remaining there sometimes for months. The ammonia rising from beneath causes the wood to assume a lovely rich colour. I have made many inquiries from experienced men, and have been unable to learn any dodge likely to be of service to you, and would, therefore, suggest you expose your tracery-work in a closely-confined metal box to the strong fumes of ammonia for, say, a fortnight, or as much more as convenient. This is all, I think, you can do other than staining, which you say is objectionable in your particular case.—S. BRETTON.

[61300.] — **Saccharine.** — I am obliged to "F. I. C.," p. 525. I have since had a chat with a medical man, and he (and others) have explained that the action of taste by the tongue is due to some nerves not in the posterior third thereof. The posterior third of the tongue is not affected by sweet or bitter, so the doctor says. Now that I know more of the action of tasting (what I do know, however, is little enough), I am not so much surprised at a substance which passes inertly (unchanged) through the system, yet causing the sweet taste. Perhaps "F. I. C." will expand.—R. S. T.

[61347.]—**N. E. Locos. (U.Q.)**—As this query has remained unanswered, I send the following particulars of Mr. Worsdell's compound goods engine:—H.p. cylinder, 18in. diam. by 24in. stroke; l.p. cylinder, 26in. diam. by 24in. stroke; diameter of wheels, 5ft. 1¼in.; wheel base, leading to driving, 8ft.; driving to trailing, 8ft. 6in.; total, 16ft. 6in. Boiler contains 203 tubes; length, 10ft. 11½in.; outside diameter, 1¾in. Heating surface: tubes, 1026·12sq.ft.; firebox, 110sq.ft.; total, 1136·12sq.ft. Grate area, 17·23sq.ft. Working pressure, 160lb. Weight in working order: on leading wheels, 14tons 3cwt. 2qr.; on driving wheels, 15tons 10cwt.; on trailing wheels, 12tons 3cwt.; total, 41tons 16cwt. 2qr. The valve gear is Joy's.—EAST ANGLIAN.

[61377.]—**Arc Lamp.**—The wires in main and shunt coils vary even in lamps of the same make; had you described the make of your lamp, you might have received more assistance. As a rule, the current in main increases as the carbons approach, and this increase should stop the approach of the carbons, at the same time the current in shunt should decrease, and so allow brake to go on and stop feed, or if a solenoid lamp the weak shunt is overpowered, and the main pulls the carbons apart. The R. of main should not exceed ·02 ohm, and the wire may be of any diameter—not less than ·120in. for a lamp carrying 15 ampères. The series coil should have a resistance not less than 200 ohms, the wire about ·013in., and this may be of either German silver or copper, according to the power required. If only to pull a brake off G.S. will do; but if a solenoid lamp, then copper will be required. When working with incandescent lamps, if the dynamo is compound wound, then your lamp will not regulate unless you include about half an ohm of resistance in series with it. This resistance may be made of iron wire ·1in. diameter, wound on iron mandrel about 1½in. diameter; this will carry the current you name without undue heating.—OHM.

[61387.]—**Ferrule Machine.**—This query is not sufficiently explicit to meet with a full answer. How are the ferrules to be made, and of what shape? One would think that the simplest way would be to cut up solid-drawn tubes into suitable lengths; but as no mention is made of brazing the pieces of hoop iron, it is possible that the ferrules are made by lapping.—E. G. M.

[61392.]—**Electric Motor.**—This querist apparently wants an electric motor to suit a flywheel he has by him. He knows, I suppose, that full directions for making motors have been given many times.—T. J.

[61401.]—**Oval Chuck.**—Should not this querist at least give a reference to the No. of the "E. M." in which he found the chuck he has made? That there is a "curious twist in the work" produced may be due to the fact that it is not properly mounted; but it is impossible to suggest what is wrong on the bare statements made by the querist. —C. L.

[61402.]—**Electric Bath.**—Is not this rather a peculiar query? Here is someone who has an order to fit an electric bath, and by his own words confesses he knows nothing about it. If he can fit an ordinary bath, that will do quite as well, and he can amuse the patient by connecting a voltaic battery to the bath, one wire to the metal and the other to dip into the water.—ANSER.

[61404.]—**Medallions.**—If the querist cannot say whether his medallions are of plaster or clay, it is only guesswork to try to help him. I am afraid there is no remedy that would not also destroy the surface. The best thing he can do is to size and paint, or cover with one of the bronzes. If of plaster, he is not likely to get them white again.—NUN. DOR.

[61415.]—**Pellet's Process.**—Would not this querist be more likely to obtain an answer to his question if he indicated where an account of Pellet's process is to be found, or at least gave an idea of the frame?—NUN. DOR.

[61426.] — **Charcoal for Small Forge.** — If "Amateur Blacksmith" means charcoal from coal, he can make it only by constructing a coke oven, or a coke mound, which consists of a central chimney around which the lumps of coal are laid with horizontal flues, the whole being covered thickly with slack. If the querist has never made any on this plan, he will find it more economical to purchase what he requires—unless he lives in some altogether inaccessible place. If he means wood-charcoal, that is comparatively easy to make by building a pile of wood and covering it with earth —the object being to char the wood throughout without admitting more air than is necessary. If he will state definitely what he wants, I will see if I can help him.—SAML. RAY.

[61430.]—**Colouring Statues.**—There is one simple way in which "E. X. P." can answer his own query and satisfy himself. Let him take a plaster cast, size carefully twice, or soak it in melted size. When dry, let him paint it with any colour he fancies, mixed with oil and turps, or with size, as he pleases. A small 3d. bust will be amply large enough to show him the effect produced by half a dozen different pigments or mixtures, and when he finds the one he likes best, he can start on the Venus.—NUN. DOR.

[61436.]—**Petroleum Tank.**—Surely it does not "smoke," but visible vapour rises from it. Perhaps the oil has still some of the lighter naphthas in it, as the fact that it throws a yellow scum (vaseline) indicates that it has not been thoroughly refined. If it is petroleum, that alone would account for it; but I have assumed that the querist really means burning oil.—NUN. DOR.

[61437.]—**Influence Machine.**—The vulcanite discs would do for the purpose; but it has been stated that glass is better for any kind of electric machine. No doubt the special discs in question would be better used in making ordinary plate machines.—J. C. R.

[61440.]—**Emery Wheel.**—The power to be obtained from a "5ft. hand-wheel" being an x quantity, it is not possible to do more than advise your correspondent to try narrow emery wheels of small diameter.—NUN. DOR.

[61442.]—**Weight of Moist Air.**—Does not the barometer (mercurial) show us that dry air is heavier than damp air? As a fact, the dry air supports the longer (higher) and heavier column of mercury—at least, is it not the fact? Also that when it rains, the air presumably then damp, or having moisture in it, supports only a shorter column of mercury. Some years ago I had the reason explained to me, but I have forgotten it: I have not time to refer to books. "Milverton" does not explain it. Will somebody do so?—R. S. T.

[61452.] — **Electrical Apparatus.** — I must gently, but firmly, protest against the assertion of Mr. W. Habgood that "secondary batteries can be charged by means of a primary battery for lighting to advantage." The cost of lighting anything beyond a single lamp or so by primary batteries is comparatively heavy, and the cost of lighting through secondaries charged by the primary is such as none but a wealthy amateur would care to incur. With an ordinary primary battery it takes about a week's charging of accumulators to get two or three hours light out of them; also the loss of solution to which he alludes as being inseparable from primaries owing to fall of E.M.F. is easily avoided by simply working the battery regularly day after day when the half-spent solution is reconverted into saturated or full-proportion solution by the addition of fresh chemicals, thus requiring one-half the expenditure that would be necessary to make full-strength solution from plain water, so that nothing need be wasted.—EDWARD CONRY.

[61452.]—**Electrical Apparatus.**—If I am not mistaken, the formula given last week is the same as one given in a pamphlet issued by some interested parties desirous of floating a battery company, and when they prove to their own satisfaction that they can supply the electricity for nothing and still make a profit, such an arrangement comes up regularly; but somehow the thing won't work. I am afraid that we have yet to obtain such lamps as mentioned—viz., giving 1c.p. for four watts, while using accumulators. My experience is that the best lamps in the market require about 3·7 watts per candle-power actual, and if we allow an efficiency of 60 per cent. (which I find is nearly correct in actual use) for accumulators, then we require over 6 watts per c.p. I may add that the lamps usually supplied as 20c.p., and taking at the best 60 watts, are really only 16c.p. While on the subject of lighting from primary batteries, I notice that in "Ours" of Feb. 11, p. 518, Hospitalier puts the cost at 2d. per 10c.p. lamp per hour. This, I believe, does not include labour.—OHM.

[61474.] — **Silver Chloride Cell.**—Jamieson says: "The internal R. of these cells increases on standing by adhesion of oxychloride of zinc on the rod. Frequent use or scraping the rod keeps the R. normal. About 15 minutes of short circuiting is required to bring the full current out of a new cell, and a few seconds that of one in use.—OHM.

[61474.] — **Silver Cell.** — TO J. PEYTON DAVIES.—Please read my reply through. If your cells are spoilt by a 20 minutes' run as you say, they must be of very faulty construction and exceedingly small. It must not be concluded that because your cells are half spoilt by 10 minutes on short circuit, that I am wrong. You had better refer to what Mr. De la Rue says about them.—C. D. R.

[61518.]—**Gas-Engines.**—To J. MC G. AND S. —I quite agree with what you say; but the thing (like the speed of dynamos), is limited by practical considerations. The heat, in my judgment, should not go over 50°. I will write more fully next week.—EDWARD CONRY.

[61519.]—**Mechanical Piano Playing.**—In No. 1,142 Sanderson offers a method for accomplishing this. May I ask him to be so kind as to fulfil his promise?—PERCY SMITH, Rugby.

[61529.]—**Mathematical: Measurement of Drums.**—My best thanks are due to Col. J. R. Campbell for his replies to this query. I should, however, very much like to have a formula in which an inch is taken as the unit of measurement, since in some cases the rope (generally steel wire rope) is of small diameter.—E. M.

[61548.]—**Shipbuilding.**—I am afraid "Video" has not given "Novice" much satisfaction in his answers to the latter's questions, which are perfectly correctly put. I understand "Novice" to ask, What is the engineer's part in getting a ship ready for launching? After the centre-line of the shafting has been fixed, the stern-post is bored to take the stern-tube by means of a portable-engine and large boring-bar supported on suitable brackets. A stage is erected round the stern of the ship for this purpose. The stern-tube itself is a massive casting bored out, "Video's" remarks notwithstanding, for a distance of 3ft. or 4ft. at

each end to take cast-brass bushes, which are usually cast with recesses, in which are put strips of lignum vitæ about 3in. broad. Brass liners are shrunk on the tail-shaft and turned to run in these bushes. These bushes are lubricated by the water which is allowed to pass in between the strips of lignum vitæ. The engineers also fit the sea-cocks and discharge and suction outlets and valves on the ship's side, some of these being below the water-line. A ship is generally launched with tail-shaft and propeller in position.—C. E. A.

[61548.] — **Shipbuilding.** — Many thanks to "Video" for the trouble he has taken in my behalf. As he shrewdly suspects, the question is verbatim from an examination paper. My own impression is that an error has arisen, and that the question should really stand "Describe method of boring out body post boss, &c." The question staggered me, because, as far as I knew, this has always been done previous to erection of stern frame; but my experience has only been with short vessels—screw tugs. "Video" says the hole is afterwards trued out to the lines of machinery, when tube is permanently fitted. Will he add further to my obligation and give *modus operandi* and description of tool used? Surely some of "ours" will give a description of launching an iron steam-ship. I don't think our Editor would think it "too technical" for the columns of a journal confessedly the organ of mechanical science; and I believe such a description would be read with interest by many who have not opportunities of visiting a shipyard.—NOVICE.

[61551.]—**Flow of Water in Pipes.**—My reply to this query has not been inserted, though sent almost a fortnight ago. I presume it did not reach you, so I repeat it. An 18in. pipe at a trifle flatter gradient than 1 in 20 would do the work of a 24in. pipe 1 in 100. The following would also give the required discharge:

A 21in. pipe	1 in	50.
„ 22in.	„	60.
„ 27in.	„	180.
„ 30in.	„	300.

—W. J. TAYLOR.

[61551.]—**Flow of Water through Pipes.**—Many thanks to "Elag" for his explanation. I now send another way of getting at the same result which may be useful to your readers.

Let G = discharge per minute,
H = head of water in feet,
L = length of pipe in yards,
D = diam. of pipe in inches,
} For larger pipe.

$$\text{Then } G = \sqrt{\frac{(3D)^5 \times H}{L}}.$$

Let G^1 = discharge from smaller pipe, and small letters to represent as above—

$$\text{Then } G^1 = \sqrt{\frac{(3\,d)^5 \times h}{l}}$$

but G must $= G^1$.

$$\therefore \sqrt{\frac{(3\,D)^5 \times H}{L}} = \sqrt{\frac{(3\,d)^5 \times n}{l}}$$

$$\sqrt{\frac{(3 \times 24)^5 \times 1}{33\frac{1}{3}}} = \sqrt{\frac{(3\,d)^5 \times 1}{6\frac{2}{3}}}$$

$$\frac{(3\,d)^5}{6\frac{2}{3}} = \frac{(3 \times 24)^5}{33\frac{1}{3}};\ d^5 \times \frac{24^5}{5}$$

$$d = \frac{24}{\sqrt[5]{5}} = 17{\cdot}39 \text{ inches},$$

which is near enough for all practical purposes to "Elag's" result of 17·35in.—ST. GEORGE.

[61554.]—**Darning Machine.**—I am afraid I cannot be of much use to "T. F. S. T." in getting one of these machines. I picked mine up quite by accident; going to an ironmonger's for some old brass, and while looking for some, I came across the machine which was in a very rusty condition, with a lot of needles broken. As I had never seen one before, I bought it and cleaned it up. Seeing the date (patented 1876) on it, I looked at my old MECHANICS of that date, and saw it was advertised by some people at Liverpool. I wrote to them for some needles, but the letter was returned, they having evidently moved. The machine is far from satisfactory, the chief difficulty being the breaking of the thread.—F. C. A.

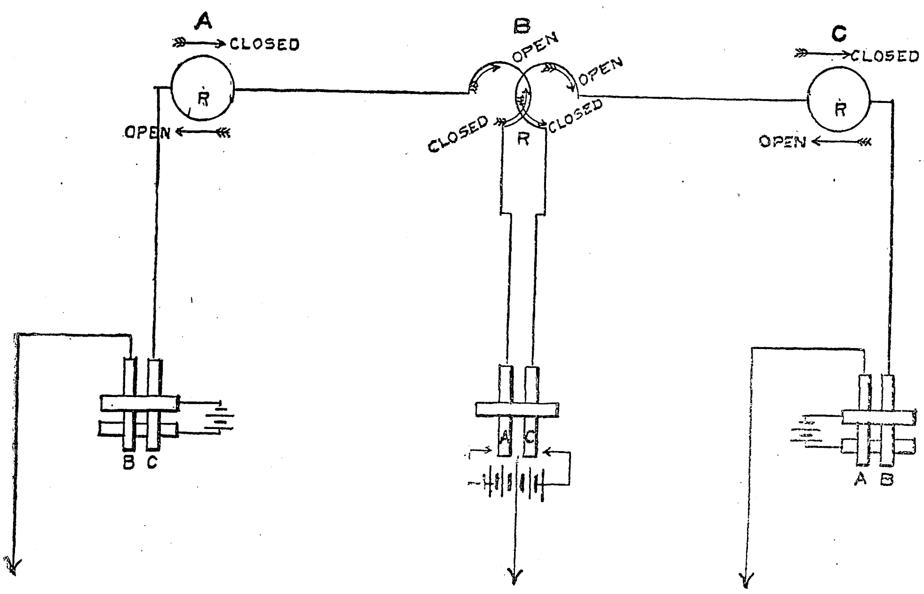
[61560.]—**Engineering.** — "J. H." does not write from the employers' point of view, but from that of a foreman who has had a good deal to do with pupils. I may say that I have had no knowledge of the "look, but don't touch" style of training," and, therefore, deem it something exceptional; but can only repeat what I have already said, that if a pupil wishes to learn he can always do so. Employers, foremen, journeymen will always, so far as my experience goes, render necessary aid to those who seek it in the proper way; otherwise how is it that in the same shops some pupils will go through their whole term and be no good at the finish, while others will be so useful in all departments in turn that their leaving will be rather a matter for regret. Those who assume social superiority, and decline to lend a hand in dirty and hard tasks, will never learn. Rough work, like all work in its earlier stages, must be monotonous at times; but we all get past "the wearisome bitterness of our learning," and, so far from being "unedifying," we regard it afterwards with triumph. Why should a pupil be exempt from a taste of that toil which the workman has to do all his life long? In old times masters could work with their men; now, alas, there is often a deep gulf of alienation between the employer and his hands which a closer intercourse in early life might do something to lessen. An old employer of mine went through his seven years of pupilage, working his ten hours a day like the men with whom he mingled. As a consequence, he, as a master, was equally at home in any department ever after, and all his men knew it, and respected him accordingly. If a pupil works hard and intelligently, without grumbling at the tasks given him, whether distasteful or not, forgets differences in social position while in the factory, makes himself popular, and keeps his eyes and mind open, there is no fear of the issue.—J. H.

[61574.]—**The Calculus.**—The difficulty found by "Another Tyro" may be explained by simple rule of three, thus: If a space expands $\triangle y$ square feet in $\frac{\triangle x}{3}$ seconds, how much will it expand in one second? By rule of three we get the following: $\frac{\triangle x}{3}$ seconds : one second : : $\triangle y$ square feet: the anwer is evidently $\frac{3\triangle y}{\triangle x}$ square feet. Of course during the infinitesimal periods of time the expansion is supposed to be uniform. While on this subject, I would like to say a word to the original "Tyro" about certain difficulties that he mentioned. I think the best way of considering a differential coefficient, at least for a beginner, is to treat the equation between x and y as that of a curve; then the differential coefficient at any point of the curve for a given value of x is the trig. tangent of the angle which the geometrical tangent line at that point makes with the axis of x; for instance, take the equation of $y = x^2$, which we have already had to do with. Now if the axis of x is horizontal, and that of y vertical, this equation will represent a parabola whose vertex is at the origin, its axis corresponding with the axis of y, and distance from vertex to focus $= \frac{1}{4}$, and hence (from conic sections) the horizontal line from the focus to the curve must be $\frac{1}{2}$; also the tangent line at this point must be 45 and the trig. tangent = 1. Now compare this with the equation $y = x^2$; from this we get $\frac{dy}{dx} = 2x$, and if we take $x = \frac{1}{2}$ to agree with the focal line in the parabola, the differential coefficient = 1, and in all cases the differential coefficient will agree with the trig. tangent; and so also for the 2nd, 3rd, &c., differential coefficients. For instance, suppose $y = x^4$, the first differential coefficient will be $4x^3$; put $z = 4x^3$, and suppose this curve to be plotted, then we may differentiate again, and say $w = 12x^2$, and so on, getting a succession of curves, and thus, I think, getting some tangible idea as to the 2nd, 3rd, &c., differential coefficients.—M.I.C.E., Bath.

[61574.]—**The Calculus.**—The fact is, the difficulty which "Tyro" imagines to exist in the meaning of successive differentiation does not really exist, at least in the manner he conceives it, and he seems only to be put astray by confused ideas on the relation between abstract and concrete quantities. It would be of advantage towards avoiding difficulty of this kind if it be borne in mind that algebraic quantities—even negative and imaginary ones—always represent numbers. This generally-received view has, indeed, been combated by at least one very distinguished mathematician, Dr. G. Peacock (obiit, Nov. 1858), who, in his "Algebra," and also in a lengthened and celebrated article on "Analysis" in the British Association Report for 1833, has maintained that there are two distinct sciences of algebra—arithmetical algebra and symbolical algebra—but his contentions do not apply to such a consideration of abstract and concrete magnitudes as has confounded "Tyro's" reasoning powers. A person may have any degree of difficulty in understanding the meaning of differentiation of functions; but once he does understand it, he must at the same time understand the meaning of successive differentiation, since the meaning is the same in both cases. A little consideration ought to make "Tyro" perceive that whatever difficulty of reasoning can exist in a second or third differentiation the same must also exist in a first differentiation; because when we differentiate a function we may consider it as really successive differentiation with regard to the function which is the integral of the one we differentiate. He declares that though he can understand differentiating a function in the first instance, still he cannot understand differentiating its differential co-efficient, because it has been obtained as a ratio. And would he mean to assume that the function which he first differentiates may not itself be conceived as a ratio? If he tries by inquiry to warrant such an assumption, he will no doubt find greater difficulty in his way than what he seeks to have explained for him. All magnitudes can only be relative, and any analytical function would be a real abstraction if considered without reference to some supposed though arbitrary unit of measurement to serve as a common standard of proportion. Moreover, any function may be expressed as a ratio by putting it in a fractional (*i.e.*, proportional) form, with itself for the numerator and unity for the denominator. The differentiation, too, of such functions as sin. x or tan. x is the differentiation of a ratio—the ratio which these lines bear to the radius. Taking his own example, the function mx^2, we may consider the finding of the first differential coefficient $2mx$ to be successive differentiation with reference to the function $\frac{1}{3}mx^3$, which is the integral of mx^2. With regard to any difficulty in the meaning of differentiating $2mx$ from the fact that it has been obtained as a limiting ratio, that fact has nothing whatever to do with the matter, and may be left out of consideration altogether. When we proceed to differentiate it there will be no longer any necessity to consider it as a ratio. Before differentiating a function, then, it is not of any consequence in what manner we may have derived it; if it were so, it would be necessary to consider not only derivation by means of differentiation, but also by all other possible means—as $2mx$ might be derived from $4m^2x^2$ by the extraction of the square root, and there could be no more reason for any difficulty in differentiating it as a ratio than as a square root. To illustrate a second differential coefficient geometrically, let us conceive $y = f(x)$ as the equation to any plane curve; then we know that the integral of this expresses the magnitude of the area, that itself expresses the length of the ordinate, and that its differential coefficient expresses the trigonometrical tangent under the tangent to the curve, and this trigonometrical tangent gives us thus a geometrical representation of the second differential coefficient of the area of the curve. I should think, however, that the most satisfactory solution of his difficulty on successive differentiation by the theory of limits would be to compare that method with the method of derived functions of Lagrange, which excludes all ideas of ratios and infinitesimals, and therefore excludes all difficulty in the meaning of differential coefficients of any order. As Hall says, the idea of a series gives to the differential calculus "a clearness and precision of which it stands much in need." It would always be of advantage not to confine our ideas to one method only; but to understand at least the fundamental principles of two or more methods, and to make use of whichever is best adapted in each case. Lagrange's method is to be preferred for the definitions and meaning of the science, while in practical application the method of limits or of elements is much plainer to the perception. It is quite evident, too, that the differential coefficient is the same quantity in all methods. The development $f(x + h)$, according to Taylor's theorem, is of the utmost importance in its applications, and we might consider the meaning of successive differentiation by the method of limits to be merely a means of finding the successive coefficients of the powers of the increment h in that important development. We know by Taylor's theorem that each successive coefficient of the powers of h can be derived from the preceding one by a single differentiation, and therefore we could perform those differentiations by the methods of limits, considering each of them as only a first differentiation, and thus avoiding "Tyro's" difficulty in regard to this matter. In such a manner the operation involving the difficulty in question might be considered as a means to the end.—VLADIMIR.

[61575.]—**Indicator Diagram.**—In your table of quantities you omit to give the temperature of the hot well (as in your original query), and I suppose the injection in the table is gallons per minute. If this is so it disagrees with your first statement that the quantity as well as the temperature of injection remain the same. I make the feed per I.H.P 23·37, and 28lb. of water per hour respectively, and the injection water 22·6 and 22·8 times the feed respectively, or practically in the same proportion, and temperature of hot well should be about the same in both cases. As regards the increased feed, and consequently fuel per I.H.P., I think there is nothing to add to my former reply, as the expansion is high for such low-pressure steam. How do you find ratio of expansion? Is it a variable expansion valve, and the grades you give are those marked on the stem? I think the actual expansions are higher than your table shows.—T. C., Bristol.

[61581.] — **Telephone Switch.** — I have designed the above circuit arrangements, thinking that they may perhaps suit "Enswitched." Station B can communicate with either of the terminal stations, and vice versâ, while the terminal stations



can communicate, but without the invention of B's operator. R and R, at A and C, are polarised relays, closing local bell circuits at these stations with currents passing thus ———> ; but unaffected by currents passing in the opposite direction. R at B is a similar relay, having two coils wound in the same direction, but so connected up that currents which by their direction affect the relays at A and C, leave that at B unaffected, and contrarily those affecting B leave relays at A and C unaffected. A and C are furnished with reversing keys which are lettered in the diagram according to the station with which they are designed to communicate. Normally each pair rests against the top plate or bridge. The keys at B are rather different in detail, being arranged to make, when depressed, contact with the opposite poles of a battery which is divided and put to earth. Normally they, too, rest against the bridge piece, and are thereby connected when at rest. I have, for the sake of simplicity, omitted the local bell circuits, as also the usual switch actuated by the weight of the receiver; but if the insertion of these proved to be any difficulty with "Enswitched," I would prepare a diagram of the whole. It would be necessary to arrange that A B and C should give distinguishing rings when calling, that the receiving station might know who is calling, and depress the proper key in reply. Conversation over any part of the circuit would be liable to interruption by the third station breaking in, but unless the circuit were a very busy one, I do not imagine this would prove a serious difficulty.—C. P. BARTHOLOMEW.

[61577.] — **Meridian Instrument.** — Many thanks to "J. K. P." Dent has discontinued the manufacture of dipleidoscopes, and the book is out of print. I wrote there some time ago. Would "J. K. P." kindly say how the moment of transit is known from the reflected images on the mirrors; is it by contact? If "J. K. P." would allow me, I should like to drop him a line.—HERMES.

[61589.] — **Coal Economy.**—There is one assertion in the remarks of "Sugar Cane," on p. 543, which is worth further comment. He says that this matter (presumably coal economy) is of "very little interest to your readers." As a matter of fact, it is of interest to everybody, for cheap coal is a necessity of our existence as a manufacturing nation. By "cheap coal," it should be observed, is not meant low-priced coal, but that the coal-bill, when compared with any given quantity of work done, is small—much smaller than 900 tons for refining 1,800 tons of sugar. A tax on a necessity of industrial existence is barbarous, whether it takes the form of a "royalty" paid to the landholders or of a "due" paid to a town's exchequer; but that is beyond the humbug now being reiterated about "hampered industries," when those very "industries" employ steam-engines which use double the coal that need be expended, and take long lengths of steam-pipes through the air without coating them with a "non-conductor." Some of us may live to see the time when engines will give an indicated horse-power for 1lb. of coal; but whether that may be so or not, it is well known that coal is wasted nowadays to an enormous extent. "Sugar-Cane's" remarks on p. 549 are all cane and no sugar—not a word of information; and as to his assertion that my answer (?) to his inquiry (?) is exactly what he expected, I would point out to him that (on p. 529) I expressly drew attention to the fact that, in his imaginary "inquiry," there was "not even a question on a matter of fact." Perhaps he will say what he did mean by the statement (p. 508) "I do know that, in a refinery working about 400 tons weekly, it is nearly 130 horse." Such a statement is neither one thing nor the other, and would be made only by someone who "knows nothing whatever about the matter"—to quote "Sugar-Cane."—NUN. DOR.

[61604.] — **Chemical Equivalents.** — "The Alkali Makers' Pocket-Book," by Lunge and Hunter (Geo. Bell and Sons, London), would probably suit "Vulcanite." It contains a table of "Symbols, Molecular and Equivalent Weights, Percentage Composition of (158) Chemical Compounds important to the Alkali Industry."—CHROMIO.

[61634.]—**Will o' the Wisp.**—I think Will o' the Wisp is still seen in the New Forest. What is the cause of the electric sparks over the bridge at Teignmouth, Devon?—E. R. D.

[61637.]—**Dewing of Object-Glass.**—"H. A." asks about the dewing of his telescope. I have had a Romsey Observatory for about ten years. My practice is to cover the object-glass (not dew-cap) with a stout brass cap, then the dew-cap is put on over this, and its end left open. Inside the brass cap I keep a circular piece of card with cotton wool stitched upon it. I fancy this helps to absorb moisture, but I rely more on carefully covering the glass as soon as work is done, and never leaving it open without the dew-cap, even for a moment. I have very rarely found it dewed, even with constant work in indifferent weather. The dew-cap should be long. Mine is 20in. for a 4in. glass, and is not at all too long. The second point "H. A." mentions—that the ironwork and circles become covered with moisture I also find. It usually takes place when we have a low temperature or frost at night, and thaw or warm sun by day. It used to cause me a great deal of trouble, and I tried various methods to prevent it, but without success. Gradually, I found that it did but little harm, especially if I rubbed down all the brasswork now and then. I painted some bright steel parts black, such as the end beyond the counterpoise, and for the brass circles I made chamois leather covers, which I keep on them when not in use. I always wipe them with a soft leather before putting up.—M. A.

[61640.]—**Battery.**—To MR. CONRY.—For that battery your carbons should be nearly as large as your zincs, and you can reckon about one ampère for every 11sq.in. of acting carbon surface. With four carbons, say, 6in. by 9in., both sides acting, you should be able to get in practice about 30 to 35 ampères; which would require No. 10 leads for distances up to each way; but No. 8, if you have it, will be better still.—EDWARD CONRY.

[61643.]—**Boiler.**—Steam at 45lb. pressure has a temperature of 291° F.; at a pressure of 65lb. it would have a temperature of about 312° F. A jet of steam, having a temperature of 312° F., would raise a given volume of cold water to the boiling point in less time than a jet having a lower temperature. The time required by either jet will depend on the volume of water to be heated and its initial temperature. — HARRY CARTER DRAPER.

[61647.] — **American Organ.** — Would Mr. Fryer oblige by giving a sketch of the bellows for an American organ, the size he recommends in his letter on p. 550? What is meant by the reservoir board being allowed to open 7in.? I am about making an American organ, but am puzzled to know how the bellows is worked, as the air has to be drawn through, not blown, as in the harmonium. —A. C. W.

[61647.]—**American Organ.**—Perhaps it will be of some benefit to "J. S.," and also to other readers, if I give a brief description of the arrangement now of some of the cavity boards now in general use. I agree with our friend "Organon" (p. 550), as to the peculiarity of the board described by "J. S." If "J. S." wants his board arranged as he describes he will have to order it specially. A cavity board containing two full rows of reeds is usually arranged for the 8ft. row to draw towards the back of the instrument, and the other (usually 4ft.) draws out towards the front. In a 2½ row board, the half-set of reeds draws towards the front, and is usually placed immediately above the treble portion of the front 4ft. set of reeds. A 3-row cavity board is often arranged as follows:—Back row, 8ft.; two front rows, consisting of a complete row of 4ft. (bottom row); a 2½ octave treble set of 8ft., and the remainder of the row a 4ft. bass. There is in this arrangement one 8ft. and two 4ft. basses, two 8ft. trebles to form the celeste, and and also a 4ft. treble set. There is not often more than three complete rows of reeds under the control of a single row of pallets. The above remarks apply to the cavity boards of F scale. I will here explain some of the arrangements usually found in cavity boards of C scale. A 2-row, C scale, cavity board is arranged the same as one of F scale, that is, it contains a back row of 8ft. and a front row of 4ft. pitch. A 2½ row cavity board contains an extra half set of 8ft. treble reeds placed over the treble portion of the 4ft. row. A very useful arrangement of a 3-row C scale is that which contains one row 16ft., one row 8ft., and the other row 4ft. The two former rows are placed at the back, the 16ft. row being situated immediately over the 8ft. bottom row. This arrangement, with the addition of bass and treble couplers, makes a fine instrument, quite powerful enough and of sufficient variety of tone for any moderate size room. Additional solo sets can be added by fixing on to the mortise board what are called detached tube boards, which consist only of the tubes and reeds. A series of holes, according to the number and pitch of the reeds of the solo sets, are cut in the mortise board. Over these holes the detached tube boards must be firmly cemented or glued. This arrangement requires an extra set of pallets, actuated by the main pallets, and so arranged that each set of pallets open exactly at the same time. To those who wish also to have an octave of 16ft. reeds in the bass, and who do not like the trouble of fixing the ordinary sub-bass, I may here inform them that cavity boards are now to be obtained which contain a manual sub-bass so arranged on the tube board that it is under control of the same pallets as that of the other sets of reeds; but it is not quite so powerful as the ordinary sub-bass.—G. FRYER.

[61649.]—**Defective Accumulator.**—You have got all your cells short-circuited somehow, except the one that gave off gas. Take them to pieces, and instead of the felt arrangement separate them carefully with perpendicular strips of glass, which you can get or make almost for nothing, or loop, thick indiarubber bands round them, and start again, keeping current on for about an hour and a half each time before reversing, and discharge between each reversal. The alcohol does help a little.—EDWARD CONRY.

[61649.] — **Defective Accumulator.** — Felt only adds to the resistance of the cells, and had better be discarded. I presume the sheet lead is not very thick, or you could not have rolled it. The easiest way to form a Planté secondary cell is to cut sheet lead about ⅛in. thick into plates of convenient size, depending, of course, upon the purpose they are intended for. They should then be arranged in pairs in suitable vessels and charged with a diluted solution of sulphuric acid, 1 in 10 of water. A current of at least two ampères must now be put through each pair of plates from a dynamo. On the circuit being completed, gas will be evolved from the cells, and continue to be evolved the whole of the time current is being passed through. After the charge has been continued for some twenty minutes, the current should be switched off and the cells examined. It will be seen that the plates have now changed in appearance. The ones connected to the positive pole of the dynamo have become covered with a brown coating; this is peroxide of lead, and the other with a greyish colour, this is a spongy lead. The cells should now be discharged through a high resistance slowly; when discharge has taken place the cells should be reversed and connected to the dynamo in the opposite direction. What was previously the positive plate must now be connected to the negative terminal of the dynamo, and another charge passed in. Precisely the same effect is now produced upon the lead plates as before, only that their positions are changed, and the peroxidised one is now being converted into spongy lead, and vice versâ. The same process of charge and discharge must be gone through until the whole of the lead in all the plates is converted into a spongy condition. This change is the work of some time

—weeks, in fact. The charge should be continually increased by degrees at each operation. After a week from commencing formation the cells should be allowed intervals of rest, and stand with the charge in them. As formation goes on it will be manifest by the increased charge the cells will take and give out. The manufacture of secondary batteries is a costly and tedious one. When the cells are approaching completion torrents of gas will be given off as the cells become fully charged. When this is unduly prolonged the liquid begins to heat. They should never be allowed to get more than warm. It must be distinctly understood that the dynamo must have an E.M.F. at least 25 per cent. higher than the cells being formed.—C. D. R.

[61651.]—**Induction Coil.**—On p. 550 two correspondents state that if the secondary is broken no spark can be obtained at the terminals. Will not the current spark across a small internal break, causing merely a reduction of length in the outside spark at terminals? If the original querist does not possess a galvanoscope the tongue makes a very fair substitute, and has the honour of having been commonly used for the purpose by the great pioneers of electrical discovery. A friend of mine, who made a 6in. spark coil, never had a galvanometer, and says his tongue tells him as much as my whole collection of apparatus. With practice one might, perhaps, estimate the strength of a current from terminals placed near each other on the tongue as easily as a postman tests the weight of a letter by sense of touch. There is a tendency in these days to drift too much into a love of "brass and glass."—J. BROWN, Belfast.

[61652.]—**Screw-cutting.**—Exact Whitworth threads cannot be cut with single-point tools, because with a point tool the groove only is shaped. The ridge of a Whitworth thread requires to be rounded, and this can only be done with a comb screw-tool, though it need not have more than one tooth and a half. When you wrote "chaser," I assume you meant an ordinary comb tool. Messrs. Lockwood publish a little book on screw-cutting (price 1s., post-free) which tells all about Whitworth's and other threads, and from that you will see how the exact shape is obtained for making screw tools so that nut and bolt fit.—GOOLWA.

[61653.]—**Colliery Superstitions.**— Colliers are not quite so superstitious as the question would lead many to believe; but when they show any tendency in that direction it is generally to favour themseves in some fancied way or other. They are governed more by custom than anything else; but space will not allow of anything like a full description of their customs and practices to be given. Many miners think that more falls of roof take place about midnight than at any other time; but this is probably due to the workings being quieter, and falls of roof, warnings, movements of the roof, &c., being in consequence more easily noticed. I have come across even colliery managers who thought falls of roof were more liable to take place at midnight than at any other time; but they could not give anything like a satisfactory explanation. The account given, however, of miners generally gathering at the shaft-bottom at midnight to be out of danger, is an exaggeration.—G. WORLANDS.

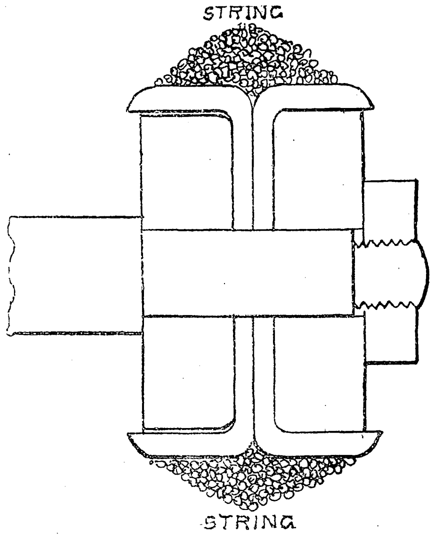
[61658.]—**Dyeing Canoe Sails.**—This querist can dye his canoe sails a golden brown by using Bismark brown. Dissolve 3oz. in 40 gallons warm water. Enter the work, and keep moving till the colour is satisfactory, then dry them, or he may dye them buff by using 2lb. nitrate of iron in 40 gallons of water. Leave them in 12 hours; get them up, pass them through a warm soda water to develop the colour. This is a fast colour.—DYER.

[61660.] — **Picking Lever Locks.** — If "J. W. R." will read "Price on Fire and Thief-Proof Depositories and Locks and Keys," published by Simpkin, Marshall, and Co., London, 1856, he will learn a good deal about the picking of locks without serving an apprenticeship to Mr. William Sykes.—D. H.

[61660.]—**Picking Lever Locks.**—I think "J. W. R." will find this rather a difficult job unless he is a good locksmith. The picks I generally use are made on the same principle as the lever key, and I have always found them successful. Of course there are several other ways; but their shapes would be rather awkward to describe on paper.—PICKLOCK.

[61664.]—**Partial Silvering.**—Hot paraffin wax would be one of the best substances, but in any case I fear you will scarcely get a clear impression with an indiarubber stamp. One of the best ways, if time and cost permitted, would be to paint the parts of the medal, &c., with fine oil, say, paraffin, and a camel-hair brush.—EDWARD CONRY.

[61662.] — **Pump for Compressing Air.** — Make piston of two thickish discs, with one edge of each rounded, the rounded sides to go back to back on the piston-rod; between them put two cup leathers back to back. These can be "cupped" thus: Provide two flanges of leather of sufficient size, soak them in cold water, put them (with the flesh



sides in contact) between the discs, screw them up tight, and then wind string round in between the leathers to force them apart till they are "coaxed" quite smooth on to the edges of the disc; leave till dry, pare edges true, and thin edges a little on flesh side. In working the skin-side at the edge will swell out and make a strong edge for working. See drawing.—T. F. S. T.

[61671.]—**To Mr. Conry, Mr. Bottone, &c.**—I cannot say absolutely, but should certainly think the uncovered wire would keep the cooler of the two. I should use a bit of good sponge for the drying agent of actual drops of liquid, or a mixture of equal parts of the calcic chloride and ordinary gypsum for moisture. If I have an ammeter to calibrate, I do it with a good tangent galvanometer, using the London "horizontal component of terrestrial magnetism" (what a mouthful!) for London and 12 miles round, or, indeed, for all the home counties if rigid accuracy be not required. For voltmeters (up to 20) I use a lot of little Daniell cells made up in egg-cups, with porous cells of blotting-paper, or for over 20 volts a dynamo whose E.M.F. at particular speeds I know.—EDWARD CONRY.

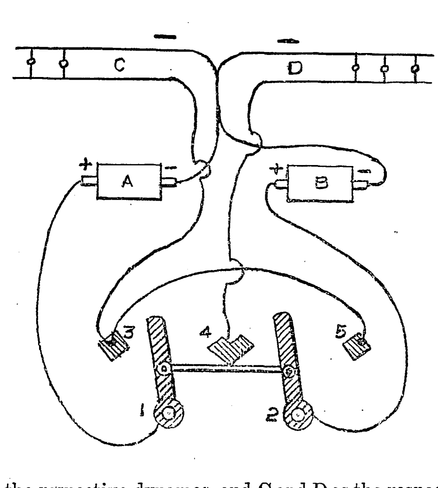
[61671.]—**To Messrs. Conry, Bottone, and "Ohm."**—Thanks for reply about drying agent. The gaslighter has improved since treated as "Ohm" described. The other two points I am not at all clear on. I have read Sprague; but can see nothing relating to matter on hand. Does a covered wire carry a larger current than an uncovered one with same heating, or why is it that an insulated conductor will carry more current than a wire uncovered and exposed to the atmosphere? What effect has insulating a wire on its carrying power? I should think that radiation would be hindered, and the safe carrying power would fall rather than rise. Also in calibrating an ammeter (having lent number containing 61131, page 352), I don't see how you know what current you have accurately. Given a mirror galvanometer of two coils, ·05w. and 2,000w. resistance, resistance-box 1—1,000w. set of secondaries, Clark cell, and variable resistance, to carry ten ampères, how could I tell when I had an ampère exactly? I tried calibration by electrolysis; but would rather do it by some quicker method. The voltmeter I would like to do separately, so that any error in calibration of the ammeter might not influence the other. What is best resistance for voltmeter for E.M.F.'s, as stated?—ATOI.

[61676.]—**Pitch Striker.**—The tool illustrated in Greenwood's book is not worth the trouble of making; but a few explanations will render its "make and action" understandable to "Young Turner." Referring to the illustration shown in Greenwood's book (p. 89, ninth edition), it appears to be drawn just half-size; but, owing to several parts being shown incorrectly, it is very difficult to understand. The section shows a bar about $\frac{3}{4}$in. by $\frac{5}{8}$in. and 8in. long. This bar has a $\frac{3}{8}$in. hole drilled lengthways about 6in. deep; the other end is pointed to drive into a handle. A steel rod is fitted into the $\frac{3}{8}$in. hole, and this rod has an arm moved by a tangent screw so that it (the rod) may be moved to a small extent in a rotary direction. The end of this rod is first drilled up, say, $\frac{1}{8}$in. diameter, and then filed off equally on both sides to make the end like a bradawl; but the hole in the centre leaves a notch. The steel rod is hardened and tempered, and the notched end which projects just beyond the end of the bar is the part used for striking the thread. If the rod is placed with its edge quite upright when the bar is flat on the T-rest, the two points formed by the notch would trace a concentric circle on a rod running between the lathe centres. By placing the edge inclined slightly from the vertical, the tool will trace a spiral, and by increasing the inclination of the tool, the pitch of the thread traced is increased. The pitch striker merely serves to mark a path for the comb chaser to follow. If this information, taken with the drawing given in Greenwood's book, does not make the "make and action" clear to the querist, I will send an illustration. The book mentioned in reply No. 61652 should be consulted by all interested in screw-cutting.—GOOLWA.

[61681.]—**Electrical Measurement.**—The ampère is the unit of current irrespective of the time for which the current lasts. The coulomb is an exact ampère per second, neither more nor less. The coulomb is very little used. The volt, ohm, ampère, and watt are the only generally used terms, except for very special purposes, such as the capacity of "condensers." The weber is merely an old-fashioned name for an ampère.—EDWARD CONRY.

[61689.]—**Heat in Dynamo.**—In my reply, p. 551, read, "When does the heat appear greatest in the coils or core?"—OHM.

[61692.]—**Electric Lighting.**—I think the following may suit you. It is a plan I have applied with success in a similar case. Taking A and B as



the respective dynamos, and C and D as the respective circuits, the wires from both circuits are united and coupled direct to the terminals of dynamo. The + terminal of dynamo A is connected to stud 1 of a two-armed switch. The + terminal of B is connected to 2. The + wire of circuit C is led to contact 3 of switch and also continued to 5. The + of circuit D is joined to contact 4. The two arms, x and z, of switch are joined by a bar K, so that when x is moved round its axis 1, z makes a corresponding movement. The switch is best made of solid brass mounts on a slate bed, with vulcanite continuity-pieces.—ARCADIAN, Failsworth.

[61700.]—**Nickel Crucibles.**—These can be bought at the laboratory furnishers for about 2s. each. They will stand fusion of silica or alkaline substances. Acids dissolve the metal. On ignition the crucibles lose weight much more rapidly than platinum does. See results of experiments by Wanklyn and other chemists in *Chemical News* for past few weeks.—CHROMIO.

[61702.]—**Turning.**—Fix the ram in the dog-chuck, and let it run in the revolving stay or thimble, and proceed.—WALLACE NEWLAND.

[61702.]—**Turning.**—What is the difficulty? You can chuck it between centres, and then surface the end to within a $\frac{1}{4}$in., which can afterwards be cleaned off with a file.—T. C., Bristol.

[61703.]—**Saw.**—Make a piece of flat iron red hot, and hold the saw on it with the teeth pointing to the sky, and cool, when the colour is a deep purplish brown.—T. C., Bristol.

[61704.]— **Cocaine.**— Probably the spray or blowing of cocaine would be preferable to injection for small teeth and stopping operations. The strength of solutions as applied to mucous membranes varies from four to ten per cent. Take care that you don't let the cocaine fall into the larynx, as Dr. Havilland Hall has recorded a case (*Lancet*, Nov. 21, 1885), where it produced severe laryngeal spasm.—B.SC., Plymouth.

[61704.]—**Cocaine.**—If "C. E. A." is a dentist in practice he must have let himself fall very much behind so as to put such a query. For hypodermic injection to produce local anæsthesia in extractions one grain is generally sufficient for one operation,

the time of taking effect, being longer or shorter according to the patient, usually from four to fifteen minutes; for an operation extending to three or four extractions $2\frac{1}{2}$ grains may be used. As regards its use in stopping teeth, a practical demonstration by a brother dentist would be of more real value than any directions, as the circumstances vary, and the treatment of one case would not do for another. The strength is still a matter of opinion, as some dentists use it full strength, and others more or less diluted. If "C. E. A." is not a competent dentist, or registered, then he will, if wise, defer experimenting on the human subject, unless he wishes for "free board and lodgings."—DENS.

[61705.]—**Faulty Micro. Prism.**—Micro. objectives require to be specially adapted for binocular work; any ordinary objective cannot be used with the binocular prism. You are using too high powers; but it can be done by a very careful manipulation of the mirror with the $\frac{1}{2}$in. Your prism, I have no doubt, is quite as good as you can make it; leave it alone, and practise with the mirror.—T. M.

[61707.]—**Centre of Pressure.**—If you can manage the calculus, "Besant's Hydro-Mechanics" will suit you; but I may at once say nothing so advanced as this is required for the advanced stage examinations, but for honours. Firstly, the centre of pressure in any plane surface in a fluid, and not horizontal, is always below its centre of gravity. Besant gives a case of a quadrant of a circle with its edge level with surface of water, and the depth of centre of pressure below surface is $\frac{3}{16}\pi r = {\cdot}59\, r$ where r is radius of circle. The centre of pressure of a semicircle will evidently be at same depth. The c.g. would be ·424 r below surface; you will therefore see by this that centre of pressure is below c.g.—T. C., Bristol.

[61707.]—**Centre of Pressure.**—It is impossible to give a formula suitable to all cases. For a semicircle we shall have to use the integral calculus. Suppose the origin at the centre, axis of x horizontal, that of y vertical, downward measurements (for depth) positive, a the radius. Now, suppose we take a horizontal strip of the surface at a depth y and of a width dy, which is supposed infinitesimal, then the area of this strip will be $2\sqrt{a^2 - y^2}\,.\,dy$, and the pressure on the strip will be that area multiplied by the depth, and by a constant P, whose value depends on the nature of the liquid and the unit of measurement; the pressure on the strip will therefore be $2\,\mathrm{P}y\sqrt{a^2-y^2}\,.\,dy$. Again, the moment of this strip round the axis of x will be the pressure on the strip multiplied by its distance from the axis of x—that is, it is to be multiplied by y, and the sum of the moments of all the strips which make up the semicircle will be—

$$2\,\mathrm{P}\int_o^a y^2\sqrt{a^2 - y^2}\,.\,dy.$$

If this is worked out, it will be found to come to $\frac{\mathrm{P}\,a^4\,\pi}{8}$. Now, the sum of the moments divided by the total pressure of fluid will give the length of the arm or distance from axis of x at which the resultant pressure is applied—that is, the centre of pressure. The total pressure is the area of the semicircle multiplied by the depth of its centre of gravity and by the constant P; the depth of the c.g. in a semicircle is $\frac{4\,a}{3\,\pi}$, and the area is $\frac{\pi a^2}{2}$ which gives a total pressure of $\frac{2\,\mathrm{P}\,a^3}{3}$. Divide the result obtained for moments by this, and we get depth of centre of pressure below surface $= \frac{3}{16}\,a\,\pi$. —M.I.C.E., Bath.

[61709.]—**Medical Electricity.**—You must get an induction coil. The resistance of the human body is too high for even 20 cells to be of any use without one; but with the coil, one cell will do.—EDWARD CONRY.

[61712.]—**Chloride of Silver Battery.**—Skrivanoff's cell is an ordinary chloride of silver excited by a solution of caustic potash. The method of construction has been given several times. Chloride of silver is fused in a porcelain dish, and poured into a mould of any convenient shape; a cylindrical one is best. Previous to pouring, a silver wire should be placed in the mould and chloride run round it. This serves for the positive pole. Two indiarubber rings should now be slipped over the round stick, and a cylinder of zinc fitted outside them. The elements must then be placed in a suitable vessel and charged with a solution of caustic potash. Very little current will be generated at first, owing to the resistance of the chloride. After the cell has been at work some little time the current rises to its normal strength. If you require the full current at once, the cell should be short-circuited until sufficient current is obtained. Chloride of silver cells are not used for house-lighting: the first cost is too great.—C. D. R.

[61714.]—**Steam Ports.**—Drill two $\frac{1}{8}$in. holes up for ports. Yes, cast brass will do for dome—turned in lathe to, say, $\frac{1}{8}$in. thick; but why have a dome at all?—T. C., Bristol.

[61716.]—**Electric Light from Batteries.**—See replies to 61452.—OHM.

[61716.]—**Electric Light.**—Batteries do not maintain light efficiently. Even if they did, the term 10c.p. is so vague that it may mean anything. You must state what the resistance of the lamps is, and also the current required. There are plenty of batteries in the market, but all fail on the score of efficiency.—C. D. R.

[61720.]—**Photo Exposures.**—The table you want is to be found in Platt's "Exposure Book" (Cartwright and Rattray, Manchester, 1s.), and is to the following effect for the example you give: Sunshine, 1; diffused light, 2; dull, 3; very dull, 4; gloomy, 5. I shall be glad to give you any help (being a fellow townsman) on your writing to 23, Hyde Park-road.—B.SC., Plymouth.

[61721.]—**Quick Writing of Notes.**—If "J. R." will get the *Journal of Science, Letters, and Art*, Vol. V., No. 1, price 6d., from Wm. Reeves, 185, Fleet-street, he will find therein a paper, by the Rev. W. J. B. Richards, D.D., on a method of using abbreviations or symbols to facilitate quick writing. Dr. Richards uses the letters of the alphabet, either singly or in combination, to represent words in common use, and the accentuation shows the parts of speech. It seems both an easy and a good method.—SM.

[61721.]—**Quick Writing of Notes.**—Many of these systems of shorthand turn out to be inconveniently longhand when put into practice. An easy way of taking short notes quickly is to ignore vowels and spell words as they are sounded. For instance, to explain what I mean, I will quote the first part of "J. R.'s" query written in the form I suggest: Sm tm snc, bt do nt knw wn, sw advt. in r's stm abrvtd lnghnd." It will be observed some vowels must be used to assist in translation, and even then some practice must be given to this style of writing, which, in my humble opinion, would be more profitably utilised by devoting one's time at once to Pitman's system of shorthand. Get a 6d. primer of this art, and I think you will see I am right.—S. BRETTON.

[61721.]—**Quick Writing of Notes.**—If "J. R." watches the advertisement columns of the London dailies he will very likely come across a notice of one of the abbreviated longhand systems: if I am not mistaken, a new one appeared the other day under the title "Swift-hand." I examined an abbreviated longhand system some years ago, and found it to consist mainly of contractions for oft-recurring words and a general omission of vowels. I don't know whether "J. R." requires information for reporting or cognate purposes; but if he does, I can inform him from my own experience (though now a shorthand writer), that reports, and very full ones, too, can be taken by one well conversant with abbreviated longhand and a rapid pen (or pencil) man. There is no greater mistake than to suppose that a good shorthand writer will necessarily make a good reporter; and conversely, an intelligent man, clever at abbreviated longhand, will take a better report than a mere stenographist without the other reporting qualifications. "J. R." will save some time if he learns thoroughly the various contractions, such as—/, the; o, of; t, that; w, with; f, for; fm, from; wh, which; wd, would; cd, could; h, have. This list (from Reed's "Reporter's Guide") can be amplified to an almost unlimited extent. By committing one contraction after another carefully to memory, by-and-by a large stock of abbreviations will be easily and pleasantly at the service of the writer. But however expert he may be in abbreviated longhand, a good memory is an indispensable adjunct to its use.—ARTHUR MEE.

[61721.]—**Quick Writing of Notes.**—A system of abbreviated longhand, by Ritchie, was extensively advertised some years ago, but it appears to have dropped out. I obtained a copy at the time, and found that the work possessed no particular merit, and was not very brief. It gave a few special contractions for very common words, and directed that only the consonants should be written in the majority of words. There is a recent system by Anderson which is very ingenious and rather elaborate. It is undoubtedly brief, but I should say there is a lot to remember, and that it would not be applicable to unfamiliar words. If you care to communicate with me I will send you further particulars of the last-named scheme and the author's address. I am afraid that unless you use a very large number of contractions you will find abbreviating longhand disappointing as regards speed, and I have found from experience that if written roughly, as is usually the case in note-taking, it is at least as difficult to read as roughly-written shorthand, if not more so. Have you tried shorthand and failed, or are you afraid to tackle it? A system I use might suit you. It is by far the best for scientific and literary purposes, as its great characteristics are legibility and freedom from ambiguity. I do not speak as a mere partisan, knowing one system only, but as one who has given much time and attention to the examination of various systems, old and new. I will not mention the author's name here, as it might provoke a shorthand discussion, which would hardly be suitable for the columns of the "E. M."; but I shall be happy to tell you more about the system and assist you by letter, gratis, if you like to attempt to learn it. It can be learned in a week, and there is little to remember. It can be scribbled at a high rate of speed without becoming illegible, and shows all the leading vowels written in with the consonants in proper order. It does not require delicate penmanship, and can be written at a useful rate with little practice.—F., 5, Hawstead Villas, Catford, London, S.E.

[61722.]—**Photography.**—It is quite possible to get an "Optimus" lens which will give the sharp definition referred to by "A Novice"; but if he has to buy it without a trial and can afford the price, he is safer to get a Ross R.S. or Dallmeyer R.R.—B.SC., Plymouth.

[61724.]—**Telephonic.**—Blake's transmitter is generally acknowledged to be the best. The patent covers such a wide area that it embraces nearly all forms of carbon transmitters. I suppose you are aware that they cannot be purchased?—C. D. R.

[61724.]—**Telephonic.**—Querist asks which is best form of transmitter? On this point there will be difference of opinion. He should try the Blake and the Gower-Bell. Both (I might say all) have been illustrated in your columns.—NUN. DOR.

[61724.]—**Telephonic.**—I think it is generally conceded that the "Blake" transmitter is the best all-round form to be used in connection with telephone, but I would warn "Zirconium" that its use is most carefully protected by patents. Its principle is very simple: A carbon button has pressing against it a platinum point, the amount of pressure being regulated at will by means of a little screw pressing against a spring carrying the said button. —S. BRETTON.

[61724.]—**Transmitter.**—A very good and cheap transmitter can be made with some pieces of arc-light carbon, after the style of the Gower-Bell transmitter, which is one of the best. If you intend making one, I shall be happy to give details of mine, which are copies of an amateur's private line set. Of course, the Blake transmitter tops the list; but there are many others very efficient, especially for short lines.—IOTA.

[61725.]—**Photographic Query.**—You don't give enough particulars; you must give ratio of aperture to stop, date and hour of exposure, if sunshine, diffused light, dull, or very dull. It looks like, though, that you have over-exposed. Try four seconds and develop with a sodic sulphite developer.—B.SC., Plymouth.

[61725.]—**Photographic Query.**—"Four stop" does not convey to one's brain the least idea of its value, and especially not knowing the rapidity, &c., of the lens. Your negatives, however, are sure to be over-exposed: they are very quick plates; 8 secs. is much too long. Try less exposure, also develop longer, with more bromide in the developer; it may be due to under-development.—R. A. R. BENNETT.

[61726.]—**Cotton-Seed Oil.**—The addition of cotton-seed oil to olive oil would undoubtedly be a fraud—as a matter of fact, it is one frequently committed—because olive oil is so much more expensive. If the querist likes cotton-seed oil, there is no reason why he should not use it. Perhaps he will say what he means by its "recognition" as a food. Surely no one wants to adulterate it.—NUN. DOR.

[61727.]—**Locos—L. and S.W., G.E., L.B. and S.C., L. and S.W.**—"Dane" was No. 147, a four-coupled engine, recently employed in goods traffic on the main line. "Castleman" was, I believe, No. 159, of the same class as 157 "Clyde," cyl. 17 by 22, coupled wheels 7ft. This class had Beattie's patent coal-burning firebox, and was built about 1859. Most of the engines are now scrapped. 470 is a four-coupled bogie express, class 470-478, drivers 6ft. 7in., weight in working order $46\frac{1}{2}$ tons. Built by Robert Stephenson and Co., 1884. Full dimensions given in "E. M.," Vol. XLI. p. 35. The 135-146, 147, and 460-469 classes have the same dimensions. 521 is a bogie tank, built by Dübs and Co., 1885, of the same class as 517 to 525, 415 to 432, 45, 47 to 57, 169-171, 173, 479 to 495. G.E.: 659 is a four-coupled radial tank, built at Stratford, 1885. Class 650-659. Weight loaded, 51 tons $18\frac{1}{4}$cwt. Full dimensions were given in *Engineering*, Vol. LIX. p. 204. I have seen two other engines of this type, Nos. 673 and 676; but do not know how many similar engines there are at work. L.B. and S.C.: 34 "Balham," Brighton, 1876, and 252 "Buckhurst," Neilson and Co., 1881, both belong to the numerous class of passenger tanks designed by Mr. Stroudley in 1876, and fully

described in *Engineering*, Vol. XXI. p. 28. Weight empty, 34 tons 7cwt. 68 "Clapham" belongs to the "Terrier" class. Its date is 1874, Brighton Works. I believe that all the engines between Nos. 35 and 83 belong to this class, and that it is described in *Engineering*, Vol. XXXII.—V. J. B.

[61728.]—**Motor for Small Organ.**—In hydraulic blowers of the ordinary reciprocating type the rod does not work the main slide-valve (an arrangement that must come to a stand), but works the slide-valve or four-way of a subsidiary cylinder, which in its turn moves the main slide-valve. The main slide-valve is usually made to form its own piston. It is possible to arrange a spring action; but it would be jerky and noisy, two defects already difficult of remedy in engines of this class. I will send "Pressure" a sketch if he will send me his address.—T. CASSON, Denbigh.

[61730.]—**Conservation of Energy.**—Total heat of perfect combustion of 1lb. coal is equal to 14,500lb. of water raised one degree Fahr. or $14,500 \times 772 = 11,194,000$lb. raised one foot high. A first-class engine uses, say, 2lb. of coal per I.H.P. per hour = 22,388,000 foot-pound units, and does $33,000 \times 60 = 1,980,000$ foot-pounds of work = $1,980,000 \div 22,388,000 = \cdot 09$, or, say, $\frac{1}{11}$ the theoretical energy of the fuel. Part of the heat goes up the chimney, however.—T. C., Bristol.

[61732.]—**Models of Buildings.**—If I wanted to do this myself, I should try a mixture of French chalk and gold size, which would set quite hard, but would stay soft long enough to be marked if mixed to the right consistency. Portland cement might also do. Either could be coloured so as to imitate old stone.—R. A. R. BENNETT.

[61735.]—**Screw-Cutting.**—Having first centred and drilled the steel, get a tool the same shape as you want your buttress-thread to be, tighten in rest, and put running stay on the saddle to prevent it from springing, and proceed. Respecting what number of wheels you will require, to cut your thread: you do not state number of threads to leading screw; but assuming it to be 2, then $\frac{3}{4}$in. pitch = $1\frac{1}{3}$ thread in 1in.; $\frac{2}{1\frac{1}{3}} \times 30$ (to obtain wheels with even number of teeth); $\frac{60}{40}$ = 60 for mandrel, and 40 for leading screw, and any wheel that will gear for intermediate. As regards the round thread: the leading screw, the same as in the last question, put on the same wheels; but cut the thread as a square-threaded screw, and then put radius tools in for rounding off the tops. Grind your screwing tool slightly smaller than thread wants to be for roughing cut.—WALLACE NEWLAND.

[61737.]—**Size of Steam Boilers.**—You are asking a strange thing. The engine would want a different size boiler according to the pressure at which it was worked, the speed it was run, and the grade of expansion, all of which would have to be considered in putting in a suitable boiler.—T. C., Bristol.

[61739.]—**Sand Figures.**—First see that the plate (which should be perfectly square or round, and the edges well ground) is firmly fixed. It is a good plan to support it underneath at the centre by a fine-grained cork, with a thin disc of the same above on which the point of the clamp-screw may rest. A firm elastic support is thus obtained, without any fear of the plate being unduly strained or flying to bits when the screw is tightened up. Next see that the sand used is quite dry, free from bits, and fine enough. The surface of the plate should be quite dry, or the sand will adhere to it and be sluggish in its motions. The violin-bow should be well rosined before commencing, and the strokes should be made with a firm hand, the same pressure being maintained throughout. Practice alone will give you full command over the bow. It will be as well if the fingers of the left hand be damp, but not actually moist. Finally, it is of the utmost importance that all draughts be excluded. Having got everything in working order, we will consider the different ways in which the method can be varied. (1) The point of support of the plate. The greatest variety can be obtained from a plate fixed at the centre; but many very beautiful forms may be obtained when fixed at some eccentric point, provided it be *symmetrical.* By this I mean some point situated either on a diagonal, at a distance from the corner which is an aliquot part of the diagonal, or on a diameter at a distance from the side which is an aliquot part of the diameter. For instance, many interesting figures are got with a plate fixed at a point on the diagonal, one-fourth of the diagonal distant from the corner of the plate. (2) The point of application of the bow. This may be either at a corner, or the centre or other aliquot portion of the side. (3) The position of the nodal points. These may be at the edge, or some symmetrical point on the upper surface of the plate. Then, again, there may be only one nodal point, or there may be several; further, one nodal point may be at the edge, and another on the plate. In short, by varying the position of the three above points an endless number of different figures can be easily obtained. It is as well to go to work systematically, and not go skipping about from one to another, building up the figures as it were, by varying the position of the nodal points, and passing from the simple to the more complex forms. Thus, if a plate be fixed at the centre, and the bow be applied at the middle of the side, the sand arranges itself along the diagonals. If now the fingers be applied at equal distances on either side of the bow, the previous figure will be produced, with the addition of four semicircular arcs, and so on. I hope to hear that "S. Z." has been able to produce the 300 figures, and many more besides.—REYMOND.

[61740.]—"**Frankenstein.**"—It is now published as a sixpenny book, and may be seen at several of the shops in Holywell-street and elsewhere.—SIGMA.

[61740.]—"**Frankenstein.**"—This can be obtained in a cheap form from Messrs. Dick, publishers. I think their address is 313, Strand. It is to my mind a horrible work.—S. BRETTON.

[61740.]—"**Frankenstein,**" by Mrs. Shelley, has recently been republished by Messrs. Routledge and Sons in their "World Library." This is a series of cheap reprints of English classics; the price is threepence per volume in paper covers.—W. J. S.

[61740.]—"**Frankenstein.**"—This work is contained in one of the half-yearly volumes of the "Illustrated English Library," published by John Dicks, 313, Strand, London. As many of the novels are published separately, "Frankenstein" may be so had; but full information will be given on application at the above address.—DENS.

[61740.]—"**Frankenstein.**"—A cheap edition of Mrs. Shelley's "Frankenstein" is published by Routledge at 6d. I don't think it was written for a "wager," but there was something of that about its origin. Byron, Shelley, Mrs. Shelley, and Polidori each agreed to write a ghost story, and Mrs. Shelley was the only one who kept to the agreement; but she did not write "Frankenstein" in a few hours. I have mentioned the edition I know: doubtless there are others.—NUN. DOR.

[61741.]—**Brake Trial at Ipswich.**—This trial was made on the Hadleigh and Bentley branch with a Great Eastern engine, No. 20, and six coal waggons fitted up with the Parker-Smith brake; it is put on by a dead weight falling down, and held off by air or vacuum holding the weight up. It is illustrated in *Engineer* and *Engineering*, but it does not seem a brake likely to come into large use—the leakage round each piston and the want of power at high speed seem fatal objections.—LOCO.

[61745.]—"**Mechanics.**"—Buy up the last dozen numbers or so, and you will find all you require—the last half dozen I think has sketch. Simply a ratchet wheel and pawl connected to lever and moved by table.—T. C., Bristol.

[61746.]—"**The Last Quarrel.**"—What "Arques" wants is entitled "The First Quarrel"—Tennyson; p. 625 in my 1883 copy.—H. T. W.

[61748.]—**Electric Light.**—You could light four 20's, but it will depend upon the efficiency of the dynamo. Small machines have been described several times; you had better look up back numbers.—C. D. R.

[61748.]—**Electric Light.**—Certainly you can; and if you will say the maximum actual H.P. your engine will give, or about that, I will send you dimensions, &c., for a dynamo. The relations of nominal and actual H.P. alter much with different varieties of gas-engine, and I do not know how it stands with the "Bischopp."—EDWARD CONRY.

[61748.]—**Electric Light.**—A small dynamo to work off your gas-engine would not light much more than four 10c.p. lamps (actual); but that would be, most likely, quite as good as gas. Crofts, of Dover, supplies castings that might suit you. No. 14 Cu mains and 18 branches would be necessary. The dynamo would be about 70 per cent. efficiency, and then your leads would take a watt or two. Is the power given indicated—i.e., actual, or the nominal H.P. of the engine?—IOTA.

[61748.]—**Electric Light.**—"Selim," being a cutler, has a good reason for using the electric light; but his two-man engine will not do much, as I suppose at the utmost it will not give more than half a horse-power, if so much. Probably he wants the engine during the daytime for other work, or he might employ it in charging secondary cells, which, however, would make the light very expensive. To light a shop in such a manner as to make it worth while, he will find that an engine of at least one horse-power is requisite.—NUN. DOR.

[61748.]—**Electric Light.**—Your better plan will be to utilise your 2-man gas-engine to drive a small shunt dynamo, but specially wound to suit requirements, so as to charge during the day four small 60-ampère-hour (Woodward's spongy lead storage batteries). These plates have ample surface, and would feed six of our 8-volt 5c.p. low resistance battery lamps for general requirements; and during the evening, if you wanted additional light, you could run the engine and dynamo direct to feed another circuit of lamps installed of suitable voltage. By the above combination you could obtain fair and satisfactory results from the small power at command, and for an expenditure of, say, about £15; but if you do not mind a little extra outlay, by all means change your engine for one of 4 or 5-man power, from which you could obtain much better results, as you would be able to charge eight cells, and use our 15-volt 12c.p. standard lamps, which, when fully incandesced, would absorb 2 ampères to obtain full candle-power; and if you wind your machine to give 34 volts you can run three lamps for direct lighting coupled two in series as one lamp, and thus obtain better results from a given expenditure of energy. If you reside in or near London, and desire to inspect such an installation as the latter, you can do so; or if you insert your address, we will communicate direct upon the subject. But for the present let us advise you, if you mean to introduce electric lighting, do it well, or not at all. See our advertisement in the Sale Column for small sets of plant.—SHIPPEY BROTHERS.

[61750.]—**The Exact Time.**—Nothing can be easier than some simple form of transit instrument. It need not be expensive; if within half a minute is near enough for you.—S. BRETTON.

[61750.]—**The Exact Time.**—Why does not "Montmartre" establish a small transit instrument, and thus obtain "the exact time" by original observation? There is a form specially adapted to a window frame, where no better position can be had, though its strict adjustment is evidently more difficult. Admiral Smyth, in the Bedford Catalogue (Prolegomena), tells his readers how Mr. Troughton was able to use a transit even in Fleet-street, taking the instant of passage when a star vibrated (thanks to passing vehicles) equally on each side of a wire, and how he jocularly insisted that such conditions were preferable to perfect steadiness.—ANTARES.

[61751.]—**The Exact Time.**—Do not all signal-boxes and railway signals receive a time signal once a day? The Midland, I believe, get it at 10 a.m. Surely there can be no difficulty about the matter, as nearly all railways accept Greenwich mean.—C. D. R.

[61751.]—**Exact Measures.**—To begin with, tape measures in any form are not considered accurate. A really reliable standard for any amateur is a machine-divided engineers' steel flat foot-rule, procurable at most mathematical instrument makers for a shilling or eighteenpence. Mine is marked "Chesterman, Sheffield." London makers use the standards in Guildhall.—S. BRETTON.

[61752.]—**Dirty Ceiling.**—Make up some coloured distemper for the mouldings and centre rose, and paper the remainder of ceiling with one of the many excellent designs now produced for this purpose.—S. BRETTON.

[61757.]—**Legal**—"**Back Letters.**"—Your "back letter" is of no use; you actually got cash for the amount in the bill, and even in the hands of your brother it would be good against you. A "B. L." is given and is of limited benefit under the following circumstances:—Supposing you had granted the bill referred to for your brother's accommodation, and had received no value for it, and he gave you a "B.L." narrating these circumstances, you could produce this letter if he (the drawer) took proceedings or diligence on it. If the bill, however, got into the hands of a third party you would have to pay it, but would be entitled to relief from your brother. What you have to do is to get back the bill from him and give up his letter: otherwise he can come down on you at any time.—B.SC., Plymouth.

[61759.]—**Oxygen Gas (Liquefaction of).**—This gas cannot be liquefied by any pressure at ordinary temperatures. There is for each gas a certain temperature, above which it remains unchanged in appearance at any known pressure, but below which a certain pressure will cause a part or all of it to become liquid. This was called by our famous townsman the late Dr. Andrews its "critical temperature." Although the simple apparatus with which Andrews carried out his beautiful and accurate research was not capable of liquefying what were then called the permanent gases, he considered that the critical temperature of oxygen was probably below 110° C. In 1877 the liquefaction of oxygen was accomplished by Cailletet, of Paris, and about the same time, in a more perfect way, by Pictet, at Geneva, using a powerful apparatus, in which the gas, inclosed in a long glass tube, was subjected to a pressure of 320 atmospheres and a temperature of 140° C. An account of the apparatus appeared in these pages soon afterwards.—J. BROWN, Belfast.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "G. J." has replied to 61059, 61250; "Bertram Blount," 61124; "East Anglian," 61347.

61174. Cane-Splitting Machine, p 355.
61184. Sheep Dip, 355.
61199. Fan, 355.
61201. Range Boiler, 355.
61210. Mean Pressure, 356.
61220. Boxwood, 356.
61221. Cutters, 356.
61229. To Mr. Striffler, 356.

61385. Shunt Dynamos. To Mr. Eaves, p. 441.
61413. Irish Locos., 442.
61417. Midland Engines, 442.
61422, To Mr. C. E. Stretton, 442.
61427. Energy in Coal-Gas, 442.
61429. Calculation of Chemical Analyses, 442.

QUERIES.

[61763.]—**Bellows.**—I have a pair of pear-shaped bellows, which has a few small holes in. I want to repair the same, but I cannot get my hand in the trap underneath to do blind stabbing. Which is the best and most perfect way of repairing the same?—A SUBSCRIBER.

[61764.] — **Hydraulic Bending.** — Will any of "ours" kindly give formula of hydraulic pressure required for bending cold steel plates? For example, say Siemens steel plate, ⅜in. thick, 2ft. 6in. wide, to be bent to a right angle, with inside radius of curve 2½in.—H. S. P.

[61765.]—**Staining or Dyeing India Matting.**—I want the best and easiest means of dyeing, staining, or colour-varnishing pieces of India matting about a yard square. Colours preferred—Navy blue, dark green, or crimson.—ZERO.

[61766] — **Coal and Water.** — If 1lb. of coal evaporates 10lb. of water at the atmospheric pressure, or 212° Fahr., how much water will 1lb. of coal evaporate at 80lb., 90lb., and 100lb. pressure, everything under the same circumstances, with exception of pressure?—DUTCH PAUL.

[61767.]— **Gun-Barrel Boring.** — Will someone oblige me by giving a description of the tools used in boring gun barrels? A sketch of the drills, &c., will be the best. I do not wish to bore gun-barrels myself; but often have lengths of pipe to bore, and can get nothing like so good a hole as there is in the commonest gun-barrel.—S. B.

[61768.]—**Battery for Lamp.**—Kindly inform me how many cells (using chromic acid) would be requisite to light a 5-candle lamp, as advertised, say, by Shippey Bros., and could you give me any hints as to fitting up battery?—SEVERGA.

[61769.]—**Oxide of Copper Battery.**—Will someone inform me what is the proper proportion of copper oxide to caustic potash, and what is the electro-chemical combination and equation?—RIFLE.

[61770.]—**Electric Motor for Sewing Machine.**—Will Mr. Bottone, or others, give me particulars and sketch of how motor is connected to sewing machine to drive it? Also connections from battery to motor?—ELECTRO-MOTOR.

[61771.]—**Photo. Developers.**—"Burton" recommends sulphurous acid in the pyro. solution. What is this, as I cannot find it in chemical lists? Is it same as sulphuric, or what? How long will a pyro. solution with this added, as, I suppose, a preservative, keep good? Fry gives citric acid. Which is best?—J. R.

[61772.]—**Lantern Transparencies.**—Let N be a whole-plate negative, L be a lens, P a positive chloride plate 3¼ square; N, L, and P being arrranged in a line thus—

N..............................L.....................................P

L being a view lens of either 11in. or 4½in. focus, with, in either case, ¼in. stop. Will someone tell me how to calculate roughly the distances of N L and P L, so as to enable me to construct a copying camera in which to reduce whole plates to 3¼ square, and also say probable exposures?—J. R.

[61773.]—**Compressed Oxygen.** — I should feel greatly obliged for any information respecting the compressing of oxygen gas for limelight, likewise the simplest way to make the wrought-iron bottles, what pressure generally obtained, &c.—G. G.

[61774.]—**Bronzing Iron.**—I have a small quantity of malleable bright iron tips in stock. Can you kindly inform me how I can make them appear as brass or copper on the face? I have been told copperas, and tried same without effect. I am now having the rest bronzed over at the casters; but what I have in stock will not sell a long-side of these. Is there any lacquer I can use?—C. KEMP.

[61775.]—**Legal.**—A. is the occupier and owner of a semi-detached house. B., the owner of the other house, lets it to C. on a lease for seven years. After about three years, C. allows the drains to get stopped, and, also, a water tap constantly leaking causes an overflow to A.'s house, which is on a slightly lower level. Great signs of wet showing themselves, and being ignorant of the cause, A. has a large hole dug in front of the kitchen range, into which gallons of impure water flow, and are traced to the foundation wall between the two houses. The inspector of nuisances forces his way into B.'s house and pronounces the drains choked, which explains the cause of the water. C. (the tenant) is obliged by a magistrate's summons to unstop them, but immediately his goods are sold by auction. B. takes possession, and sells the house at once. A. has bills sent in amounting to £4 15s. 10d. for work done in the kitchen, beside months elapsing when it could not be used. B. refuses to pay it, C. has left, and is there any remedy for A., who is in a hard case?—A. B. C.

[61776.]—**Water Question.**—In order to induce condemned criminals to confess the names of their accomplices, it is stated to have been customary in the reign of Louis XIV. in France to pour down their throats through a horn as much as twelve quarts of water. I do not understand how this was possible. Would not the water when it became oppressive to the stomach naturally be thrown up, and, if so, how could, or was this prevented? Any information on the subject of this torture would be acceptable to—RETLAW.

[61777.] — **Ferro-Chrome.** — Will someone kindly give the method of determining chemically the amount of chromium in the above when manganese is also present?—GAMES.

[61778.]—**Blake Transmitter.**—Could some correspondent kindly inform me where I can obtain a sketch of the connections of the Blake transmitter, as used by the National Telephone Co.?—TELEPHONIST.

[61779.]—**Micro. Mounting.**—Can Spirillum undula be mounted as a permanent specimen to show the flagellum as well (or better) than when it is living? If so, will some of "ours" say by what means? Have tried a great number of stains and mounting in various ways, but with only poor success.—MOYHITT.

[61780.]—**Mainspring Gauge.** — Would someone tell me the use of the different size circles on watch mainspring gauge, numbering 1 to 16? One gauge has only circular marks, and the other has them all sunk with hole through centre.—TINKER.

[61781.]—**Family Oven.**—Can any reader inform me what materials I should require for building a fair-sized baking oven? Also the best shape for the same?—CONSTANT READER.

[61782.]—**Sugar.**—Will some correspondent inform me how to purify this? I have Dutch crushed and Russian granulated, and wish to make a clear, bright solution, removing all impurities from the same. Also would like to know how to tell the variety of sweetness in the different sugars. I do not think the saccharometer gives this, although it may give the density; but do these agree—density and sweetness? A little book on sugar I would like. Can anyone suggest one?—J. GREEN, March.

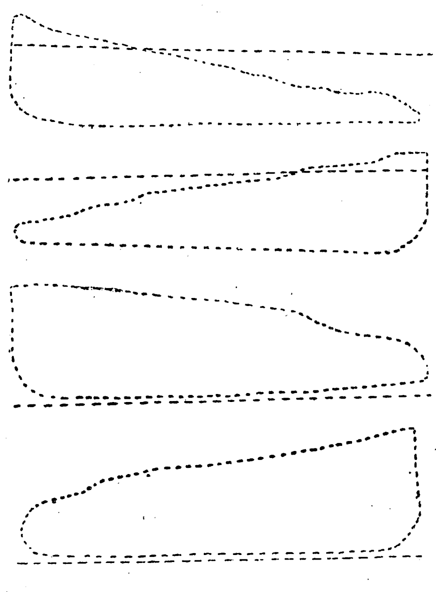
[61783.]—**Flywheel for Gas-Engine.** — Would some of our readers kindly inform me what size and weight of flywheel will suit a non-compression gas-engine with cylinder 4⅝ dia. and 10in. stroke?—REVOLUTION.

[61784.] — **Phonograph.** — I have just bought a phonograph, second-hand. It is perfect, and has a receiving mouthpiece at one side and speaking mouthpiece at the other. I would be greatly obliged for instructions how to adjust and work successfully.—A REAL IRISHMAN.

[61785.]—**Corn Store.**—I propose to build a small corn store with ground floor and loft 75ft. long by 35ft. wide. The loft will hold about 300 tons of oats. I propose to make the walls and roof of corrugated iron, lining the walls inside with 1in. or ⅞in. boards, leaving a space of 4in. between boards, and outside walls of corrugated iron of about 4in. This space to be filled with concrete. Loft proposed to be of deals 9in. by 3in., on beams, laid across, and, say, 10ft. apart, and two props to each beam. Would be greatly obliged for hints and opinions as to whether this would be a good and successful job or not.—A REAL IRISHMAN.

[61786.]—**Organ at Albert Hall.**—Can anyone inform me if the organ in the Royal Albert Hall, Kensington, London, is worked by steam power, and how many horse-power is employed for the working of it?—A TWENTY YEARS' SUBSCRIBER.

[61787.]—**Indicator Diagrams.**—The accompanying diagrams are taken from a compound horizontal tandem engine: cylinders, h.p. 18in., l.p. 36in.; stroke,



5ft.; revs. 45 per min.; boiler pressure, 60lb. Will any correspondent tell me if there is any rule to calculate the evaporation of water from the diagrams, and, if so, will he please apply it to the inclosed diagrams?—J. C. T.

[61788.]—**Anchor Ice.**—Will someone who knows tell us whether ice does form at the bottom of streams, and, if so, state what enables it to do so?—DOUBTFUL.

[61789.]—**Loss of Power in Gas-Engine.**—Will some able correspondent kindly answer? Is there not a great loss of power by employing so heavy a flywheel? I do not want it explained that it is necessary to the steady running of the engine. As a practical mechanic, I understand that; but what would be the gain if it could be dispensed with? The reason of my query is I have an invention that would take up the sudden impulse of the piston and give it out again during the rest of the stroke, instead of as now. I think there must be a great loss of power in the sudden impulse attempted to be given to the flywheel. Please give plain figures, as I do not understand algebra.—T. N. C.

[61790.]—**Acid-proof Gilding.**—Will brass, if gold gilt, stand nitric acid for a few minutes, say two? If so, how should I proceed to gild some small articles of brass?—DYER.

[61791.]—**Pumps.**—Will some correspondents kindly give me their experience? I want to draw water from the sea with two 3½in. bucket pumps. Can I draw it 1,000ft. with 28ft. lift? What should be the speed of the buckets in feet per minute? What are the best means to secure good results?—H. H.

[61792.]—**Watch Jobbing.**—I have a few cylinders and verges to turn in. Will any of your practical readers help a young one who has no one to show him, and how to try both escapements properly? If any would answer privately, I would pay for all trouble.—E. W. W.

[61793.]—**Sponge.**—Any information, the result of experience, respecting the washing, bleaching, and colouring of sponges will be acceptable to—A SPICULE.

[61794.]—**High-Pressure Steam for Heating Purposes.**—I am a printer, and have a building three stories high, containing a number of rooms. At present they are heated by hot-water pipes; but these are found insufficient, as we have no means of keeping them hot all night. We have a steam boiler on the premises, and the idea has occurred to me that the place could be much more effectually warmed if both ends of the hot-water pipes were attached to the boiler, so that the steam should circulate through them instead of the hot water, the condensed water flowing by gravity down into the boiler. In that case there would be no heat lost except by radiation from the pipes, and the wasteful mode of fizzing steam through pipes open at one end avoided. I should be much obliged if any of your practical readers would say whether this mode of heating is practical, whether the ordinary cast-iron hot-water pipes would stand the boiler pressure of 60lb. to the square inch, and whether it would be absolutely necessary that all the pipes should be above the level of the boiler?—S. P.

[61795.]—**Incandescent Light.**—I have an incandescent lamp, about 6in. in circumference, carbon film of ordinary loop form. Could anyone kindly inform me what candle-power it might be, what battery power it would require to light same, and best kind of battery to use?—BEGINNER.

[61796.]—**To Mr. S. Bottone.**—I am making a dynamo up. The size will be, Siemens H armature 6in long by 2¼. The pole-pieces are 6in. long, 2½ diam., by 3½ wide. Fields are 6in. long, 2½ by 2, upright. I want, if I can, to get six 20c.p. Will you kindly inform me how much wire I shall want on the fields and armature, and what size wire? Will the lamps want to be arranged in parallel or in series?—NEW READER.

[61797.] — **Locomotive Boilers.** — Will "Loco." enlighten me as to following? The engine Gladstone and the new North British express engines have boilers of almost exactly the same dimensions; but Gladstone has 1,492ft. of heating surface, while N.B. has only 1,102ft. On the other hand, the N.B. engine has 1sq.ft. of grate to 52ft. of h.s., while Gladstone has only 1 to 72. Which may be considered the most powerful engine?—SPECTATOR.

[61798.]—**Condenser.**—Could any of our subscribers tell me anything of which is the best kind of siphon condenser? Do they work as well as the old kind, with air-pumps, &c.? Want one for a pair of engines; h.p., 8½in. by 24in.; l.p., 14in. by 24in.; revs., 85, cut off in h.p. at ⅝ stroke; initial pressure, 60lb. I believe there are various kinds in the market, but do not know the cost.—JOINER.

[61799.]—**Boiler Front.**—Will someone tell me what will fetch the old grease off that is very rough and cracked? Also, what is best to paint it with to keep it smooth and a good gloss?—COUNTRY LAD.

[61800.]—**Setting Lever Watch in Beat.**—Will some reader tell me how to set a lever watch in beat? Is there any mark same as Geneva watches, which are so easy, or is it like many English ideas, stupid rule of thumb? I have referred to back vols.—"Seconds Practical Watchmaker." He says: "When a bar is at rest exactly over pallet hole and ruby roller pin is an exact line with that and the staff pivots." I can't see this, nor anyone else, I think. Also, how is the moon plate worked in a large clock, eight days? It is up in the arch part, with two faces painted; but this one has no connection. Inside count wheel under dial are 52 teeth doing nothing. Should something work in this? It is a modern clock cost £12, but moon does not work.—PROGRESS.

[61801.]—**Oak Cantilever.**—What must be the breadth in inches of an oak cantilever 6ft. long and 9in. deep in order to carry a load of ½ton at its extremity? The actual stress is not to exceed quarter of the breaking stress; and the breaking weight of an oak cantilever 6in. long, 1in. deep, and 1in. broad is 280lb.—BATTEN.

[61802.]—**Drilling Holes.**—I have a large number of holes to drill, ⅛in. dia., ⅛in. deep, in deal, mahogany, and brass, mostly at regular intervals of 1in. or 2in., on lathe about 3ft. long. Can any practical reader suggest a plan or a machine whereby these may be done quickly, without measuring or otherwise setting out? I have lathes, foot motors, &c.; but my difficulty lies not in the drilling, but in a quick and certain way of bringing up the stuff into required position for the next hole, and all to be equally distant apart. I have a remote remembrance of once seeing a machine doing similar work for blind lath or rails, but it was Yankee made, I believe, but cannot find one offered in any maker's list. Any information would be greatly esteemed by—LIMELIGHT.

[61803.]—**Testing Model Engine.**—What might be considered the actual gain per cent. if, when testing my model engine by means of a dynamometer, I find that, under ordinary working, a weight at end of lever attached to clip (dynamometer) of 8lb. suffices to stall the engine, whereas on connecting (throwing into gear) a peculiar arrangement (not yet patented), which I have devised, a further weight of 3lb. is required to bring engine to a

stand, pressure of steam and all else being strictly as in first (ordinary) trial, the difference appearing as $\frac{3}{8}$th? Can I consider this an actual gain equivalent to, say, 38 or 40 per cent.?—ONE PLEASANTLY PUZZLED.

[61804.]—**American Organ Question.**—Will some reader kindly say what weight of springs would be required for an American organ of eight rows in the treble, five in the bass, and one octave sub-bass, with 30 notes on the pedals? Also what size the bellows and feeders would require to be? Would the feeders do at the back, so as to be more convenient for handle? If so, what would be the most simple method of communication between pedals and feeders?—R. H. W.

[61805.]—**Lawn Tennis Tournament.**—Can any reader explain the method of drawing for tennis and billiard tournaments, so that, with an uneven number of players there shall be no "byes" after the first round? It is, I believe, called the "Bagnall-Wylde System." It is simple enough to arrange in playing "singles"; but how is it carried out for "doubles"?—A. LLOYD.

[61806.]—**G.E.R. Locos.**—Can anyone tell me (1) the number of the G.E. coupled engine exhibited in the 1862 exhibition, (2) the number of the G.E. single express engine exhibited in the Paris Exhibition, 1867, (3) principal dimensions of the new six-coupled tanks, 275 class?—EAST ANGLIAN.

[61807.]—**Organ Question.**—I am about to add to my organ in the swell a 3-rank mixture. Would any reader kindly give me instructions how to proceed? It will require to be placed at the back of the wind chest.—R. H. W.

[61808.]—**Watch Pivoting, &c.**—I have been looking through my back numbers for instructions how to use the gravers for turning pivots, &c., and have failed to find any. Would some of your horological correspondents supply me with this want, giving the shape of gravers used and the means adopted to prevent the pivots from falling off when being turned?—WORKMAN.

[61809.]—**Cyclometer.**—I propose making a cyclometer for tricycle with 48in. wheels. I thought of using two ratchet wheels, with 422 and 25 teeth respectively. Will some fellow reader inform me as to the best mode of applying same, or a better plan? A diagram showing details would be very useful, as I can find nothing on the subject in back numbers.—C. M. R.

[61810.]—**Spirit Lamp.**—Will any kind reader help me out of this difficulty? Having a small model of engine and boiler, I have tried to get a regular heat from a lamp with three burners of 3-16 brass tube, $\frac{1}{8}$ hole, $\frac{3}{8}$in. above lamp top, and $\frac{1}{2}$in. from boiler bottom, which is horizontal. The lamp is inclosed in a copper cage that carries the boiler, and which is screwed to a brass plate $\frac{1}{8}$ thick, and well perforated with air holes all round. Depth of lamp, $\frac{3}{4}$in.; length, 4in.; width, $1\frac{3}{4}$in. Now the difficulty is that the lamp, after burning a few minutes all right, gets hot, and very soon becomes a mass of flame, and, of course, soon burns itself out. I may say the burners are of the ordinary screw pattern of common oil lamps. How can I remedy this defect?—ONE IN A FIX.

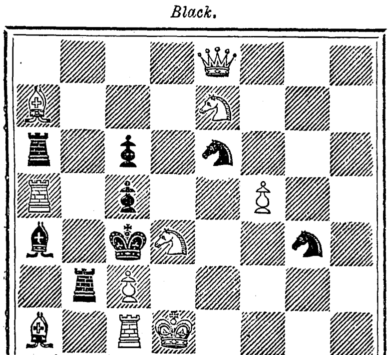
[61811.]—**Electro-Plating.**—I have been doing a little electro-plating; but have failed to plate the articles bright. I have tried bisulphide of carbon; but instead of the articles coming out bright they were a dark brown. I altered the battery power, but that made no difference. Will some kind reader of "Ours" help me out of the difficulty?—NOVICE.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM MXXXII.—BY T. H. BILLINGTON.

Black.



White. (10 + 8

White to play and mate in two moves.

SOLUTION TO 1,030.

White.	*Black.*
1. Q-K Kt 6.	1. K takes B or (*a*).
2. Q-K B 7.	2. K-B 4.
3. Q-Q B 4 mates.	
	(*a*) 1. K-Q 5.
2. Q-K Kt 3, &c.	

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A BEGINNER.—1,030 cannot be done as you propose.

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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 23, and unacknowledged elsewhere:—

J. W. QUEEN AND CO.—S. R. Bottone.—Amateur.—W. H., Newport, Mon.—H. A. C.—T. R. Glanfield.—N. M. M.—Beginner.—A Country Parson.—G. E.—A. H. J.—G.—Moyhitt.—F. C. S.—Violinist.—G. and S.W. Ry. Fitter.—J. R.—E. P. M.—H. J. Hardy.—Jigger.—Valve Rod.—Inquiry.—A. J. L.—Apollo Belvedere.

O. P. Q. (This volume ends with the present number. It commenced with the number for Sept. 3 last. The papers on "The Amateur Workshop" commenced in No. 1035.)—J. FAIRFAX. (Do not understand you. The crystals of Glauber's salt, sulphate of soda, rapidly effloresce when exposed to the atmosphere, especially if the air is dry and warm. How many tons a day would you want to convert into powder?)—COMPOUND. (See the "Brakes Return," or refer to indices of back volumes. Perhaps the table in No. 1105, p. 282, will give you sufficient information.)—TOM. (There are many in back volumes, and one in last week; but in all the important ingredient is elbow-grease. Bath-brick, whiting, jewellers' chalk, rouge, &c., are all good polishers when properly applied.)—EBBO. (If former query was received it was no doubt answered in this column, for such matter has been dealt with many times. See p. 38, No. 1094; p. 430, No. 1087; or Nos. 995, 999, 1039, 1041. The four numbers last mentioned contain full explanations of various slide-valve diagrams.)—TESTER. (You do not seem to be aware that the mercurial column is the oldest form of barometer. Presumably you want information about old-fashioned weather-guides, like those with the man and woman to come outside the door in rainy and fine weather respectively; but you say weather-glasses, and we must refer you to indices and to works on the subject, for there are many designs, generally of little, if any, use.)—G. M. S. (The "Guide to the Whitworth Scholarships" can be obtained from the Secretary of the Science and Art Department, South Kensington, or of any bookseller by order. The price is sixpence. There is a useful book giving hints to candidates published in your city by Mr. Heywood. 2. The water cannot be forced higher than the level of the cistern. The supply flows down from the bottom of the cistern, and the hot-water is discharged at the top—that is, what is not drawn off en route. A sketch in No. 1029.)—LADY GARDENER AND HOUSEKEEPER. (Your questions were answered on p. 532.)—S. M. (Consult the catalogue issued by Mr. Fletcher, Warrington, and you will probably find something suitable. For Turkish baths at home, see Nos. 900, 901, 902.)—J. S. (You have only to procure Pitman's works, and practise diligently. Pitman's is in Paternoster-row, and the necessary manuals cost only a couple of shillings or so. Learn the signs thoroughly, and then practise as hard as you can by taking down the words of a lecture, or of the reader of a paper which will be published. Then you can compare your work and see how you have done it.)—ARTHUR GAPP. (The best way is to obtain employment in an engineering shop and enter as a student at the Finsbury Technical College.)—MARINE. (1. Premiums are as a rule required in good engineering shops, though they are low when the apprentice enters as a worker. 2. Depends entirely on arrangements. 3. There are plenty of shops near London, the one you mention being amongst the best, especially for marine work. 4. Reed's "Engineer's Handbook," published by T. Reed and Co., Sunderland.)—A SCIENCE STUDENT. (All information of the kind can be obtained by consulting the "Calendars" of the respective universities. The degrees B.Sc., D.Sc., are granted by London, Edinburgh, and Glasgow.)—CARINO. (See numerous articles on the subject in back volumes under heading of "Lantern Transparencies." See, for instance, No. 1091, p. 510, and a letter in No. 1093, p. 13.)—E. R. D. (They are embossed in the usual way, using a yellow ink or plain gold size or printer's varnish. The powder (imitation gold or Bessemer's gold) is dusted on, and the surplus removed with cotton wool or a hare's foot.)—T. LAIDLER. (Machines for making matches illustrated in Nos. 785, 786. We do not know the names of the makers.)—DELTA. (You do not seem to be aware that exactly what you require was given not long ago. There are three different designs of footblowers in No. 1111, p. 423; a mineralogist's arrangement in No. 1075, p. 185; a handblower in No. 975; and a variety of other devices in back volumes. See also the catalogue issued by Mr. Fletcher, Warrington.)—M. KEOGH. (Mixing with a solution of alum retards the setting; but you cannot make plaster of Paris into "putty" and retain its special properties.)—RAMESES. (You could have a reflecting lantern, or you could enlarge them by photography. To exhibit such illustrations in lectures, the only really satisfactory way is to make transparencies and show them by means of the lantern. You will find full details in recent volumes.)—YOUNG AMATEUR. (Instructions of the kind are not to be given in a few lines. Before attempting to plate with gold, you should procure and read some such book as Watts's "Electro.-Metallurgy," Crosby Lockwood and Co., price 3s., in which you will find directions for making several solutions.)—JAS. WADE. (We do not know of any "practical" works on the subject; but there is a good deal of information on details in back volumes. Perhaps the treatises published by E. and F. N. Spon, 125, Strand, may supply your wants. One is Hedge's "Useful Information on Practical Electric Lighting," 3s. 6d.)—TRAVELLER. (No work giving such information in full. The best is, perhaps, Vernon Harcourt's "Treatise on Rivers and Canals," Oxford Press, £1 1s.; but that gives only examples.)—ALARMED. (Consult the lists issued by publishers. Such queries only afford an opportunity for the gratuitous advertising of books, and are of little, if any, interest to anyone but the questioner.)—W. H. DEVONPORT. (The only way to obtain situations in the engine-room of steam vessels as supernumerary engineer is to apply to chief engineers on board, or to managing owners. As you have had three years' experience in the engine factory, you will have to serve only one year at sea in the engine-room before sitting for the certificate. If, as we understand, you could make yourself very handy and useful in doing repairs, you ought to have little difficulty in getting a berth, and if you determine to go in for the certificate you cannot do better than procure Reed's "Engineers' Handbook" (T. Reed and Co., Sunderland), and study that thoroughly during the interval.)—JAMES SINCLAIR. (Why not give the information through our columns for the benefit of all interested?)—G. M. S. (Is there not a library in your great city where you could see various books on the subject, and choose for yourself? Maxton's "Engineering Drawing," Crosby Lockwood and Co. may perhaps suit you.)—BOILER-MAKER. ("The, Theoretical and Practical Boiler-Maker," by S. Nicholls, published by the author at Blackpool, we think; but procurable through Mr. Calvert, Great Jackson-street, Manchester, whose catalogue will give you the titles of other works which may be suitable.)—AMITURE. (It is not easy to find the "query" in your rambling statement. You cannot expect much of a spark with only 3oz. of No. 40, and the primary should be preferably covered. Directions for making coils have been given over and over again. If querists will not follow directions, they must expect to fail. See No. 1117, p. 564, and the indices of back volumes. Or look on pages 18, 138, 176. 225, 309, 310, 390, 398, 439, 550, of the present volume for a good deal of information. 2. No cheap books on that special subject. Sprague's "Electricity" is published by E. and F. N. Spon, 125, Strand, W.C., price 15s. It is in the second and enlarged edition, and is published in one form only.)—JOE. (Generally done by means of a scraping tool, with light touches.)—TINKER. (First query against the rules. See Hints No. 4.)—J. H. (No doubt if you advertised for working drawings some one would offer to supply them; but if you can refer to Clegg's or King's "Treatise on the Manufacture of Gas," you will be able to work out the required drawings from the illustrations.)—V. J. B. (No; the standard gauge, however, is very near the old B.W.G. It has been given several times, most recently in No. 1101, p. 199, and the B.W.G. can be found in most of the pocketbooks.)—J. H. B. (There are many recipes for silvering glass in back numbers; but if it is "ordinary looking-glass" that you require it is much cheaper to purchase pieces from the makers. See No. 1072, p. 125, and the indices generally.)—A REGULAR SUBSCRIBER. (See pp. 353, 373, this volume, or p. 456, No. 1088, for polishing and removing stains from black marble.)—I. KONER. (The only way is to become an apprentice to an electrical engineer, or to obtain work in a shop where electrical apparatus is made.)—SR. ARTURO HEEREN. (Prof. Fuller's spiral slide-rule is manufactured by W. F. Stanley, Railway Approach, London Bridge, S.E.)—A CLOCKMAKER'S APPRENTICE. (Surely you are acquainted with Britten's "Watch and Clockmakers' Handbook," in which you will find the rule for calculating length of pendulum.)—VOLTMETER. (See the indices of back volumes. It would require several columns to answer your questions fully. The first question seems to be contradictory, and

the others have been answered or are unanswerable, except at considerable length.)—R. W. (What sort of black do you want? Will blacklead do, or must it be a stain? It cannot be done by merely dipping in acid. See No. 944, p. 168, No. 1086, p. 401, and the indices generally.)—ARTHUR. (A coil constructed on what you call the "latest style" was illustrated and described so far back as p. 472, Vol. XI., and in almost every volume since there have been directions more or less complete for making coils. You will find a good deal about section-wound coils in Vols. XLII. and XLIII. No. 885, if you can get it, will give you some useful information. See answer to "Amiture" above.)—HOBSON JOBSON. (There is a small hole in the brass cap, or the upper end is covered with bladder. Not worth making, but you will find the proportions in the "Answers" for Nov. 12 last, p. 250, this volume. 2. Shenstone's "Glass-Blowing," published by Rivingtons; Glazebrook and Shaw's "Practical Physics," may answer for the other, or Weinhold's "Experimental Physics," both published by Longmans.)—T. RICHARDSON. (Shenstone's "Glass Blowing" is published by Rivingtons, and was reviewed at some length on p. 25 of this volume. 2. Prof. S. P. Thompson's "Electricity" is published by Macmillans, and was reviewed on p. 45, Vol. XXXV.)—MEDICAL. (We are not aware that there is such a method, nor that there is a work dealing with the subject. Consult a surgeon, and take his advice about the tumour. Electricity is very useful in his hands occasionally; but amateur surgeons had better leave it alone.)—F. J. LORD, MECHANIC, and other inquirers about Marine Engineers and their Certificates. (Candidates for the certificates of the Board of Trade may obtain all requisite information at any mercantile marine office. They must have served an apprenticeship of at least three years in the making and repairing of engines, or have been employed as journeymen mechanics for that time in similar work, and at least one year in the engine room "on the watch." Or where there is no practical workshop experience, candidates must have served at least four years in the engine room "on the watch." See Reed's "Engineer's Handbook," published by T. Reed and Co., Sunderland.)—J. A. E. MITCHELL. (Send sketch and drawing, and we will see.)

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Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Organ, church or chamber, 8 stops, pedals, bourdon, composition pedals, interior new, 312 pipes. Exchange Harmonium or American Organ.—HOLT, Ormskirk.

Wanted, **Launch Engine**, Propeller, Lathe, Tricycle, Perambulator or Parts, for new Tools, Cutlery, Plate, Miscellaneous Hardware, Sewing Machine, Revolver, Air Gun.—HARRISON, Devoran, Cornwall.

Flywheel, 10½, bored, turned, 9lb.; also Engine, crank turned, 1¼ round. Offers.—16, Lesbourne-road, Reigate.

Bench Lathe, 3in. centre, 30in. bed, planed, driver, prong, eccentric hand-rest, and 2 tees, new. Offers.—H. W., 138, Abbey-street, Bermondsey, S.E.

Half-plate mahogany **Camera**, 2 dark slides, perfect order. What offers?—BOLWELL, 14, Raglan, Weston-super-Mare.

Exchange first-class Exhibitor's Mahogany **Lantern**, 4in. condensers, portrait lenses, four-wick lamp, in case, cost £5. Exchange good slides, or cash.—COLLINS, Seaside, Eastbourne.

Small **Electro-Motor and Battery** combined, 2s.; Wheatstone's Bridge, with six terminals and polished mahogany base, 6s. A few 1, 2, and 5 Ohm Resistance Coils, 2s. each. Good exchange wanted.—E. THORNTON, Barrow-in-Furness.

Engine Castings and Forgings.—Complete set, 1in. by 2in., with bed-plate, screws, and everything for making perfect model, cylinder nearly finished, cost 19s. Offers in cash or exchange.—EDWARD G. ABBOTT, Diss, Norfolk.

Exchange **"Photographic News"** and 19 numbers "Amateur Photographer," and "Scientific American," 1886, unbound, and 5 Tin Boxes to hold 12 dry ½-plate negatives. Wanted, strong folding half-tripod stand, or anything useful.—J. B., 55, Tavistock-road, Westbourne Park.

One horse-power **Boiler** and all Fittings, vertical, 8 tubes and gauge; also Engine for same; £2 10s., or will exchange for one man-power model Engine and Boiler. Above is too large for my use.—F. FOWLER, Haslemere.

What offers for **Old Bible**, about 200 Dutch steel engravings in it, and bound in leather? Also D. Clarke's new book, "The Gas Engine," quite new.—As above.

I will exchange my 52in. **Bicycle** (by Bayliss and Thomas, Coventry), in perfect condition, cost £17 10s., for a useful Lathe, about 4in. centre, with gap bed, value about £6.—T. MASTERS, Tenterden, Kent.

Exchange **Drawing Board**, 28in. by 19in., and 25in. T-square, only used once, for ½lb. No. 38 silk-covered Copper Wire.—W. SCOTT, Exminster, Exeter.

Will exchange 56in. Matchless **Bicycle**, good condition, balls both wheels, for Lathe, with slide-rest, &c.—PENNEY, Highcroft, Dyke-road, Brighton.

330 Rare Coins and Tokens. What offers in exchange?—H. BUDD, Stoke-road, Gosport.

Four-keyed Concert **Piccolo** (slide) good instrument. Offers in exchange to value of 5s. 6d. Also a collection of 90 rare stamps.—Send for list to W. FENN, Grovehill-road, Redhill.

Piano, Gabriel Buntebart et Stevers, 1789; 48in. Bicycle; Cylinder, 4 by 10; 2 Thomas Machine. Offers.—A. W., 16, West-street, Maryland Point, Stratford, E.

B **Clarionet**, Lafleur, leather case, Books by Klose, cost £3 18s., for pair back-gear Lathe Heads, 5 or 6 centres.—THIRKETTE, Vauxhall-street, Norwich.

What exchange in **Electrical Apparatus** or other offers for Vols. XXII. to XXXII., inclusive, of "The Architect."—A. TIMMINS, Stanley Villas, Runcorn.

Little Rapid **Knitting Machine**, Sewing Machine, six-air Musical Box, half-plate Camera, &c. Wanted, good Magic Lantern for enlarging.—BEDE, Belbroughton, Stourbridge.

What offers in exchange (small **Dynamo Castings**, wire, &c., preferred) for small hand-power oat-crusher, E. R. and F. Turner, makers, Ipswich, order as new. Offers to value of 45s.—PATRICK, Chelmsford.

Wanted, good work on **Conchology**, with coloured plates; other Books in exchange.—Post Office, Lower Ford-street, Coventry.

A splendid tone 6-octave **Piano**, by Broadwood, in good condition. Exchange American Organ or offers.—HORI, 44, Kimberley-road, Nunhead.

Wanted, a half-plate **View Lens**, from 8in. to 9in. focus. Good exchange.—H. S., 45, Cumberland-street, Lower Broughton, Manchester.

Micro. Slides and Electrical Apparatus wanted, for 5-4 Landscape Lens, Opera Glass, Micro. Objective, 3-wick Lamp for lantern.—DIXON, Photographer, Colne.

Bicycle, 54in. Singer Challenge, black enamelled, in first-class condition, lamp, &c. Exchange for 50in. or offers.—B. BRICKLAND, West-street, Abingdon.

Sewing Machine.—Singer-system Hand Machine, new and perfect, with all attachments and walnut cover, complete, cost £4 15s. What offers?—GOODYEAR, New-road, Spalding.

Vertical **Engine and Boiler**; 3in. stroke, with all fittings, complete, cost £15. Exchange for Bicycle or offers.—GOODYEAR, New-road, Spalding.

Wanted, **Drawing Instruments** and Joiner's Tools. Exchange 120 ENGLISH MECHANICS to date, bound or unbound. "Boy's Own Paper."—W. R. H., 20, Tudor-grove, Hackney, E.

21 Vols. **"English Mechanic,"** 10 volumes complete, XI. one or two numbers short, all clean. Sell, or exchange for Joiner's Tools, Fretsaw, or offers.—N. BROWN, 24, Victor-road, Bradford.

Slide Rest wanted, or Self-centring Chucks, for 2½ centre lathe. Exchange Swords, Sewing Machine Works, Chemical Cabinet, Seltogene, &c.—HALHEAD, Chemist, Carlisle.

Bench Lathe, 3in. centres, 30in. iron bed, 2-speed pulley, driving wheel, standard, and rests, complete. Particulars on application. Offers. Will add cash for Camera.—W. SHAPLAND, 12, South-street, Wellington, Somerset.

Wright and Butler's "Eclipse" Heating **Stove**, pair model Rod Rolls, and set Waterhouse Diaphragms. Lancaster's ¼ dark slides wanted.—WILSHAW, 455, Shoreham-street, Sheffield.

10 **Telescope** and stand, for gold watch, musical box, cabinetto, or offers. Also 16 Geneva Watch Movements. Exchange.—41, Breck-road, Everton, Liverpool.

Wanted, **"Rankine's Machinery and Millwork,"** bound Vols. of ENGLISH MECHANIC and "Metal World," "Willis' Mechanism." State date.—Offers to RICHARSON, 106, Higher Ardwick, Manchester.

2¼ **Lathe**, gunmetal headstock and poppet head, dog chuck, and foot motor for same, in good condition. Offers requested.—DOVER, 8, Clifton-street, S.W.